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Bird communities on natural eutrophic fen mires in the Biebrza river valley, NE Poland

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Introduction

Natural, minerotrophic fen mires (GOODWILLIE 1980) were quite wide-spread in ancient Europe; they covered large areas in river valleys. As this type of bog constitutes a very fertile habitat, most of it has been changed for agricultural purposes. The old river valley of the Biebrza is probably the largest area of eutrophic fen mires preserved in a more or less natural condition. The bird life is there very rich both with regard to the number of species and the breeding bird populations densities (DYRCZ et al. 1972, 1984). In ornithological literature there are only few papers dealing with bird communities of such a habitat. We have found the following papers: VEROMANN (1979) on the Estonian Kasari river, NAWROCKI et al. (1983) on the Warta river in central Poland, and DYRCZ et al. (1973) on the Łęczna-Włodawa Lake District of eastern Poland. The aim of the present study was to obtain quantitative data on species composition in main natural plant aggregations in the Biebrza marshes, and to compare them with some other similar habitats.

Study area

The Biebrza river valley is situated in NE Poland (mainly in Łomża district) at altitude of 100—125 m. The fen area is of ca. 900 sq. km and has a roughly elongated shape (Fig. 1), ca. 90 km long and from several to ca. 15 km wide. The river with its winding is 164 km long. According to GOODWILLIE (1980) classification, Biebrza fens constitute minerotrophic and intermediate, flood plain, horizontal fens. The valley can be divided into three basins: northern, middle, and southern (Fig. 1). The whole southern basin has been preserved in natural state. The river, in places more than 20 m wide, winds its way through a labyrinth of old river-beds. In spring, extensive and long-lasting floods occur. This kind of water regime produces a distinct zonation of plant communities. Passing from the river to the valley edges one can distinguish the following five zones (OŚWIT 1968) : (1) immersive plant communities (mainly Scirpo-Phragmitetum, Glycerietum maximae, Magnocaricetum, Caricetum gracilis) in the areas with longlasting spring floods; (2) immersive-emersive communities (Caricetum elatae, Caricetum rostratae, Caricetum paradoxae) in the areas of brief spring floods; (3) emersive communities (mainly Caricetum diandrae typicum) — only exceptional overflooded; (4) emersive communities with short *Carex* species and mosses never overflooded; (5) alder forests (Carici elongatae-Alnetum) — ca. 3400 ha in area. This zonation is obscured in many places by patchy environment.

The mean yearly temperature in the Biebrza valley is + 6.2°C, the mean temperature of the hotest month (July) being +17°C, and of the coldest one (February) −5.2°C. The total year precipitation amounts to 566 mm (KRZYWONOS 1965).

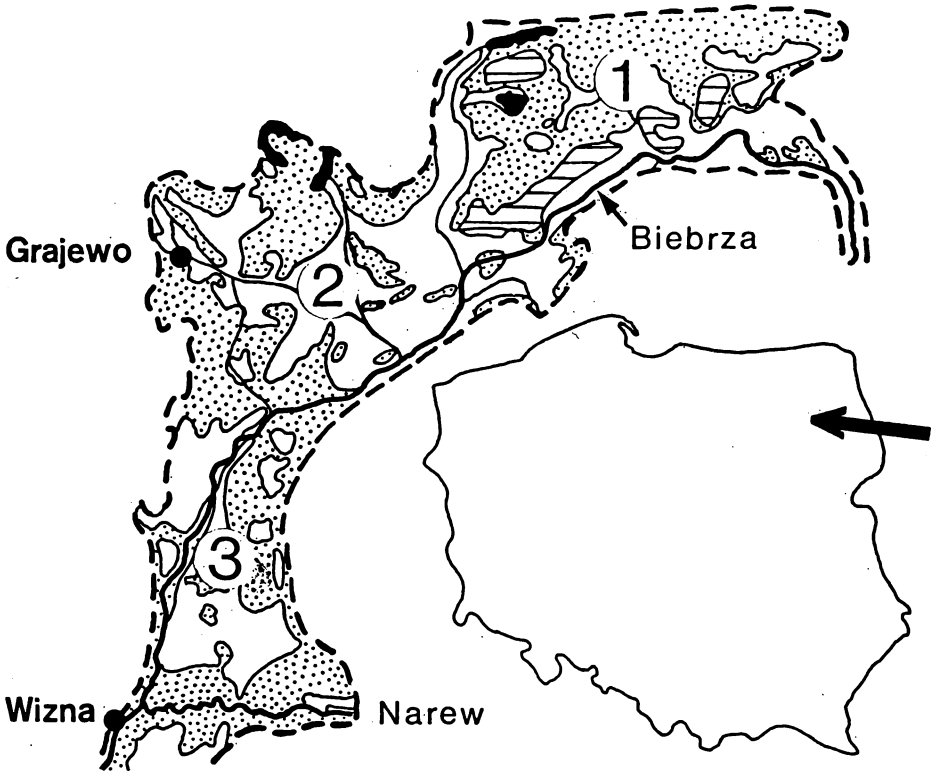

Fig. 1: Biebrza ancient river valley. Broken line: diluvial upland margin; white area: peatbogs; dotted area: other formations; I — northern basin, II — middle basin, III — southern basin (after Okruszko 1973). Arrow indicates location of the study area in Poland.

Abb. 1: Das ursprüngliche Flußbett der Biebrza. Gestrichelte Linie: Rand des diluvialen Hochlandes; weiße Flächen: Torfmoore; punktierte Flächen: andere Formationen; 1 — nördliches Becken, 2 — mittleres Becken, 3 — südliches Becken (nach Okruszko 1973). Der Pfeil kennzeichnet die Lage des Untersuchungsgebietes in Polen.

Methods

The study was carried out in 1977—1980. The mapping method of ENEMAR (1963) was applied with modifications for wetland habitats (DYRCZ & TOMIAŁOJĆ 1974). Eight sample plots (Table 1 and 3—9) were traced, marked in a grid by poles every 50 m. For comparison, some data from 1967 and 1968 (Table 2) were also taken. For another comparison, two additional sample plots were traced at the ameliorated marsh Wizna, situated near the southern Biebrza basin. Each sample plot was visited 8—10 times during the breeding season in the period from April 28 to June 23. Species diversity (H') was defined by means of the Shannon-Wiener function (KREBS 1972). The dominance structure of species (eveness, J') was described by means of the equation given by TRAMER (1969). In qualitative comparisons of bird communities in different census plots, the SØRENSEN (1948) index (SQ) was employed, while for quantitative comparisons Renkonen (1938)

index (Re) was used. If, after comparing bird communities on two plots of the size 10—100 ha with Sørensen index, one gets the value of 80—95 %, this means that the two communities are almost identical. A result of 60—80 % means that there is a clear similarity. In case of the Renkonen index the value 50—70 % shows clear similarity, more than 70 % may be evidence for belonging to the same community (TOMIAŁOJĆ 1970). Quantities of Renkonen index were arranged in the form of a dendrite by means of the „Wrocław taxonomy" method (FLOREK et al. 1951).

Bird communities at the sample plots

In the whole old valley of the Biebrza river (including forests) 176 breeding, and probably breeding, species were found (DYRCZ et al. 1984). Of this number only 59 species were recorded on our sample plots including all the more numerous species of the real fen. Below, the census plots were arranged according roughly to their increasing distance from the river.

1. Open flooded meadows (FM, Table 1 and 2, Fig. 2).

This habitat changed most from year to year. The breeding avifauna composition was extremely influenced by the depth and duration of spring floods. This becomes clear when one compares Table 1 to Table 2. In springs with high water level the breeding bird community was highly impoverished; there were no breeding waders, the dominant species then were birds which could build nests somewhat above the ground (e. g. *Acrocephalus schoenobaenus*) or emerging from water *(Fulica atra)*. The quantity of Renkonen index calculated from Table 1 and 2 was very low (Re = 19.8 %); this means that in overflooded areas in different years, different bird communities may exist. It might also be essential for breeding species to utilize far taller vegetation during the springs with high water level. In 1977 the spring floods were even higher than in 1978 which re-

Table 1: Birds of open meadows close to the river. Large parts flooded over. Dominated by *Carex hudsonii* 70—120 cm, locally mixed with *Equisetum limosum* and *Carex lasiocarpa* 60—90 cm. Single *Salix* spp. bushes averages 1.5 m. Plot size: 34.5 ha (FM). H' = 2.07, J' = 0.65.

Tab. 1: Vögel der offenen, größtenteils überschwemmten, flußnahen Wiesen; dominant: *Carex hudsonii* (17—120 cm), lokal gemischt mit Teichschachtelhalm, Fadensegge (60—90 cm) und einzelnen Weidenbüschen (1,5 m). Probefläche: 34,5 ha (FM). H' = 2,07, J' = 0,65.

No.	Species	No. of breeding pairs			Pairs per 10 ha			Dominance in %	Biomass in g per 10 ha
		1977	1978	$\bar{x}$	1977	1978	$\bar{x}$		
1.	*Acrocephalus schoenobaenus*	7	35.5	21.2	2.0	10.3	6.1	39.8	146
2.	*Fulica atra*	10	30	20.0	2.9	8.7	5.9	37.6	9947
3.	*Emberiza schoeniclus*	4.5	2.5	3.5	1.3	0.7	1.0	6.6	38
4.	*Acrocephalus paludicola*	—	5	2.5	—	1.4	0.7	4.7	17
5.	*Aythya ferina*	5	—	2.5	1.4	—	0.7	4.7	582
6.	*Porzana porzana*	1	2	1.5	0.3	0.6	0.4	2.8	72
7.	*Locustella luscinioides*	—	2	1.0	—	0.6	0.3	1.9	9
8.	*Acrocephalus arundinaceus*	1	—	0.5	0.3	—	0.1	0.9	3
9.	*Anas querquedula*	1	—	0.5	0.3	—	0.1	0.9	45
	Total	29.5	77.0	53.2	8.5	22.3	15.3	100	10859

sulted in a lower total density (Table 1), mainly due to more dispersed breeding of *Acrocephalus schoenobaenus.*

In addition to the bird species listed in Tables 1 and 2, the following species bred in the open overflooded meadows zone: *Podiceps nigricollis, Podiceps griseigena, Anas acuta, Anas clypeata, Aythya fuligula, Aythya nyroca, Circus aeruginosus, Porzana parva, Calidris alpina, Tringa totanus, Gallinago media, Larus minutus, Larus ridibundus, Chlidonias leucopterus* and *Sterna hirundo.*

Table 2: Birds of open meadows close to the river (in the vicinity of MF plot). More than half of plot is occupied by water logged-areas with *Carex hudsonii* and *Equisetum limosum.* Numerous hummocks with short grass. Single *Salix* spp. bushes. Plot size: 34.5 ha.

Tab. 2: Vögel der offenen, flußnahen Wiesen, nahe zu Fläche FM. Mehr als die Hälfte der Fläche steht unter Wasser, mit *Carex hudsonii* und Teichschachtelhalm, zahlreichen Grashügeln und einzelnen Weidenbüschen. Probefläche: 34,5 ha.

No.	Species	No. of breeding pairs			Pairs per 10 ha			Dominance in %	Biomass in g per 10 ha
		1967	1968	$\bar{x}$	1967	1968	$\bar{x}$		
1.	*Philomachus pugnax*	14	18	16.0	7.0	9.0	8.0	20.5	1040
2.	*Alauda arvensis*	10	13	11.5	5.0	6.5	5.7	14.7	448
3.	*Acrocephalus paludicola*	12	9.5	10.7	6.0	4.7	5.3	13.7	128
4.	*Limosa limosa*	5.5	11	8.2	2.7	5.5	4.1	10.5	1886
5.	*Motacilla flava*	6	4	5.0	3.0	2.0	2.5	6.4	85
6.	*Gallinago gallinago*	4	5	4.5	2.0	2.5	2.2	5.7	522
7.	*Emberiza schoeniclus*	3.5	5.5	4.5	1.7	2.7	2.2	5.7	85
8.	*Acrocephalus schoenobaenus*	3	5.5	4.2	1.7	2.7	2.2	5.4	50
9.	*Anthus pratensis*	2	2.5	2.2	1.0	1.2	1.1	2.8	46
10.	*Porzana porzana*	1	3.5	2.2	0.5	1.7	1.1	2.8	198
11.	*Saxicola rubetra*	2	2	2.0	1.0	1.0	1.0	2.5	36
12.	*Crex crex*	1	2	1.5	0.5	1.0	0.7	1.9	227
13.	*Vanellus vanellus*	2	1	1.5	1.0	0.5	0.7	1.9	280
14.	*Chlidonias niger*	3	—	1.5	1.5	—	0.7	1.9	91
15.	*Anas querquedula*	1	1	1.0	0.5	0.5	0.5	1.2	225
16.	*Anas platyrhynchos*	—	1	0.5	—	0.5	0.2	0.6	220
17.	*Sylvia communis*	—	1	0.5	—	0.5	0.2	0.6	6
18.	*Locustella naevia*	—	1	0.5	—	0.5	0.2	0.6	6
		70	86.5	78.0	35.1	43.0	38.6	100	5579

2. The open fen with few bushes in the transitional belt between immersive and emersive zone (T, Table 3, Fig. 3)

Patches of high *Carex* enable *Acrocephalus schoenobaenus* and *Emberiza schoeniclus* to breed in a high density, and also prevented all wader species (except Snipe) from breeding.

3. The open Cares-moss fen in emersive zone (OE, Table 4, Fig. 4 and 5).

The total breeding density was 50.1 pairs/10 ha — a very high value for a habitat with single vegetation stratum (see Discussion). Such a high breeding density with the accompanying high total biomass was due primarily to larger waders and ducks. These species hatched precocial young which they then guided to places with better foraging conditions. This behaviour prevented overexploitation of breeding grounds. In the

Fig. 2: Open meadows close to the river. Census plot FM.

Abb. 2: Offene, flußnahe Wiesen. Probefläche FM.

Table 3: Birds of partially open fen with no stagnant water, dominated by *Carex paradoxa* and *Equisetum limosum* averages 0.75 m and mixed in places with *Carex hudsonii* and *Carex diandra*; 1000 m from the river-bed. Transitional zone between immersive and emersive bog. Shrub covers ca. 28 % of the area. Plot size: 10.5 ha (T). H' = 2.72, J' = 0.86.

Tab. 3: Vögel teilweise offener Wiesenmoore ohne Stauwasser; dominant: Schwarzschopf-Segge und Teichschachtelhalm (75 cm), stellenweise mit *Carex hudsonii* und Drahtsegge gemischt. 1 km vom Fluß entfernter Übergang zwischen immersiver und emmersiver Zone. Gebüschdeckungsgrad ca. 28 %. Probefläche: 10,5 ha (T). H' = 2,72, J' = 0,86.

No.	Species	No. of breeding pairs			Pairs per 10 ha			Dominance in %	Biomass in g per 10 ha
		1977	1978	$\bar{x}$	1977	1978	$\bar{x}$		
1.	*Acrocephalus schoenobaenus*	8	7.5	7.7	7.6	7.1	7.3	26.5	175
2.	*Emberiza schoeniclus*	7	8	7.5	6.7	7.6	7.1	25.8	270
3.	*Acrocephalus paludicola*	1	8	4.5	1.0	7.6	4.3	15.5	103
4.	*Anas platyrhynochos*	3	4	3.5	2.9	3.8	3.3	12.0	3617
5.	*Anthus pratensis*	1	3.5	2.2	1.0	3.3	2.1	7.6	88
6.	*Motacilla flava*	1.5	1	1.2	1.4	1.0	1.2	4.1	41
7.	*Aythya ferina*	2	—	1.0	1.9	—	0.9	3.4	749
8.	*Gallinago gallinago*	2	—	1.0	1.9	—	0.9	3.4	209
9.	*Saxicola rubetra*	—	1	0.5	—	1.0	0.5	1.7	18
	Total	25.5	33.0	29.1	24.4	31.4	28.0	100	5270

Fig. 3: Open area in transitional zone between immersive and emersive fen. Census plot T.

Abb. 3: Offene Fläche in der Übergangszone zwischen regelmäßig überschwemmter und nicht regelmäßig überschwemmter Zone. Probefläche T.

open, emersive zone we found nests of some rare or vanishing in Central Europe breeding species, namely *Lymnocryptes minimus* (Okulewicz & Witkowski 1979), *Gallinago media* and *Philomachus pugnax. Acrocephalus paludicola* — a stenotypic species was restricted more or less to fertile fens (Wawrzyniak & Sohns 1977). It bred in this habitat in a relatively very high density. In addition to the species listed in Table 4, and mentioned above, in this vegetation zone in low densities the following species bred: *Numenius arquata, Locustella naevia* and *Alauda arvensis.*

4. A mosaic of dense and high shrub patches, of areas covered by *Carex* of different size and pools of stagnant water (MS, Table 5, Fig. 6).

Basically this plot is in the emmersive zone but in springs with very high floods (as in 1977 and 1978) some stagnant water appeared. In spite of the natural character of vegetation, the bird community comprised ecologically different groups like waders, some crakes and coots, ducks and shrub nesting passerines. The total density was rather high if we take into consideration the existence of overflooded parts.

5. Rather low shrub patches interrupted by areas with tall *Carex* (SP, Table 6, Fig. 7).

Very high total density, comparable with some multistratum forest habitats, was associated here with strong quantitative dominance of two species (*Acrocephalus schoenobaenus* and *Emberiza schoeniclus*). Among the bird species recorded on SP sample plot, five bred more or less in bushes and constituted 67 % of the breeding pairs, while the ten remaining species were ground-nesters (33 % of the breeding pairs).

Table 4: Birds of open fen with wringing water, ca. 5500 m from river-bed in emersive zone. Dominated by *Carex paradoxa* and *Carex limosa* (20—40 cm) with extensive moss ground layer. *Carex hudsonii* up to 60 cm. Single *Salix* spp. bushes average 1 m. Plot size: 44 ha (OE). H' = 3.26, J' = 0.82.

Tab. 4: Vögel des offenen nassen Wiesenmoores in der emmersiven Zone (ca. 5,5 km vom Fluß entfernt). Dominant: Schwarzschopf-Segge und Schlamm-Segge (20—40 cm) mit ausgeprägter rasenbildender Moosschicht; mit *Carex hudsonii* (bis 60 cm) und einzelnen Weidenbüschen (1 m). Probefläche: 44 ha (OE). H' = 3,26, J' = 0,82.

No.	Species	No. of breeding pairs			Pairs per 10 ha			Dominance in %	Biomass in g per 10 ha
		1977	1978	$\bar{x}$	1977	1978	$\bar{x}$		
1.	*Limosa limosa*	46	71	58.5	10.5	16.1	13.3	26.4	6118
2.	*Gallinago gallinago*	35	26	30.5	8.0	5.9	6.9	13.8	1601
3.	*Acrocephalus paludicola*	25.5	20.5	23	5.8	4.7	5.2	10.4	125
4.	*Anthus pratensis*	16	26	21	3.6	5.9	4.7	9.5	197
5.	*Emberiza schoeniclus*	23	18.5	20.7	5.2	4.2	4.7	9.3	179
6.	*Vanellus vanellus*	19	13	16	4.3	3.0	3.6	7.2	1440
7.	*Philomachus pagnax*	10	19	14.5	2.3	4.3	3.3	6.5	429
8.	*Anas querquedula*	16	8	12	3.6	1.8	2.7	5.4	1218
9.	*Anas platyrhynchos*	11	12	11.5	2.5	2.7	2.6	5.2	2850
10.	*Porzana porzana*	4	3	3.5	0.9	0.7	0.8	1.6	144
11.	*Tringa totanus*	2	5	3.5	0.5	1.1	0.8	1.6	208
12.	*Anas clypeata*	3	3	3	0.7	0.7	0.7	1.4	385
13.	*Acrocephalus schoenobaenus*	1	2.5	1.7	0.2	0.6	0.4	0.8	10
14.	*Lymnocryptes minimus*	2	—	1	0.5	—	0.2	0.5	13
15.	*Crex crex*	—	1	0.5	—	0.2	0.1	0.2	32
16.	*Saxicola rubetra*	1	—	0.5	0.2	—	0.1	0.2	7
	Total	214.5	228.5	221.4	48.8	51.9	50.1	100	14956

Fig. 4: Open fen in emersive zone. Census plot OE.

Abb. 4: Offenes Wiesenmoor in der nicht regelmäßig überschwemmten Zone. Probefläche OE.

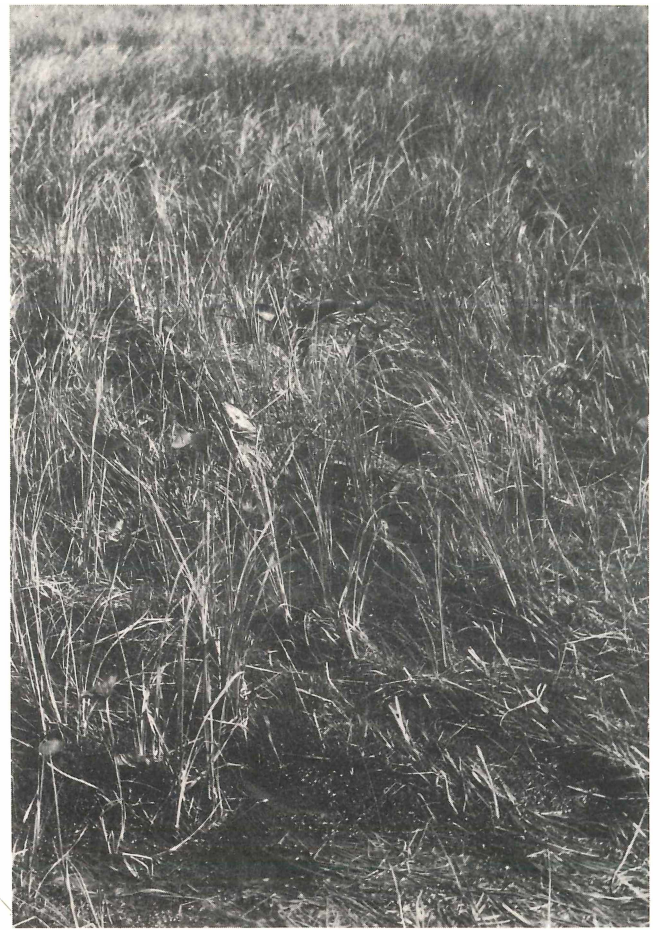

Fig. 5: Soaked part of OE census plot.

Abb. 5: Nasser Teil der Fläche OE.

Table 5: Birds of fen consisting of mosaic of dense shrub/*Salix* spp. — up to 3 m, *Alnus glutinosa* 5—8 m and *Betula pubescens* — up to 6 m/, *Carex hudsonii* ca. 90 cm, *Carex paradoxa* averages 40 cm and stagnant water. Shrub covers ca. 31 % of the area. Plot size: 14.5 ha (MS). H' = 3.02, J' = 0.71.

Tab. 5: Vögel der Mosaikvegetation aus dichtem Weiden- (bis 3 m), Schwarzerlen- (5—8 m) und Moorbirken-Gebüsch (bis 6 m), *Carex hudsonii* (ca. 90 cm) und Schwarzschopf-Segge (40 cm) mit Stauwasser. Gebüschdeckungsgrad ca. 31 %. Probefläche: 14,5 ha (MS). H' = 3,02, J' = 0,71.

No.	Species	No. of breeding pairs			Pairs per 10 ha			Dominance in %	Biomass in g per 10 ha
		1977	1978	$\bar{x}$	1977	1978	$\bar{x}$		
1.	*Acrocephalus schoenobaenus*	26	23.5	24.7	17.9	16.2	17.0	43.6	408
2.	*Emberiza schoeniclus*	11	9	10.0	7.6	6.2	6.9	17.6	262
3.	*Anas platyrhynchos*	5	4	4.5	3.4	2.8	3.1	7.9	3398
4.	*Fulica atra*	—	5	2.5	—	3.4	1.7	4.4	2866
5.	*Sylvia communis*	2	3	2.5	1.4	2.1	1.7	4.4	70
6.	*Vanellus vanellus*	4	—	2.0	2.8	—	1.4	3.5	560
7.	*Locustella luscinioides*	1.5	2.5	2.0	1.0	1.7	1.3	3.5	40
8.	*Gallinago gallinago*	3	—	1.5	2.1	—	1.0	2.6	232
9.	*Carpodacus erytrhinus*	1	2	1.5	0.7	1.4	1.0	2.6	42
10.	*Rallus aquaticus*	—	2	1.0	—	1.4	0,7	1.8	151
11.	*Anas querquedula*	1	—	0.5	0.7	—	0.3	0.9	135
12.	*Anas acuta*	1	—	0.5	0.7	—	0.3	0.9	210
13.	*Porzana porzana*	—	1	0.5	—	0.7	0.3	0.9	27
14.	*Tringa totanus*	1	—	0.5	0.7	—	0.3	0.9	78
15.	*Limosa limosa*	1	—	0.5	0.7	—	0.3	0.9	138
16.	*Acrocephalus palustris*	—	1	0.5	—	0.7	0.3	0.9	7
17.	*Sylvia borin*	1	—	0.5	0.7	—	0.3	0.9	12
18.	*Phylloscopus collybita*	1	—	0.5	0.7	—	0.3	0.9	5
19.	*Luscinia luscinia*	—	1	0.5	—	0.7	0.3	0.9	15
	Total	59.5	54.0	56.7	41.1	37.3	38.5	100	8656

Fig. 6: MS census plot. Abb. 6: Probefläche MS.

Table 6: Birds of shrub fen in emersive zone with patches of dense *Salix spp. 1—2 m and Betula pubescens* up to 3—4 m and open patches dominated by *Carex paradoxa* and *Carex hudsonii* 40—70 cm. Locally scarce reeds. 3.5 km from the river. Shrub covers ca. 48 % of the area. Plot size: 21 ha (SP). H' = 2,88, J' = 0.74.

Tab. 6: Vögel der bebuschten emmersiven Zone mit Flecken dichten Weiden- (1—2 m) und Moorbirken-Gebüsches und offenen Flecken mit Schwarzschopf-Segge, *Carex hudsonii* (40—70 cm) und lockerem Schilf, 3,5 km vom Fluß entfernt. Gebüschdeckungsgrad ca. 48 %. Probefläche: 21 ha (SP). H' = 2,88, J' = 0,74.

No.	Species	No. of breeding pairs			Pairs per 10 ha			Dominance in %	Biomass in g per 10 ha
		1977	1978	$\bar{x}$	1977	1978	$\bar{x}$		
1.	*Acrocephalus schoenobaenus*	51	43.5	47.2	24.3	20.7	22.5	41.0	540
2.	*Emberiza schoeniclus*	24.5	19	21.7	11.7	9.0	10.3	18.9	391
3.	*Anas platyrhynchos*	8	8	8	3.8	3.8	3.8	7.0	4165
4.	*Locustella luscinioides*	5	6	5.5	2.4	2.9	2.6	4.8	81
5.	*Sylvia communis*	6	4.5	5.2	2.9	2.1	2.5	4.5	70
6.	*Rallus aquaticus*	5	4	4.5	2.4	1.9	2.1	3.9	454
7.	*Anas querquedula*	2	6	4	1.0	2.9	1.9	3.5	857
8.	*Gallinago gallinago*	4	4	4	1.9	1.9	1.9	3.5	441
9.	*Locustella naevia*	5	3	4	2.4	1.4	1.9	3.5	53
10.	*Anthus pratensis*	3.5	4	3.7	1.7	1.9	1.8	3.2	76
11.	*Carpodacus erythrinus*	3.5	2	2.7	1.7	1.0	1.3	2.3	55
12.	*Saxicola rubetra*	2.5	2.5	2.5	1.2	1.2	1.2	2.2	43
13.	*Anas clypeata*	2	—	1.0	1.0	—	0.5	0.9	275
14.	*Phylloscopus trochilus*	0.5	0.5	0.5	0.2	0.2	0.2	0.4	4
15.	*Crex crex*	—	1	0.5	—	0.5	0.2	0.4	65
	Total	122.5	108	115.0	58.6	51.4	54.7	100	7570

6. A mixture of shrub, small birches and *Carex* patches (SC, Table 7, Fig. 8).

The shrub vegetation was on average higher and *Carex* shorter than in the previous sample plot. The dominance of the two most numerous species was even more striking than in SP census plot.

In addition to species listed in Table 5—7, in shrub bog, the following species were found breeding: *Circus aeruginosus, Circus pygargus, Lyrurus tetrix, Grus grus, Numenius arquata, Asio flammeus, Cuculus canorus, Anthus trivialis, Acrocephalus palustris* and *Sylvia nisoria.*

7. The dense shrub with reeds and *Carex* (DS, Table 8, Fig. 9)

This type of vegetation covered a relatively small area. The total breeding bird density was extremely high. As in the previous sample plots, two species strongly predominated, but *Emberiza schoeniclus* was replaced by *Locustella luscinioides.* Apart from those listed in Table 8, the breeding of the following species was found: *Columba palumbus, Cuculus canorus, Locustella fluviatilis* and *Carpodacus erythrinus.*

Fig. 7: Shrub patches fen in emersive zone. Census plot SP.

Abb. 7: Bebuschtes Moor in der nicht regelmäßig überschwemmten Zone. Probefläche SP.

Table 7: Birds of fen in emersive zone dominated by *Salix* spp. 1.5—3 m and *Betula pubescens* up to 7—9 m. With patches of *Carex paradoxa* and other *Carex* 40—70 cm. Dispersed *Phragmites communis*. 6000 m from the river. Plot size: 7 ha. Shrub covers ca. 50 % of the area (SC). H' = 2.14, J' = 0.60.

Tab. 7: Vögel der nicht mehr überschwemmten Zone, in Weiden (1,5—3 m) und Moorbirken (7—9 m) dominieren mit Flecken von Schwarzschopf-Segge und anderen Seggen-Arten (40—70 cm) und zerstreutem Schilf, 6 km vom Fluß entfernt. Gebüschdeckungsgrad ca. 50 %. Probefläche: 7 ha (SC). H' = 2,14, J' = 0,60.

No.	Species	No. of breeding pairs			Pairs per 10 ha			Dominance in %	Biomass in g per 10 ha
		1977	1978	$\bar{x}$	1977	1978	$\bar{x}$		
1.	*Acrocephalus schoenobaenus*	15	15	15	21.4	21.4	21.4	56.2	514
2.	*Emberiza schoeniclus*	5	6	5.5	7.1	8.6	7.8	20.6	296
3.	*Saxicola rubetra*	1	2	1.5	1.4	2.9	2.1	5.6	76
4.	*Anas platyrhynchos*	1	1	1	1.4	1.4	1.4	3.7	1534
5.	*Anas querquedula*	—	1	0.5	—	1.4	0,7	1.9	316
6.	*Circus cyaneus*	—	1	0.5	—	1.4	0.7	1.9	318
7.	*Rallus aquaticus*	—	1	0.5	—	1.4	0.7	1.9	151
8.	*Gallinago gallinago*	1	—	0.5	1.4	—	0.7	1.9	162
9.	*Locustella naevia*	1	—	0.5	1.4	—	0.7	1.9	20
10.	*Sylvia communis*	1	—	0.5	1.4	—	0.7	1.9	20
11.	*Phylloscopus trchilus*	1	—	0.5	1.4	—	0.7	1.9	14
12.	*Pica pica*	0.5	—	0.2	0.7	—	0.3	1.1	127
	'Total	26.5	27.0	26.7	37.6	38.5	37.9	100	3548

Fig. 8: *Carex*-shrub fen in emersive zone. Census plot SC.

Abb. 8: Moor mit *Carex* und Gebüsch in der nicht regelmäßig überschwemmten Zone. Probefläche SC.

Table 8: Birds of dense shrub wetland dominated by *Alnus glutinosa* 4—5 m, *Betula pubescens* 3—6 m and *Salix* spp. up to 2 m. Small patches of *Carex hudsonii* with *Phragmites communis* scattered. 8 km from the river. Shrub covers ca. 86 % of the area. Plot size: 6 ha (DS). H' = 2.66, J' = 0.72.

Tab. 8: Vögel des dichten von Schwarzerle (4—5 m), Moorbirke (3—6 m) und Weiden (bis 2 m) dominierten Gebüsches mit kleinen Flecken von *Carex hudsonii* und zerstreutem Schilf, 8 km vom Fluß entfernt. Gebüschdeckungsgrad: ca. 86 %. Probefläche: 6 ha (DS). H' = 2,66, J' = 0,72.

No.	Species	No. of breeding pairs	Pairs per 10 ha	Dominance in %	Biomass in g per 10 ha
		1978	1978		
1.	*Acrocephalus schoenobaenus*	19	31.7	41.8	761
2.	*Locustella luscinioides*	11.5	19.2	25.3	595
3.	*Acrocephalus palustris*	3	5.0	6.6	115
4.	*Sylvia communis*	2	3.3	4.4	92
5.	*Emberiza schoeniclus*	2	3.3	4.4	125
6.	*Phylloscopus trochilus*	1.5	2.5	3.3	50
7.	*Anas platyrhynchos*	1	1.7	2.2	1863
8.	*Rallus aquaticus*	1	1.7	2.2	367
9.	*Sylvia nisoria*	1	1.7	2.2	102
10.	*Luscinia luscinia*	1	1.7	2.2	85
11.	*Luscinia svecica*	1	1.7	2.2	68
12.	*Phylloscopus collybita*	1	1.7	2.2	29
13.	*Saxicola rubetra*	0.5	0.8	1.1	29
	Total	45.5	76.0	100	4281

Fig. 9: Shrub wetland with reeds. Census plot DS.

Abb. 9: Feuchtgebiet mit Gebüsch und Schilf. Probefläche DS.

8. Alder forest (AF, Table 9, Fig. 10).

There was no striking dominance of any species; the diversity index here reached its highest quantity. In comparison to all other sample plots, the list of breeding species was the longest. In addition to those listed in Table 9, the following species bred: *Ciconia nigra, Haliaetus albicilla, Aquila clanga, Aquila pomarina, Grus grus, Scolopax rusticola, Streptopelia turtur, Cuculus canorus, Bubo bubo, Strix aluco, Upupa epops, Dendrocopos leucotus, Oriolus oriolus* and *Carduelis carduelis.* The breeding of some rare raptor species in this habitat is worth mentioning.

9. Ameliorated, grass meadows with pools of stagnant water (AW, Table 10, Fig. 11 and 12).

Total density was very low in comparison to natural fen, but some waders *(Limosa limosa, Vanellus vanellus, Gallinago media)* still bred there. However, their brood losses were very high (ca. 90 %), which suggests that this breeding habitat constitutes an ecolo-

Table 9: Birds of alder wood 15—22 m (70—80 years old). Locally stagnant water. Herb layer dominated by *Carex* spp. and ferns. 8 km from the river. Plot size: 20 ha (AF). H' = 4.01, J' = 0.82.

Tab. 9: Vögel der Erlenbruchwälder (15—22 m, 70—80jährig), lokal mit Stauwasser, Krautschicht hauptsächlich aus *Carex*-Arten und Farnen, 8 km vom Fluß entfernt. Probefläche: 20 ha (AF). H' = 4,01, J' = 0,82.

No.	Species	No. of breeding pairs			Pairs per 10 ha			Dominance in %	Biomass in g per 10 ha
		1979	1980	$\bar{x}$	1979	1980	$\bar{x}$		
1.	*Fringilla coelebs*	23.5	24	23.7	11.7	12.0	11.8	21.7	525
2.	*Sturnus vulgaris*	9	12	10.5	4.5	6.0	5.2	9.6	811
3.	*Phylloscopus sibilatrix*	12	9	10.5	6.0	4.5	5.2	9.6	104
4.	*Anthus trivialis*	8	10	9.0	4.0	5.0	4.5	8.2	198
5.	*Erithacus rubecula*	5	10	7.5	2.5	5.0	3.7	6.9	118
6.	*Troglodytes troglodytes*	5.5	6	5.7	2.7	3.0	2.8	5.2	50
7.	*Phylloscopus collybita*	5.5	6	5.7	2.7	3.0	2.8	5.2	48
8.	*Phylloscopus trochilus*	3.5	5.5	4.5	1.7	2.7	2.2	4.1	44
9.	*Sylvia borin*	4	4.5	4.2	2.0	2.2	2.1	3.8	84
10.	*Hippolais icterina*	4	2	3.0	2.0	1.0	1.5	2.7	41
11.	*Muscicapa striata*	3.5	2.5	3.0	1.7	1.2	1.5	2.7	57
12.	*Parus major*	3	3	3.0	1.5	1.5	1.5	2.7	56
13.	*Anas platyrhynchos*	3	2	2.5	1.5	1.0	1.2	2.3	1315
14.	*Turdus philomelos*	1	3.5	2.2	0.5	1.7	1.1	2.0	154
15.	*Turdus iliacus*	2	2.5	2.2	1.0	1.2	1.1	2.0	132
16.	*Ficedula hypoleuca*	2.5	1.5	2.0	1.2	0.7	0.9	1.8	23
17.	*Turdus merula*	3	—	1.5	1.5	—	0.7	1.4	133
18.	*Parus caeruleus*	1	2	1.5	0.5	1.0	0,7	1.4	15
19.	*Locustella fluviatilis*	2.5	—	1.2	1.2	—	0,6	1.1	25
20.	*Luscinia svecica*	0.5	1.5	1.0	0.2	0,7	0.5	0.9	20
21.	*Parus palustris*	1	1	1.0	0.5	0.5	0.5	0.9	11
22.	*Jynx torquilla*	1	0.5	0.7	0.5	0.2	0.3	0.6	21
23.	*Buteo buteo*	—	1	0.5	—	0.5	0.2	0.5	170
24.	*Tringa ochropus*	—	1	0.5	—	0.5	0.2	0.5	36
25.	*Dendrocopos minor*	0.5	0.5	0.5	0.2	0.2	0.2	0.5	9
26.	*Sylvia atricapilla*	1	—	0.5	0.5	—	0.2	0.5	8
27.	*Aegithalos caudatus*	—	1	0.5	—	0.5	0.2	0.5	3
28.	*Certhia familiaris*	—	1	0.5	—	0.5	0.2	0.5	4
29.	*Luscinia luscinia*	0.5	—	0.2	0.2	—	0.1	0.2	10
	Total	106	113.5	109.3	52.5	56.3	53.7	100	4225

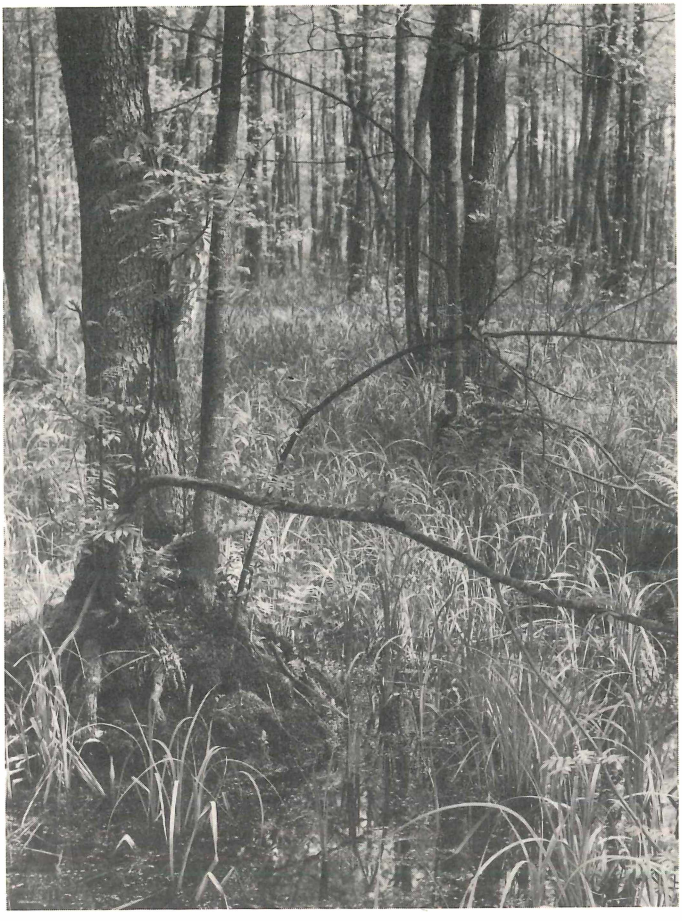

Fig. 10: Alder forest; wetter part. Census plot AF.

Abb. 10: Nasser Erlenbruchwald. Probefläche AF.

gical trap for these species, and that such a breeding populations of waders exist only because of constant immigration from neighbouring natural habitats. The heavy losses from predation were probably connected with low population density of *Limosa limosa* (in comparison to natural habitats); these birds defend their broods collectively and form a „protective umbrella" for other wader species broods (see also Dyrcz et al. 1981). The bulk of bird community there was actually made up of by small passerines (mainly *Alauda arvensis*) and total biomass was low in comparison to the natural open fen (OE). There were also heavy differences in avifauna composition between the year 1978 and 1979.

10. Ameliorated grass meadows with no stagnant water (AD, Table 11, Fig. 13).

Total density was even lower than in the previous plot; it was six times lower than in the natural open fen (OE) as well. The biomass was thirteen times lower than in the open fen, due to the predominance of small passerines and low breeding density. The

Table 10: Ameliorated meadows with the grass up to 25 cm. Two ditches border with the plot. Single bushes (ca. 1 m) along two sides of the plot. A few small ponds of stagnant water. Plot size: 22.5 ha (AW). H' = 2.67, J' = 0.80.

Tab. 10: Vögel entwässerter Wiesen (Gras bis 25 cm) mit einigen kleinen Tümpeln. Zwei Gräben grenzen an die Fläche, an zwei Seiten einzelne Büsche (ca. 1 m). Probefläche: 22,5 ha (AW). H' = 2,67, J' = 0,80.

No.	Species	No. of breeding pairs			Pairs per 10 ha			Dominance in %	Biomass in g per 10 ha
		1978	1979	$\bar{x}$	1978	1979	$\bar{x}$		
1.	*Alauda arvensis*	10.5	5	7.7	4.7	2.2	3.4	29.2	265
2.	*Limosa limosa*	8	2	5	3.6	0.9	2.2	18.9	1012
3.	*Vanellus vanellus*	5	3	4	2.2	1.3	1.8	15.2	720
4.	*Motacilla flava*	4	4	4	1.8	1.8	1.8	15.2	61
5.	*Saxicola rubetra*	1.5	2	1.7	0.7	0.9	0.8	6.4	29
6.	*Anas querquedula*	3	—	1.5	1.3	—	0.6	5.7	271
7.	*Gallinago media*	1	1	1	0.4	0.4	0.4	3.8	136
8.	*Crex crex*	—	1	0.5	—	0.4	0.2	1.9	65
9.	*Anthus pratensis*	1	—	0.5	0.4	—	0.2	1.9	8
10.	*Acrocephalus schoenobaenus*	—	1	0.5	—	0.4	0.2	1.9	5
	Total	34	19	26.4	15.1	8.3	11.6	100	2572

Fig. 11: Wet ameliorated meadows; less humid part. Census plot AW.

Abb. 11: Wenig feuchte trockengelegte Wiesen. Probefläche AW.

Fig. 12: Wet ameliorated meadows; damp part. Census plot AW.

Abb. 12: Feuchte trockengelegte Wiesen. Probefläche AW.

Table 11: Ameliorated meadows Bagno Wizna with the grass up to 25 cm. Plot size: 25 ha (AD). H' = 2.47, J' = 0.78.

Tab. 11: Vögel entwässerter Wiesen (Bagno Wizna, Gras bis 25 cm). Probefläche: 25 ha (AD). H' = 2,47, J' = 0,78.

No.	Species	No. of breeding pairs			Pairs per 10 ha			Dominance in %	Biomass in g per 10 ha
		1978	1979	$\bar{x}$	1978	1979	$\bar{x}$		
1.	*Alauda arvensis*	10	9	9.5	4.0	3.6	3.8	46.6	296
2.	*Anas querquedula*	5	—	2.5	2.0	—	1.0	12.3	451
3.	*Saxicola rubetra*	3	2	2.5	1.2	0.8	1.0	12.3	36
4.	*Motacilla flava*	1	2.5	1.7	0.4	1.0	0,7	8.3	24
5.	*Anthus pratensis*	2.5	1	1.7	1.0	0.4	0.7	8.3	29
6.	*Crex crex*	—	2	1.0	—	0.8	0.4	4.9	130
7.	*Limosa limosa*	—	1	0.5	—	0.4	0.2	2.5	92
8.	*Vanellus vanellus*	—	1	0.5	—	0.4	0.2	2.5	80
9.	*Emberiza schoeniclus*	—	1	0.5	—	0.4	0.2	2.5	8
	Total	21.5	19.5	20.4	8.6	7.8	8.2	100	1146

Fig. 13: Dry ameliorated meadows. Census plot AD.

Abb. 13: Trockene entwässerte Wiesen. Probefläche AD.

dominance of the most numerous species — *Alauda arvensis* — reached a high value there (47 %); species diversity (H') was lower than in the natural census plot (OE) with a similar vegetation structure.

Comparison of different census plots (Table 12)

Total breeding density was evidently at the lowest on ameliorated meadows plots (AD, AW), especially on drier ones. Regarding natural habitats, there were no marked differences in breeding density between open, shrub, and even wooded marshland. However, in bird communities of open habitats the proportion of nidifugous species was much higher than in shrub and forest habitats (Table 12). Relatively low density on FM plot was connected with the fact that large parts of this area were overflooded.

The structure of dominance was similar in all census plots with bushes (MS, SP, SC, DS); namely there were only three dominant species (> 5 %), two of them being very numerous (usually *Acrocephalus schoenobaenus* and *Emberiza schoeniclus*). The diversity of species (H') was the highest in multistratum forest plot (AF) but also relatively high in the open emersive zone (OE) and MS plots. This latter comprised bushes of different size, *Carex* and overflooded grounds as well. The OE census plot was also far from being homogenous; it included areas of different *Carex* structure (height and tuftiness), different portions of moss and different amounts of moisture. The dominance structure of species (J') showed a tendency to have higher values for bird communities of open and wooded areas than for communities of shrubby areas.

Table 12: Comparison of different census plots.

Tab. 12: Vergleich der verschiedenen Probeflächen.

Habitat	Symbol of census plot	Area (ha)	No. of species	No. of dominant species (>5%)	Density (p/10 ha)	H'	J'	Biomass (kg/10 ha)	Percent of precocial species breeding pairs
Open	FM	34.5	9	3	15.3	2.07	0.65	10.9	46.1
	OE	44.0	16	9	50.1	3.26	0.82	15.0	69.8
	T	10.5	9	5	28.0	2.72	0.86	5.3	18.9
Shrub	MS	14.5	19	3	38.5	3.02	0.71	8.7	24.7
	SP	21.0	15	3	54.7	2.88	0.74	7.6	19.1
	SC	7.0	12	3	37.9	2.14	0.60	3.6	11.2
	DS	6.0	13	3	76.0	2.66	0.72	4.3	4.4
Forest	AF	20.0	29	7	53.7	4.01	0.82	4.2	2.7
Amelio-rated	AW	22.5	10	6	11.6	2.67	0.80	2.6	45.4
	AD	25.0	9	5	8.2	2.47	0.78	1.2	22.1

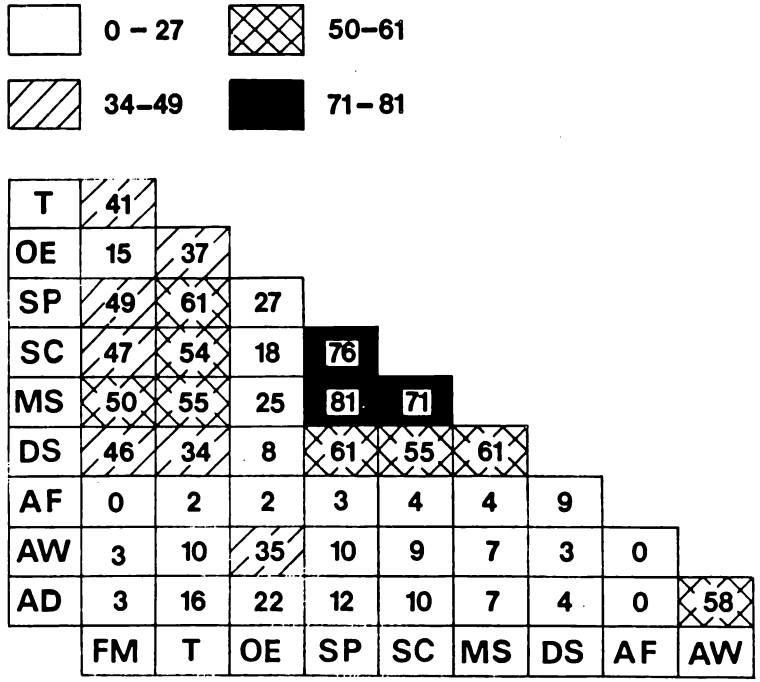

Fig. 14: The diagram showing similarities of bird communities (mapping method) in southern basin on the basis of Renkonen index. Symbols of census plots as in Tables 1–11.

Abb. 14: Darstellung der Ähnlichkeiten von Vogelgesellschaften des südlichen Beckens anhand des Renkonen- Index. Abkürzungen der Probeflächen wie in Tab. 1—11.

The highest biomass values were obtained in natural open habitats (OE and FM) due to the high number of large precocial nonpasseriformes species which lead their young to neighbouring areas and do not depend on the breeding area resources. Forest and dense shrub areas (AF, DS) supported communities of relatively low biomass due to the high share of small passerines in spite of high density of breeding pairs. The lowest biomass values were found on ameliorated meadows (AD and AW).

The dendrite (Fig. 15) constructed on the basis of Renkonen index values (Fig. 14) shows an especially strong similarity between three plots partially covered with bushes (MS, SP and SC). In their vicinity there was a dense shrub bird community (DS), yet there was also a transitory fen community with scattered single bushes (T). Flooded meadows community occupies a more isolated position however as they were relatively close to community of MS plot (a mixture of shrub, *Carex* and flooded fragments). A rather distinct position was occupied by the open emmersive fen (OE). The bird community of this last habitat bears some similarity to the more or less open transition fen (T) and also to „wet" meadows (AW). Alder forest bird community (AF) is at a quite isolated position.

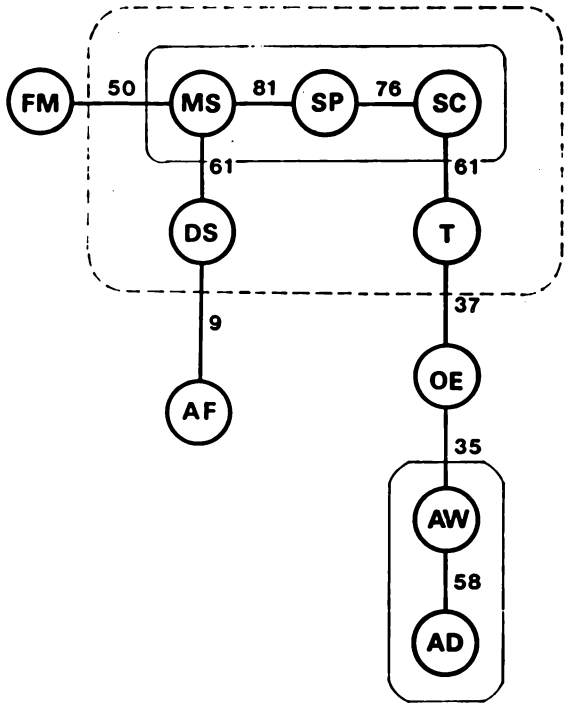

Fig. 15: Bird communities (mapping method) in southern basin arranged in a dendrite on the basis of Wrocław taxonomy (Florek et al. 1951) index. Symbol of census plots as in Tables 1—11. Further explanation in the text.

Abb. 15: Dendrogramm der Vogelgesellschaften des südlichen Beckens anhand des Wrocław Taxonomie-Index (Florek et al. 1951). Abkürzungen der Probeflächen wie in Tab. 1—11. Weitere Erklärungen im Text.

Comparison with other fens

Open fens. The available data for comparisons includes the results of the mapping method on bird communities of rich fens in the upper Warta river valley, central Poland (Nawrocki et al. 1983), and Łęczna-Włodawa Lake District, E Poland (Dyrcz et al. 1973). The following census plots were used. Noteć valley: TO-1 (28.4 ha) — 2/3 of the area overgrown with *Carex* and horsetail ca. 50—80 cm in height, the remaining drier part is overgrown with short grass; isolated, scattered, small willow bushes; soaked ground. TO-2 (20.5 ha) — the whole area is covered with *Carex* and horsetail (ca. 50—80 cm in height) on somewhat less wet ground than on the previous plot. TO-3 (40 ha) — is overgrown with *Carex* and horsetail of medium and large size; isolated willow bushes; very wet, a lot of stagnant water. L (26 ha) — ameliorated meadows (Molinetalia), locally tufted *Carex* and isolated bushes. Łęczna-Włodawa Lake District: Brus (10 ha) — is wet, natural, scythed meadows with *Carex* and grass vegetation up to 40 cm in height; several, isolated bushes. KB-I (10 ha) — is vegetated with *Carex* 20—80 cm in height, partially tufted; soaked ground; scattered, single willow and birch bushes. KB-IV (10 ha) is overgrown with *Carex* 30—60 cm in height; ground rather soaked; relatively more numerous, dispersed, willow and birch bushes.

Efforts to distinguish groups of census plots having similar bird communities (Fig. 16) showed that one cluster may contain plots from different regions. The first cluster (TO-1, TO-2, KB-I, KB-II) includes plots on natural fen with medium size *Carex* vegetation, on soaked (but not overflooded) ground, with single, scattered bushes. A second group (FM, TO-3) consists of plots in a similar habitat but with taller *Carex* and a higher water level (partially overflooded). The third group (Brus, OE) includes fen which is never overflooded, with relatively short vegetation, and very scarce, small bushes. The fourth cluster (L, AD and AW) contains plots on ameliorated grass meadows. So, the difference among bird communities are related here primarily to the height of vegetation and then to a lesser extent the water level.

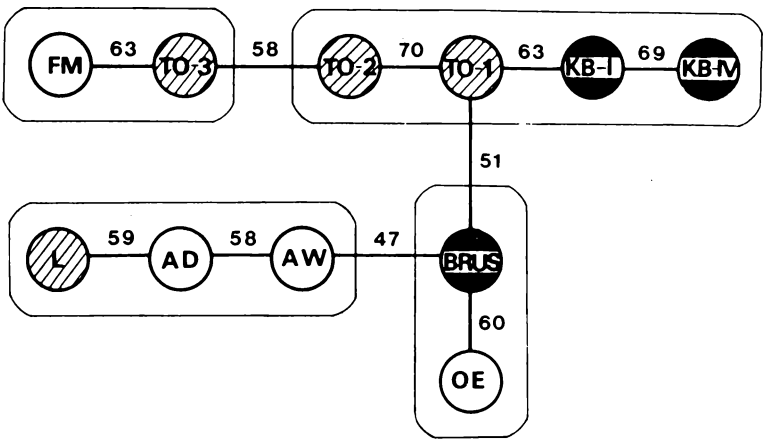

Fig. 16: The diagram showing similarities of bird communities (mapping method) of open fen in three different localities. Black circles: census plots on Łęczna Włodawa lake district (Dyrcz et al. 1973); striped circles: census plots in Noteć river valley (Nawrocki et al. 1983) (symbols of census plots — see text); white circle: southern basin of Biebrza valley. Further explanations in the text.

Abb. 16: Ähnlichkeitsdiagramm von Vogelgesellschaften offener Wiesenmoore aus drei Gebieten. Schwarze Kreise: Probeflächen des Seengebietes Łęczna Włodawa (Dyrcz et al. 1973); schraffierte Kreise: Probeflächen im Noteć Flußtal (Nawrocki et al. 1983) — Abkürzungen der Probeflächen vgl. Text; weiße Kreise: südl. Becken des Biebrza Tales. Weitere Abkürzungen siehe Text.

Shrub fens. We have included here data from the above mentioned, two localities in Poland, and also from natural fens in the Kasari river estuary (Estonia) where the mapping method was also applied (VEROMANN 1979). The following census plots were used. Warta river valley: TZ (18.5 ha) — clumps of willow bushes interspersed with partially tufted *Carex* vegetation of different size, locally mixed with sparse reeds; wet but not overflooded. Łęczna-Włodawa Lake District: L-I (10 ha) — covered with rather dispersed birches 1—4 m in height; locally larger open areas overgrown with tufted *Carex* (50—60 cm in height); very wet. L-II (8 ha) — heterogeneous plot; comprises clumps of willow bushes, tufted *Carex* areas, stagnant water bodies with floating vegetation, and dry, grassy hillocks. KB-II (10 ha) — evenly overgrown with dispersed birches 2—3 m in height; *Carex* 5—30 cm constituted the principal form of vegetation; only slighty tufty; fairly wet. KB-III (10 ha) — almost totally covered with a dense growth of *Betula humilis* (0.5—1.5 m in height) with mixture of *Salix rosmarinifolia;* tufty *Carex* and larger willow bushes occur as well; fairly wet. Kasari river fens (VEROMANN 1979): K-1 (87 ha) —

overflooded meadows with groups of willow trees and bushes with luxurious grass and *Carex* layer, 20—100 cm in height. K-2 (99.5 ha) — very wet overflooded meadows with single, as well as groups of willows 3—5 m in height. *Carex* (20—60 cm) constitutes the principal form of vegetation. K-3 (14.7 ha) — very dense and wet alder and willow thicket (1.5—2 m in height) with loose tree groups (6—12 m) and luxurious grass and *Carex* vegetation in places. K-4 (9.12 ha) — 3.1 km long sector of alder and willow wood along the river bank, interspersed with willow bushes and grassy places. K-5 (12.39 ha) — 5 km long sector of alder and willow wood along canal bank; places with grass and *Carex* more numerous than on previous plot.

Comparison of bird communities with the dendrit method (Fig. 17) allows for the following conclusions. The most similar bird communities were found on census plots including patches of shrub interspersed with patches of tufty, rather tall *Carex* on soaked ground. Such plots (MS, SC, SP and TZ) formed very distinct clusters in dendrit in Fig. 17. The plots with more or less uniform thicket cover (DS and KB-III), though related to the above mentioned group, showed also some differences, and their bird communities were also not closely related to each other, due to different character of the thicket cover. DS plot is overgrown mainly with rather tall alder shrub with reeds, while on KB-III plot low willows with tufted *Carex* predominated. Three ecotonal plots (K-3, K-4 and K-5) — trees and thickets along water course — formed a distinct, though less compact than previously found cluster. K-1 and K-2 cluster was made up of plots on overflooded meadows with the smallest bush covered area. Some degree of similarity was found also between L- I and KB-II, both plots were overgrown with rather dispersed, small birches and *Carex* vegetation of medium size. The heterogeneous L-II plot showed no analogy to other plots. So as in the case of shrub census plots, the analogies among bird communities were primarily connected with similarities of thicket cover (especially with the thicket/open area rate) and secondarily with the height and structure of herb layer, and to a lesser extent the water level.

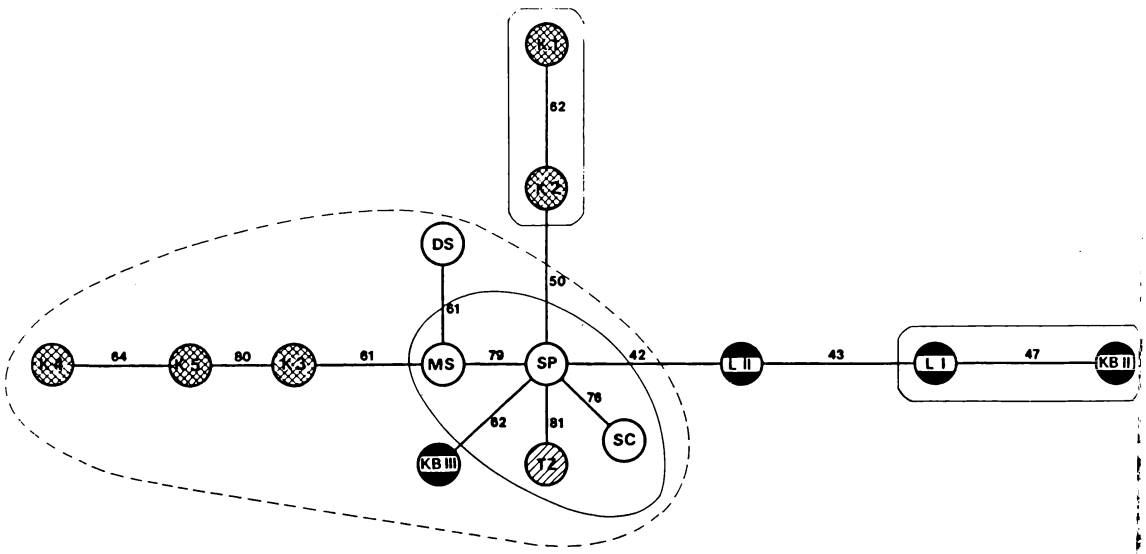

Fig. 17: The diagram showing similarities of bird communities (mapping method) of shrub fen in four different localities. Squared circles: census plots in Kasari river estuary (Veromann 1979). Further explanations as in Fig. 16.

Abb. 17: Ähnlichkeitsdiagramm von Vogelgesellschaften bebuschter Moore aus vier Gebieten. Kreise mit Kreuzschraffur: Probeflächen im Kasari Mündungsgebiet (Veromann 1979). Weitere Erklärungen wie in Abb. 16.

Discussion

Rich minerotrophic fen mires (horizontal fens) have turned out to have a characteristic avifauna which is somewhat different from bird communities studied in various other types of mires (HAKALA 1971, IRDT & VILBASTE 1974, JÄRVINEN & SAMMALISTO 1975). In the present study we found that there were quite distinct differences between open and shrub fen. The differences concern species composition, structure of dominance and year to year variability. The open areas close to the river (Table 2) which are subjected to floods showed the highest differences in bird community composition between two succeeding years of study; by comparison with Renkonen index (Re) application, they showed only 63.4 % of similarity. For three other open census plots (Tables 3, 10 and 11) analogical comparison gave the following values (in the appropriate order): 69.5, 70.6 and 66.3 % (only for OE plot — Table 4 — the value was distinctly higher — 80.4 %). A similar comparison based on the Renkonen index for shrub and wooded areas yielded usually higher values: SP — 91.3 %, SC — 82.0 %, AF — 82.8 %, and MS partially flooded — 75.2 %.

In the present study no clear differences in the total density of avifauna were found between open sample plot in emersive zone (OE) and shrub ones (Tables 4, 5—7, Fig. 18). In drier habitats WIENS (1973) found the total breeding avifauna density distinctly higher in shrub than in open habitats. We found the same tendency in partly ameliorated areas of middle and northern basin (unpublished data). Total densities on open census plots (OE, T) were very high for roughly one stratum habitats. Such density values are more characteristic for multistratum habitats like some conifer and mixed (conifer/deciduous) forests of the temperate zone (NOVIKOV 1960, HAARTMAN 1971). Similarly, high densities were found on the other eutrophic open fen mires (DYRCZ et al. 1973, VEROMANN 1979, NAWROCKI et al. 1983). Data for comparison, available to us from other than rich horizontal fen mires (bogs) concern open habitats. It is characteristic that breeding avifauna in these areas are less dense than in our study area. Namely: in different types of Finnish mires the total density ranged from ca. 1.5 to ca. 12.0 pairs per 10 ha (JÄRVINEN & SAAMALISTO 1975); HAKALA (1971) data on raised fens was, on the average 4.2 pairs per 10 ha while IRDT & VILBASTE (1974) in open peat-bog in Estonia found 2.5 pairs per 10 ha. On rich sea- and lake edge mires in north-east Siberia, KONDRATIEV (1982) found total density of waders as high as ca. 6.0—18.3 nests per 10 ha. This figure is not much different from that found in our study area (OE plot — 26.1.—30.1. pairs per 10 ha; MS plot 1977 — 6.3 pairs per 10 ha).

In our shrub plots (MS, SP, SC and DS) two top species strongly predominated forming 59.9—76.8 % of breeding pairs. Such a dominant structure is considered to be characteristic for secondary habitats, yet on Biebrza fens the natural plant succession predominates (PAŁCZYŃSKI 1975 and 1980). Total densities in shrub habitat were also very high, exceeding even those in some forest habitats (HAARTMAN 1971).

Generally, the bird community composition depends on such details of plant structure like presence of bushes, the height of herb layer and its tuftiness, and water level; the plant species composition seemed to be of minor importance.

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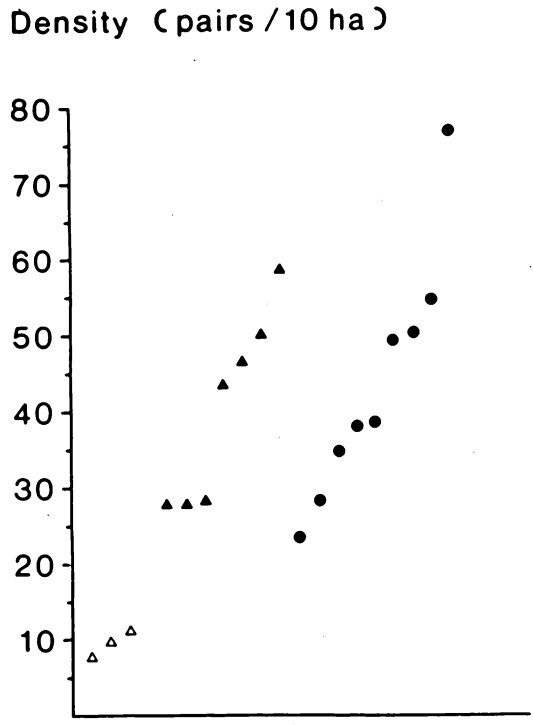

Fig. 18: Total breeding densities (mapping method) in horizontal fens. White triangles: ameliorated meadows; black triangles: open fen; black circle: shrub fen (data from Biebrza valley, Noteć valley, Łęczna-Włodawa lake district and Kasari river).

Abb. 18: Siedlungsdichte in Flachmooren. Weiße Dreiecke: entwässerte Wiesen; schwarze Dreiecke: offene Moore; schwarze Kreise: bebuschte Moore (Daten aus dem Biebrza Tal, Noteć Tal, Łęczna-Włodawa Seengebiet und dem Kasari Mündungsgebiet).

Summary

The paper contains data from the years 1977—1980. By using a mapping method in the open fen (preserved in natural state) it was found that the total density of breeding bird pairs reached 15.3—50.1 per 10 ha. In ameliorated meadows, formed after the like habitat had been dried, the total density was 8.2—11.6 pairs/10 ha. In shrub fens the density was 37.9—76.0 pairs/10 ha, and in alder forest with stagnant water — 53.7 pairs/10 ha. In a sample plot (44 ha) in an open fen of a not overflooded zone the dominant species were: *Limosa limosa* (26.4 % of dominance), *Gallinago gallinago* (13.8 %), and *Acrocephalus paludicola* (10.4 %). In structurally similar ameliorated meadows the dominant species was *Alauda arvensis* forming 29.2—46.6 % of breeding pairs. In most shrub plots the dominant species were: *Acrocephalus schoenobaenus* (41.0—56.2 %), and *Emberiza schoeniclus* (17.6—20.6 %). *Acrocephalus schoenobaenus* was also a dominant species in tall tufted *Carex* situated close to the river. The total biomass (breeding pairs or females in the species with no pair bond) in open fen was very high due to a considerable amount of large precocial Nonpasseriformes; it ranged from 5.3 to 15.0 kg per 10 ha; in ameliorated meadows the figure was 1.2—2.6 kg per 10 ha, while it was in shrub marshland — 3.6—8.7 kg/10 ha.

Basing on a dendrit formed according to the Renkonen index, it was found that there was the greatest similarity between the communities of birds in the sample plots in various types of fens partially covered with shrubs.

Zusammenfassung

Vogelgesellschaften natürlicher, eutropher Überschwemmungsmoore im Flußtal der Biebrza, Nordost-Polen

Siedlungsdichteuntersuchungen (Kartierungsmethode) aus den Jahren 1977—80 in den vermoorten Niederungen des gefällearmen Flusses Biebrza brachten folgende Ergebnisse:

Die Brutvogeldichte in natürlichen, offenen Wiesenmooren betrug 15,3—50,1 Brutpaare/10 ha, auf entwässerten Wiesen 8,2—11,6 Paare. In bebuschten Mooren betrug die Dichte 37,9—76,0 Paare/10 ha, in Erlenbruchwäldern 53,7 Paare.

Die dominanten Arten des offenen Wiesenmoores in der nicht mehr überschwemmten Zone (Probefläche 44 ha) waren Uferschnepfe (26,4 %), Bekassine (13,8 %) und Seggenrohrsänger (10,4 %). In strukturell ähnlichen, aber entwässerten Wiesen war die dominante Art die Feldlerche mit 29,2—46,6 % der Brutpaare.

In den meisten bebuschten Gebieten waren die dominanten Arten Schilfrohrsänger (41,0—56,2 %) und Rohrammer (17,6—20,6 %). Der Schilfrohrsänger war auch in höherer, bültiger Seggenvegetation nahe dem Fluß die dominante Art.

Die Gesamtbiomasse (Brutpaare, bzw. Weibchen bei Arten ohne Paarbindung) in offenen Mooren war bedingt durch einen hohen Anteil großer Nestflüchter (Nonpasseres) hoch (5,3—15,0 kg/10 ha). Sie betrug in entwässerten Wiesen 1,2—2,6 kg und in bebuschter Vegetation 3,6—8,7 kg/10 ha.

Dendrogramme basierend auf dem Renkonen-Index zeigen, daß von allen Probeflächen Vogelgesellschaften der teilweise bebuschten Moore die größte Ähnlichkeit aufweisen.

References

Dyrcz, A., J. Okulewicz, L. Tomiałojć & J. Witkowski (1972): Ornitofauna lęgowa Bagien Biebrzańskich i terenów przyległych (Breeding avifauna of the Biebrza Marshes and adjacent territories). Acta Orn. 13: 343—422. • Dyrcz, A., J. Okulewicz & B. Wiatr 1973: Ptaki Pojezierza Łęczyńsko-Włodawskiego w okresie lęgowym (Birds breeding in the Łęczna-Włodawa lake district- including a quantitative study on low peats). Acta zool. Cracow. 18: 399—474. • Dyrcz, A., J. Okulewicz, J. Witkowski, J. Jesionowski, P. Nawrocki & A. Winiecki (1984): Ptaki torfowisk niskich Kotliny Biebrzanskiej. Opracowanie faunistyczne (Birds of fens in Biebrza Marshes. Faunistic approach). Acta orn. 20: 1—108. • Dyrcz, A., & L. Tomiałojć (1974): Application of the mapping method in the marshland habitats. Acta orn. 14: 348—352. • Dyrcz, A., J. Witkowski & J. Okulewicz (1981): Nesting of „timid" waders in the vicinity of „bold" ones as an antipredator adaptation. Ibis 123: 542—545. • Enemar, A. (1959): On the determination of the size and composition of a passerine bird population during the breeding season. A methodological study. Var Fagelv., Suppl. 2: 1—114. • Florek, K., J. Łukaszewicz, J. Perkal, H. Steinhaus & S. Zubrzycki (1951): Taksonomia Wrocławska (Wrocław taxonomy). Przegl. Antrop. 27: 193—211. • Goodwillie, R. 1980: European peatlands. Strasbourg. • Haartman, L. v. (1971): Population dynamics. In: D. S. Farner, & J. R. King: Avian Biology 1: 391—459. New York, London. • Hakala, A. (1971): A quantitative study of the bird fauna of open peatlands in Finland. Ornis Fennica 48: 1—11. • Irdt, A., & H. Vilbaste (1974): Bird fauna of the Nigula peat-bog. — In: E. Kumari (ed): Estonian wetlands and their life, 214—229. Tallinn. • Järvinen, O., & L. Sammalisto (1975): Regional trends in the avifauna of Finnish peatland bogs. Ann. Zool. Fennici 12: 31—43. • Kondratiev, A. J. (1982): Biologia kulikov v tundrach severo-vostoka Azii. Moskva. • Krebs, C. J. (1972): Ecology: the experimental analysis of distribution and abundance. New York. • Krzywonos, K. (1965): Warunki klimatyczne rejonu Rolniczego Zakładu Badawczego Biebrza, w latach 1954—1963. Wiad. Inst. Melior. 17: 1—20. • Nawrocki, P., A. Jermaczek, J. Jesionowski, B. Nawrocka & A. Winiecki (1983): Ptaki Bagien Kramskich w okresie lęgowym w latach 1976—1979 (Birds of Kramskie Marshes during breeding period in 1976—1979). Prace Kom. Biol. Pozn. Tow. Przyjaciół Nauk 67: 19—41. • Novikov, G. A. (1960): Geographical variability of forest bird population density in the European part of the USSR and the adjoining countries (in Russian, English summary). Zool. Zurnal 39: 433—447. • Okruszko, H. (1973): Przyrodniczo-rolnicza charakterystyka doliny Biebrzy (The Biebrza river valley characteristics from natural and agricultural point of viev). Zesz. Prob. Nauk Rol. 134: 173—199. • Okulewicz, J., & J. Witkowski (1979): Bekasik, *Lymnocryptes minimus*, po-

nownie ptakiem lęgowym w Posce (Jack Snipe, *Lymnocryptes minimus,* again a bird breeding in Poland). Prz. zool. 23: 255—257. • Oświt, J. (1968): Strefowy układ zbiorowisk roślinnych jako odzwierciedlenie stosunków wodnych w dolinie Biebrzy. Zesz. Prob. Post. Nauk Rol. 83: 5—7. • Pałczyński, A. (1975): Bagna Jaćwieskie (Pradolina Biebrzy). Zagadnienia geobotaniczne, paleofitosocjologiczne i gospodarcze (Jacwieskie Sümpfe — Das Urtal der Biebrza — Die geobotanische, paleophytosoziologische und wirtschaftliche Probleme). Rocz. Nauk Rol. Ser. D, monogr. 145: 1—232. • Pałczyński, A. (1980): Die natürlichen Gegebenheiten der Moore des Biebrza-Tales und die Probleme ihres Schutzes. Telma 10: 205—226. • Renkonen, O. (1938): Statistisch-ökologische Untersuchungen über die terrestrische Käferwelt der finnischen Bruchmoore. Ann. Zool. — Bot. fenn. Vanamo 6: 1—226. • Sørensen, T. (1948): A method of establishing groups of equal amplitude in plant sociology based on similarity of species content and its application to analyses of the vegetation on Danish commons. Kong. Danske Vidensk. Selsk. Biol. Skr. 5: 1—34. • Tomiałojć, L. (1970): Badania ilościowe nad synantropijną awifauna Legnicy i okolic (Quantitative studies on the synanthropic avifauna of Legnica and its environs). Acta orn. 12: 295—392. • Tramer, E. J. (1969): Bird species diversity: components of Shannon's formula. Ecology 50: 927—930. • Veromann, H. (1980): Vorläufige Ergebnisse der Vogelbestandsaufnahmen in der Überschwemmungswiesen des Flusses Kasari (Estonische SSR). In: H. Oelke (ed.): Bird census work and nature conservation, 230—239. Göttingen. • Wawrzyniak, H., & G. Sohns (1977): Der Seggenrohrsänger *Acrocephalus paludicola.* Wittenberg Lutherstadt. • Wiens, J. A. (1973): Pattern and process in grassland bird communites. Ecol. Monogr. 43: 237—270.

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