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DYNAMICS OF THE AQUATIC WARBLER (*ACROCEPHALUS PALUDICOLA*) POPULATION AT THE ZVANETS MIRE (BELARUS)

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Abstract. The paper presents data of the 1999–2005 monitoring of the Aquatic Warbler (*Acrocephalus paludicola*) density, its timing of breeding and breeding success at the Zvanets mire, which hosts about 35% of the European and 64% of the Belarusian population of the species. The density of the species at the mire is characterised by significant yearly fluctuations and is closely linked to the water level in the mire. Nesting conditions for the Aquatic Warbler at the mire were extremely unstable and changed not only in different years, but also within a breeding season. Females can vary the timing of breeding and nest placement quite freely depending on nesting conditions. The main factor influencing breeding success is predation. Breeding success and habitat productivity (the number of fledglings, which have successfully left the unit of habitat) decrease in years when environmental conditions are unusual. In such years birds build their nests in an extraordinary way, making them more accessible to predators. Thus, the Aquatic Warbler is well adapted to unstable nesting conditions on fens. However, in some years the density and breeding success of the species decline to their minimal values.
Key words: Aquatic Warbler, breeding success, habitat productivity

Introduction

The center of the Aquatic Warbler (*Acrocephalus paludicola*) present-day range is within the Polesie Lowland. Over 70% of the population is found at four large mires (one in Poland and three in Belarus), which vary considerably in their ecological characteristics (AWCT 1999). At most of the mires within the habitat range species numbers fluctuate considerably from year to year under the influence of various factors (AWCT 1999). The reasons for fluctuations are generally known. However, the knowledge of how different factors actually affect populations living in varied ecological contexts is insufficient. To date, the evidence on the species population behaviour is limited only to three sites. At the Biebrza mire, Poland (Dyrcz & Zdunek 1993a, b) and Sporovskoe mire, Belarus (Kozulin *et al*. 2003), the population varies greatly from year to year showing a gradually declining trend. At the Hortobazhi mire, Hungary (Kovacs & Vegvari 1999), species numbers are growing. The Aquatic Warbler breeding ecology was studied on the basis of one mire located in the Biebrza floodplain, and the bulk of the research was carried out at one monitoring plot (Poland) (Dyrcz & Zdunek 1993a, b). However, species breeding data obtained from one site are unlikely to provide a full picture of breeding patterns and adaptive mechanisms in different environments.

The preliminary research recently conducted in Belarus indicates that fens – habitats for the Aquatic Warbler – are highly unstable ecosystems. The density and numbers of the species greatly vary from year to year as well as during the breeding season under the influence of several natural and anthropogenic factors: vegetation succession, water level fluctuations, fires (Kozulin *et al*. 1998; Kozulin & Flade 1999). Yet the knowledge of how exactly these factors affect the population is insufficient.

Population changes are mainly dependent on breeding success and mortality rate of the species during wintering. In this context, it is important to explore the causes of population changes and breeding ecology at different types of mires so as to understand the current state and population behaviour of this globally endangered species and devise protection recommendations. This article presents results of the study focused on the reasons for the Aquatic Warbler population changes and breeding success at the Zvanets mire.

Study area

The study area is a fen, which is located in the flat lowland of the Pripyat's second bottom. The mire covers a total area of 15,873 ha, about 11,150 ha of which is open sedge fens, 2,575 ha is forest and scrub, and 2,085 ha is open mineral islands. The area suitable for breeding of the Aquatic Warbler is approximately 8,000 ha. A peat deposit is about 50 cm deep. A water divide runs along the central section of the mire from north to south with relative heights of 145.3 m above the sea. The relief lowers to 144.8 m from the central part towards east and west.

Description of the monitoring plots

The southern part of the mire, where the Povitie monitoring plot is located, is more productive, with water mineralization of about 347.7 mg/l. The locality is dominated by associations of *Carex elata* (58%), *Carex appropinquata* (37%). Tussocks are about 30 cm high because of high water fluctuations.

The second monitoring plot – Novosiolki – is situated in the northern part of the mire (32 ha). This part of the mire is characterised by smaller amplitude of water table fluctuations and lower productivity. Drops in mineralization are accompanied by a substantial increase in the occurrence of *Caricetum lasiocarpae* associations here. Tussocks are about 20 cm high.

The main environmental factors

To study the reasons for changes in species density, water levels at the monitoring plots were measured and the state of the last-year vegetation was described (destroyed or not by autumn or early spring fires).

Fires

Fire events could affect breeding places and feeding resources and, consequently, densities of the Aquatic Warbler. Therefore the years when fires occurred and their effects were recorded. Since the start of fen monitoring in 1995 (for 11 years), fire cases have been recorded in eight years at the Zvanets mire. Fire occurrence is connected with the tradition of the local population to burn old grass to raise the productivity of hayfields. Spring burning of grass is usually conducted in March, early April before the start of the spring flood. In the absence of water, practically all dry vegetation burns out, tussocks burning out partially. In the past the local population mowed all fen mires by hand. As a result, old vegetation did not accumulate in large amounts, and spring fires broke out on few spots. At present in the absence of water, any local grass burn results in the burning out of the whole mire. In the presence of water, only the upper layer of vegetation burns out, which only improves habitation conditions for the Aquatic Warbler.

Hydrological characteristics

Relative to soil surface levels of ground water at the monitoring plots were measured in cm in May and July from 1995 till 2006. In 2004 special constant points of water level monitoring (simple rulers dug into soil) were established. Water levels there were measured at intervals of seven days from early March through late October in 2004–2006. Relational altitudes above the sea level were designated for every water monitoring point. The soil level in between tussocks was assumed to be a zero mark for measuring of the water table. The water table below the zero mark was recorded with a minus, that above the zero mark – with a plus. In order to reproduce long-term changes in the hydrological regime of the fens, the information on water levels for years 1995– 2003 was analysed. For that purpose, data about the water level in the Orechovski canal at a special check-point, located 5 km from the Povitie monitoring plot, were used.

The hydrological regime of Zvanets is typical of the Polesie area fens. In spring it is flooded 20–50 cm above the soil level (Fig. 1). When flood waters recede, the water level gradually drops to the soil level normally by early-mid March. From June through September or October, the water level continues to drop gradually to 10–50 cm below the soil level because evaporation is greater than precipitation. In late autumn, the water level begins to rise slowly. In some years, considerable deviations from the above hydrological regime can be observed, which, however, do not upset the general trend. Sometimes the high level of water can remain from April through the end of June, in other years the spring flood period is very short. The absence of spring floods is very uncommon.

Over the last five years, 2001 and 2004 were the years of little water content, 2000, 2002, 2003 were the years of average water content, 1999 and 2005 being the years of great water content.

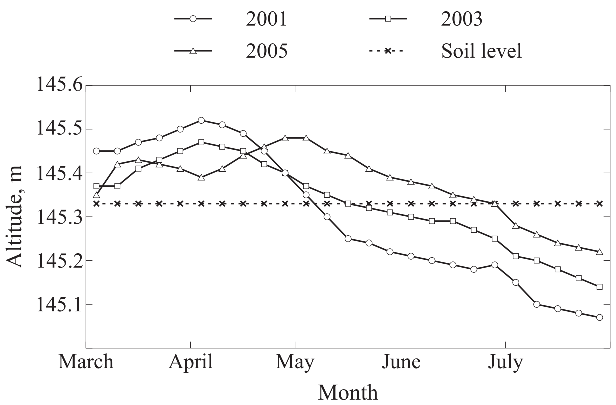

Figure 1. Water level changes (in meters above the sea level) at the Zvanets mire in different years.

Material and methods

Field study

The bulk of the field studies on breeding of the species was conducted at the monitoring plots from 1999 through 2005, during the season from 15 May through 15 August. The breeding ecology of the Aquatic Warbler was studied basing on the observation of 99 nests.

Field counts of singing males were conducted every year from 1996 till 2005 at two specially equipped monitoring plots in the south and north of the site.

The monitoring plots – Povitie (60 ha, 1,500 × 400 m) and Novosiolki (32 ha, 800 × 400 m) – were divided into 100 × 200 m rectangles by marking. The marked plots were mapped. The width of each strip was 200 m. Two people carried out field counts simultaneously, each on his own transect.

Counts were done twice a year – during the first clutch (25 May – 5 June) and the second one (1–10 July). If the first clutch occurs under unfavourable conditions, the timing of breeding is postponed and species numbers are redistributed during the breeding season. Counts were started an hour before sunset. Singing males of the Aquatic Warbler were identified, location of each male being marked on a prepared map.

Absolute counts of breeding females (nests and worrying females if detection of nest location was impossible) at the monitoring plots were conducted. Locations of nests were detected from the behaviour of females of the Aquatic Warbler during the field study. When identified, locations of nests and worrying females were marked with tags and mapped. Nests were monitored every day when possible. To avoid attracting predators, the track was laid at a distance of 5 m from the nest, and further the observer had to approach the nest in large steps without disturbing the vegetation structure.

The duration of egg incubation was assessed using the water test method. The age of nestlings was assessed by body weight and plumage development.

Data analysis

Densities of breeding females and males (number of breeding females/males per square kilometre) were calculated on the strength of their absolute counts at the monitoring plots.

Daily rates of egg and nestling mortality were calculated using the Mayfield method (Mayfield 1975; Paevsky 1985); the number of dead eggs (or nestlings) was divided by the number of egg-days or nestling-days (which is the number of eggs or nestlings multiplied by the number of exposure days). The standard deviation of findings was calculated using the Hensler method (Hensler 1985). In addition, daily mortality rates due to certain reasons were calculated.

The overall breeding success (the probability that an egg laid gives a fledgling) was derived by multiplying the probability of egg survival during incubation by the probability of the young survival into fledglings.

Nest success (the probability of survival of any contents of the nest from the start of incubation into fledglings of the young) was calculated by multiplying the probabilities of nest survival during the incubation and nestlings period.

All values calculated by the Mayfield method are indicated in this article as a value ± standard deviation (Hensler 1985).

Results

Male density dynamics at the Zvanets mire

For the duration of eight years (May–June) the mean density of singing males during the first clutch was 81.0 ± 8.17 (min – 35, max – 103) at the Povitie monitoring plot, and 44.75 ± 17.49 (min – 0, max – 75) at Novosiolki (Table 1). There were great fluctuations in density from year to year (Fig. 2).

At the Povitie monitoring plot the density of Aquatic Warbler males during the first clutch was lower than the mean value in 2001, 2003 and 2005 (Fig. 2). In the spring of 2001, due to the low water level during the whole breeding season, burning of dry vegetation reduced vegetation productivity and insect biomass, and resulted in the low density of aquatic warblers during the first clutch. By July vegetation had reached its potential productivity and the density of males of the Aquatic Warbler increased simultaneously (Figs 2, 3). The low density of males in 2003 and 2005 at the Povitie monitoring plot was caused by the water level, which was high until mid-June. In those years, the water level was higher than tussocks. Therefore it was impossible for birds to build nests in tangles of sedge above water because old vegetation had been completely burnt. Although in 1999, the water level was also high, the density of males did not suffer because birds built their nests in old sedge tangles above water (Fig. 2). In 1999 and 2003, the water level fell by mid-June and the male density increased during the second clutch (Figs 2, 3). Meanwhile in 2005, the water level was high during the whole breeding season. As a result, birds abandoned the flooded mire parts.

In other years – 1998, 2000, 2002, 2004 – nesting conditions at the Povitie plot were generally good for birds: the water level during the first clutch was ap-

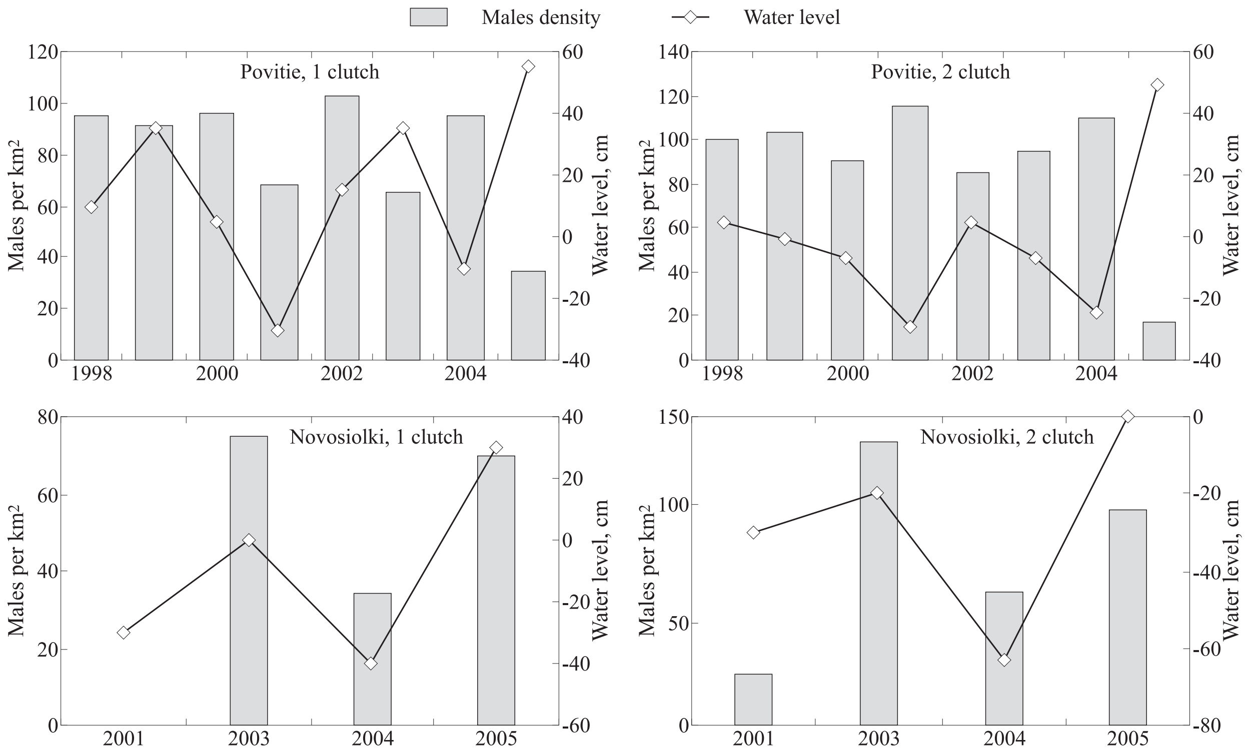

Figure 2. Male density changes during the first clutch (25 May – 10 June) and the second clutch (1–15 July) and water levels (relative to the soil level: 0 – ground level, +10 – water level above soil, -10 – water level below soil) at the monitoring plots of the Zvanets mire.

proximately at the soil level. In those years, the density of Aquatic Warbler males was high (90–105 males per 100 ha). Only in years when the water level was near the soil level and dry vegetation had survived (2000 and 2002), the density of males during the first clutch was higher than during the second one (Fig. 3).

At the monitoring plot Novosiolki situated in the north of the mire water levels did not fluctuate greatly (Fig. 2). In 2003 and 2005, a higher male density was recorded there as a result of bird movement from flooded sections in the south of the mire (Povitie). In 2001 and 2004, from March to August, the water level at the Novosiolki plot remained considerably lower than the soil surface. In such dry conditions fires burnt old vegetation and moss, causing the absence of the species in 2001 and its low density in 2004 (Fig. 2).

The density of singing males proved to be slightly higher at both plots during the second clutch than during the first one (Povitie – 89.5 ±10.91, Novosiolki – 83.0 ± 24.3) (the difference is not significant) (Table 1).

The male density was higher during the second clutch in the years when nesting conditions were unfavourable

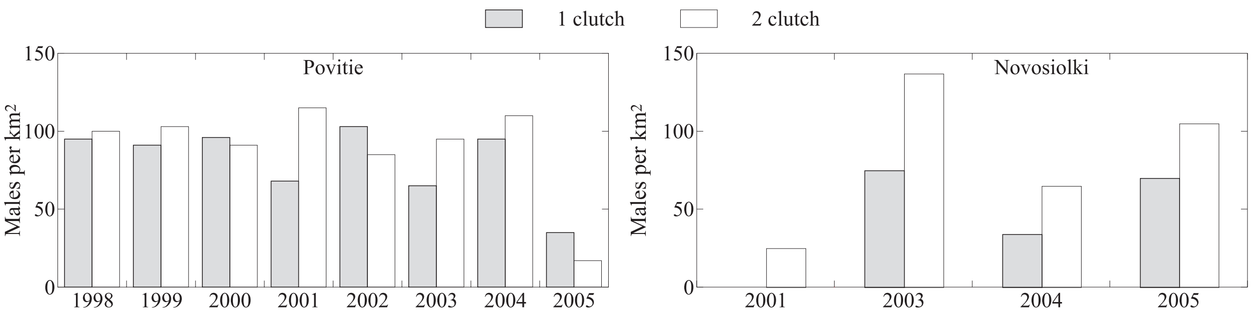

Figure 3. Male density ratio during the first and the second clutches.

in May – first half of June (burning of old vegetation, the water level higher than that of tussocks) (Figs 2, 3). By early July, during most of the years, the water level dropped to and below the soil level maximizing the Aquatic Warbler density (1999, 2003). The only exception was the year 2005, when high waters remained until early July making birds leave submerged sections of the mire. The male density was also higher during the second clutch in the years when old vegetation was burnt (Fig. 3) (Povitie – 2001, 2003, 2004, 2005; Novosiolki – 2001, 2003, 2004). Vegetation burning generally delays the breeding period. Normally nests of the Aquatic Warbler are disguised under dry vegetation, and if it is lacking, the species cannot start breeding. In such conditions some females start nesting in May – first half of June in rodents' holes and burnt hollows in tussocks. The other, greater part of females begin to construct nests at the end of June or July when full-blown green vegetation can disguise nests. It is the delayed breeding period that explains the higher density of males in July than in May.

Timing of the breeding season and nest placement at the Zvanets mire

Breeding investigations at the Zvanets mire were carried out during five breeding seasons in 1999, 2001, 2003, 2004 and 2005. Nesting conditions at the Zvanets mire were extremely unstable and changed not only in different years, but also within a breeding season.

At Zvanets, the most typical first egg date distribution (when most females breed during the first clutch and only a small number during the second one) occurred only in 1999 (Fig. 4, 26.7% of all females bred during the second clutch). In 2001 and 2004 vegetation was burnt in spring, and the number of females that started breeding in the second half of the breeding season was greater (2001: 38.1%; 2004: 40.6%). In 2003, first egg dates were distributed evenly throughout the breeding season. In those years spring fires entirely destroyed old dry vegetation which is used by birds for nest construction and camouflage. Therefore, only a small number of birds started to construct nests in May in depressions between burnt tussocks. Later, when green vegetation developed more, birds began constructing nests using green vegetation for disguise.

The timing of breeding in 2005 was rather late due to high water standing during May. As soon as tussock tops had emerged from water, aquatic warblers started nesting. That year was also characterised by a low percentage of females nesting during the second clutch (12.5%; Fig. 4).

During the observation period, the mean first egg dates during the first clutch fell within the 14–26 May time-range; the time of the second clutch ranging from 21 June to 7 July. The earliest clutch was started on the 10th of May (year 2001); the latest one on the 22nd of July (1999) (Vergeichyk & Kozulin 2006b, in press).

By means of individual ringing of breeding females during the first clutch it was ascertained that 25% of those females lay eggs during the second clutch and the mean interval between two clutches was 40 days.

During the study period four typical patterns of nest placement were recorded at the Zvanets mire (Vergeichyk & Kozulin 2006b, in press):

30.77% of nests were arranged in small depressions of

Table 1. The mean male density during the first and the second clutches.

Monitoring plot _ clutch	n	Average	Min	Max	SD	SE
Povitie _ 1	8	81.0	35	103	23.121	8.174
Povitie _ 2	8	89.5	17	115	30.873	10.915
Novosiolki _ 1	4	44.75	0	75	34.980	17.490
Novosiolki _ 2	4	83.0	25	137	48.607	24.304

	May					June					July				
	1–6	7–12	13–19	20–26	27–31	1–6	7–12	13–19	20–26	27–31	1–6	7–12	13–19	20–26	27–31
1999 n = 15			6.67	20	26.67	20					13.3	6.67		6.67	
2001 n = 21		9.52	42.9	9.52				14.29	9.52	14.29					
2003 n = 36			2.78	22.22	8.33	5.56	2.78	11.11	13.9	2.78	11.1	11.1	8.33		
2004 n = 32		3.13	15.6	28.13	12.5				9.38	18.75	6.25	3.13	3.13		
2005 n = 16				12.5	25	18.8	25	6.25			12.5				

Figure 4. Distribution of first egg dates (percent of nests) during the breeding period at the Zvanets mire.

soil or moss; in accumulations of old vegetation on tussock tops or on the soil surface and were well covered with the last year and green vegetation (standard way);
30.77% of nests were arranged in burnt hollows or in rodents' holes in tussocks. Birds usually build nests in hollows and rodent holes in May in the absence of old vegetation and when green vegetation is poorly developed as a result of fire;
27.35% of nests were arranged on the soil surface, on tussock tops and covered only with green vegetation. Such a situation is usually observed in June–July, in the absence of the last year vegetation, on condition that green vegetation is high enough and projective cover is sufficient for nest disguise;
11.11% of nests were arranged in old sedge tangles above water. Such placement of nests is observed when the water level is higher than the tussock surface and when old vegetation is abundant.

Breeding success of the Aquatic Warbler at the Zvanets mire

Identification of predators

The area within a 3 m radius of a failed nest or a nest with partial losses was carefully examined for signs that could help determine the cause of failure. The following signs were recorded: the partial or complete disappearance of nest contents, the intact or destroyed condition of the nest, characteristic bite traces on eggs and nestlings, the distance from the nest at which died nestlings were found, predators' footsteps, the water level in relation to the nest bottom. In cases of mortality caused by predators, the following two patterns of nest failure or its partial losses were detected:
The nest was found destroyed, the surrounding grass was stamped flat; feathers, typical feeding tables, etc. were found around the nest. In such cases it was often possible to identify the predator.
The nest and the surrounding vegetation were found undisturbed, though nest contents had fully or partially disappeared. In those cases, on thorough examination of the nest surroundings, eggs or nestlings with typical bite traces were found at a distance of 20–100 cm.
In case of the first pattern of nest failure, it is impossible to identify the predator accurately. However, in most cases we can presume that nests were devastated by the following predators: the Marsh Harrier (*Circus aeruginosus*), White Stork (*Ciconia ciconia*), water vole (*Arvicola terrestris*), ermine (*Mustela* sp.), raccoon dog (*Nyctereutes procyonoides*) or an unidentified large terrestrial predator. In most cases devastation by these predators has casual character and is usually observed when the Aquatic Warbler nests in unusual for it conditions. Therefore predators in all cases of the first pattern were classified as 'other predators'.
In cases of the second pattern of nest failure or its partial losses, we concluded that the reason for these were attacks of common shrews (*Sorex* sp.) (Vergeichyk & Kozulin 2006a, in press). This was proved by findings of dead chicks with bite traces, egg shells in nests, as well as by the fact that only when attacked by small insectivores a nest itself may remain untouched. It is feasible that if attacked by this animal a few nestlings or eggs may survive, especially if the female returns to the nest during the attack.

Breeding success

99 nests were monitored altogether during the four years (1999, 2001, 2003, 2004).
Partial losses, which occurred in a considerable number of nests (when eggs and nestlings die in persisting nests) provide grounds for calculations of breeding success instead of nest success (Fig. 5).
Thus, calculations show that nest success at Zvanets was greater than breeding success (63.5% vs. 42.3%) (Vergeichyk & Kozulin 2006a, in press).
The overall breeding success of the Aquatic Warbler at the Zvanets mire, calculated using the Mayfield method, is 42.28% and 2.54 fledglings per nest (Table 2).
The main cause for partial nest contents losses as well as for nest failures was predation. Nest failures and partial losses of nest contents due to predation proved to be greater at a chick stage (Fig. 6). The following predators devastated nests: other predators destroyed six nests completely, while shrews destroyed seven nests completely and eleven nests partially.
Over the study period the daily egg and nestling mor-

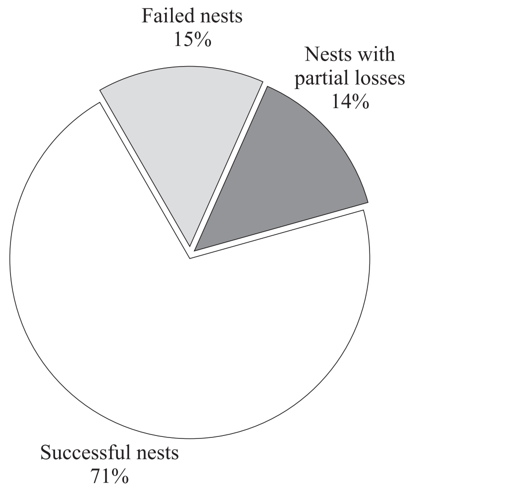

Figure 5. Proportion of failed nests and nests with partial losses.

Table 2. Overall breeding success (mean ± SD) of the Aquatic Warbler at Zvanets, calculated by the Mayfield method.

Year	Breeding success, %	Number of fledglings per nest
1999	27.68 ± 6.68	1.56
2001	45.84 ± 8.53	3.31
2003	39.02 ± 5.85	2.36
2004	54.07 ± 6.74	3.22
Total	42.28 ± 3.40	2.54

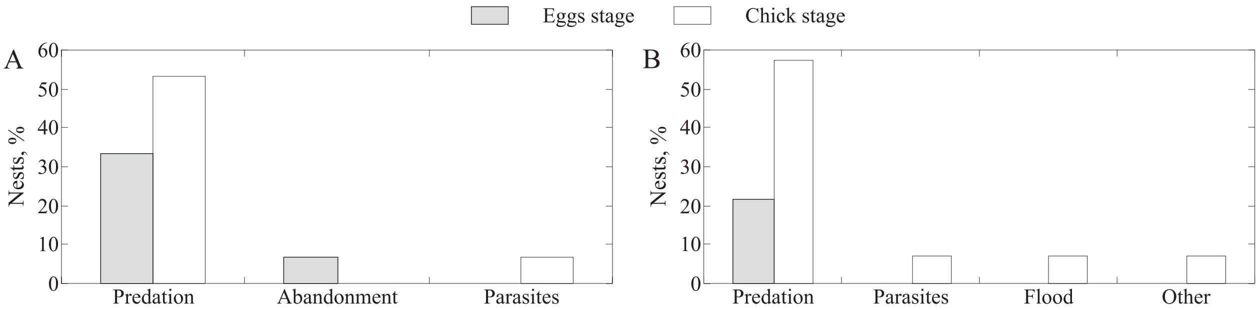

Figure 6. Causes for nest failures and partial losses at the Zvanets mire. Nests of all failures, % (A), nests with partial losses, % (B).

tality rate due to predation made up 1.88%, including predation by shrews – 1.14% and that by other predators – 0.74% (Table 3).

In 1999 the daily egg and nestling mortality rate due to predation (3.63%, Table 3) was higher than that in the other three years of the study (vs. 2001 t = 2.83, $p < 0.01$, vs. 2003 t = 2.59, $p < 0.01$, vs. 2004 t = 2.34, $p < 0.05$). The shrew predation rate in that year was not higher than in other years statistically. In 1999 in May and in the first half of June the water table was high (higher than the tussock level) and most nests were built in sedge matting above water thus making them accessible to other predators (the daily mortality rate due to other predators in 1999 was significantly higher (Table 3): 1999 vs. 2001 t = 2.74, $p < 0.01$; 1999 vs. 2003 t = 2.3, $p < 0.05$; 1999 vs. 2004 t = 3.92, $p < 0.01$).

The daily egg and nestling mortality rate due to predation by shrews was quite stable in different years. It

Table 3. Daily predation rates during the first and second clutches (%).

Clutch number / Year	Daily egg and nestling mortality rate due to predation by		
	Overall	Shrews	Other predators
1 / 1999	3.03	0.00	3.03
2 / 1999	5.42	5.42	0.00
1999	3.63	1.36	2.27
1 / 2001	0.42	0.42	0.00
2 / 2001	2.29	1.15	1.14
2001	1.31	0.77	0.54
1 / 2003	2.76	1.23	1.53
2 / 2003	0.17	0.17	0.00
2003	1.54	0.73	0.81
1 / 2004	1.61	1.61	0.00
2 / 2004	2.18	2.18	0.00
2004	1.72	1.72	0.00
Zvanets	1.88	1.14	0.74

was only in 2004 that this indicator was higher than in the other years (1.72%, vs. 2001 t = 2.02, $p < 0.05$, vs. 2003 t = 2.22, $p < 0.05$).

Daily mortality rate due to predation at the egg stage is higher during the first clutch (Vergeichyk & Kozulin 2006a, in press). Predation at the egg stage during the first clutch was observed in years with unusual nesting conditions and non-typical location of nests just during the first clutch period (1999 and 2003). Predation by shrews at the egg stage was lower than at the nestling stage, while predation by other predators at the egg stage was higher (Vergeichyk & Kozulin 2006a, in press).

Breeding density and mire productivity

The density of breeding females changed in different years and during the breeding season. In 2001 it was 116 females per sq km, in 2003 – 66 females per sq km and in 2004 – 102 females per sq km (Table 4).

In 2001 and 2004 the values of the total density of breeding females were close to the maximal male density. In 2003 the density of females was much lower than that of males. This could be explained by the concentration of males in the northern part of the mire. The water level in the southern monitoring plot Povitie in 2003 was high till mid-June and dry vegetation was absent. Later the water level fell but soil remained humid. Thus, males moved from the southern parts of the mire to the northern ones, where nesting conditions were more favourable. The maximal productivity of the Zvanets mire was 400 fledglings from 100 ha and the minimal value – 178 fledglings.

Discussion

Influence of environmental factors on species density

The male density is closely linked to the water level in the mire ($R^2 = 0.64$) (Fig. 7). The male density reaches its maximum when water fluctuates between the tussock level and that of soil. At the Novosiolki plot tussocks are about 20 cm high, at Povitie – 30 cm. Bird nesting becomes complicated when the water level rises above tussocks during the nesting season. In fire-free years, even when the water level is above the tussock level, a certain number of females nest above water in tangles of old sedge thereby maintaining high male density (1999, Zvanets, Povitie). Females are unable to nest in years when the water level is high and vegetation is lacking due to fires. Males tend to abandon submerged sections of the mire or display lack of enthusiasm waiting for water to recede.

When the water level falls below the soil level, species numbers also decline because of the generally degraded mire productivity, underdeveloped green vegetation, poorer species diversity and insect biomass, whose development is dependent upon the availability of open water and developed green vegetation. Lack of spring flood exerts a particularly negative impact on the density of birds.

In most cases burning of old vegetation leads to a delayed breeding period. Normally, nests of the Aquatic Warbler are disguised under dry vegetation, and if it is lacking, the species cannot start breeding. In such conditions some females start nesting in May – first half of June in rodent holes and burnt hollows in tus-

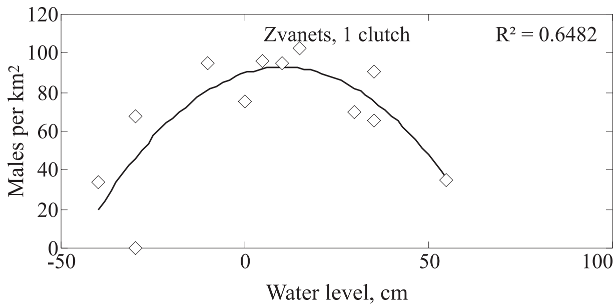

Figure 7. Change in the density of Aquatic Warbler males at the Zvanets mire depending on the water level (cm). (0 – ground level, +10 – water level above soil, -10 – water level below soil).

Table 4. Habitat productivity of the Zvanets mire (1st clutch value + 2nd clutch value).

	2001			2003			2004		
	First clutch	Second clutch	Total	First clutch	Second clutch	Total	First clutch	Second clutch	Total
Male density per km²	68	115		75	137		95	110	
Nest density per km²	72	44	116	34	32	66	37	65	102
Fledglings per nest	3.92	2.68		1.64	3.84		3.31	2.88	
Habitat productivity, fledglings per km²	282.2	117.9	400.1	55.7	122.8	178.5	122.5	187.2	309.7

socks. The other, greater part of females begin to construct nests at the end of June or July when the full-blown green vegetation can disguise nests. It is the delayed breeding period that explains a higher density of males in July than in May.

Breeding

The overall breeding success of the Aquatic Warbler at the Zvanets mire is relatively high (42.28%) compared to the breeding success of the species at Dikoie (18.47%) (Vergeichyk & Kozulin 2006a, in press), which is explained by the generally higher productivity of the Zvanets mire. The main factor influencing breeding success is predation. At the Zvanets mire the rate of shrew predation was relatively stable in different years of the study period. However, breeding success declines in years with unusual environmental conditions (the higher water table, the immaturity of green vegetation, the absence of the previous year vegetation), when birds build their nests in an extraordinary way (in broken vegetation above water, in burnt tussock holes, just on tussocks, with no disguise above) thus making them more accessible to predators. And nests with eggs are more vulnerable. Breeding success at Zvanets was determined mostly by the egg mortality rate (r = -0.65) and it almost did not depend on predation by shrews. As a rule, nesting conditions are abnormal during the first clutch. However, till the beginning of the second clutch conditions usually normalise.

One of the most important indicators of breeding success and habitat quality is habitat productivity, i.e. the number of fledglings, which have successfully left a unit of habitat. At Zvanets this indicator is relatively high: 178–400 fledglings per sq km, while at Dikoie (which is a low-productivity mire) this indicator in 1999 was just 58.9 fledglings/sq km. Habitat productivity is determined mainly by the density of breeding females. It is interesting to note, that in two of the observed years the number of fledglings, which left the habitat during the second clutch is higher than during the first clutch. It can be suggested that females can flexibly alter the timing of breeding, and if conditions are not favourable in May, they start egg-laying much later. In years with an even distribution of birds at the mire the ratio between the maximal density of males and the total density of females (the density of nests throughout the breeding season) is approximately equal. In years when birds concentrate in more favourable parts of the mire this ratio is reset to males or to females.

At the monitoring plot only a small number of individual females was found to be laying two clutches during the same year. Based on the outcomes of individual marking it was established that at Belarusian mires only 15% of those females, which bred during the first clutch, breed again during the second clutch. For Biebrza this figure is 14.3–17.9% (Dyrch & Zdunek 1993a, b). Based on these data, we can assume that a considerable number of females start breeding in late June–July. Splitting of females into early and late breeding groups gives the population a substantial advantage, especially in years when most nests of the first clutch are destroyed by floods.

Analysis of the data above can be used as a basis for devising measures needed to manage the habitat for the Aquatic Warbler during the breeding season at the Zvanets mire. In years with no fires and with abundant old vegetation the water table is expected to drop below the level of tussocks by early May. In years when old vegetation is entirely destroyed by fire, the groundwater table should lower to the soil level by the start of breeding, as birds cannot construct nests if soil and tussocks remain wet.

Sections of mires where fires had not been observed for several years in a row, have a lower density of males and breeding females as a result of the overall decline in the vegetation production (as the accumulating old vegetation carpet inhibits the growth of new green vegetation) as well as because of the increasing density of reed stalks. In such cases either managed burning or haymaking should be undertaken. Burning of old vegetation should be undertaken in winter, because in that case only the upper part of old sedges and reeds is destroyed by fire, as water is frozen just above tussocks.

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Meldinės nendrinukės (*Acrocephalus paludicola*) populiacijos dinamika Žvanets pelkiniame komplekse (Baltarusija)

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Santrauka

Straipsnyje pateikti 1999–2005 metų meldinės nendrinukės tankumo, perėjimo laiko ir perėjimo sėkmės Zvanets pelkiniame komplekse stebėsenos (monitoringo) duomenys. Šiame pelkiniame komplekse peri 35% Europinės bei 64% Baltarusiškos šios rūšies populiacijų. Rūšies tankumas, kuriam yra būdingi ženklūs metiniai svyravimai, yra glaudžiai susijęs su vandens lygiu pelkiniame komplekse. Sąlygos meldinės nendrinukės lizdų sukimui pelkiniame komplekse buvo itin nestabilios – jos kito ne tik skirtingais metais, bet ir perėjimo sezono metu. Patelės gali keisti perėjimo laiką bei lizdo sukimo vietą gana laisvai, priklausomai nuo aplinkos sąlygų. Perėjimo sėkmė pagrinde priklauso nuo to, kaip paukščiams pavyksta išvengti ar apsiginti nuo plėšrūnų. Perėjimo sėkmė sumažėja tais metais, kai dėl nepalankių aplinkos sąlygų paukščiai yra priversti sukti savo lizdus neįprastu būdu ir dėl to jie tampa prieinami plėšrūnams. Taigi, meldinė nendrinukė yra gerai prisitaikiusi prie nestabilių lizdų sukimo sąlygų pelkynuose. Tačiau kai kuriais metais rūšies tankumas bei perėjimo sėkmė sumažėja iki minimalių reikšmių, dėl ko gali sumažėti vietinės meldinių nendrinukių populiacijos.

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