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Breeding ecology of lapwing (*Vanellus vanellus*) in floodplains of the Nemunas River delta in 2006–2007

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Investigations of the breeding ecology of lapwings were carried out in 2006–2007 in five colonies, in the seasonally flooded meadows of the Nemunas River delta; 63 and 73 breeding pairs were recorded and 49 and 62 nests were monitored in 2006 and 2007, respectively. Lapwings were breeding in a relatively homogeneous open and short-grassland (stem height <8 cm) environment. The main differences of breeding conditions among colonies were seasonal and annual dynamics of spring floods, activity of predatory mammals, and grass burning. Lapwings tended to inhabit the periphery of flooded areas (most frequently 10–20 m from open water) and particularly terrain elevations surrounded by water. Long-lasting dampness, later cattle grazing dates, fertile alliuval soil, and relatively low damage of predators are considered as the most important factors that create favourable breeding habitats for the species. Certain measures to improve lapwing breeding conditions in seasonally flooded meadows are offered.

Key words: lapwing, flooded meadows, nest-site characteristics, nest fate, polders

INTRODUCTION

Historically, the lapwing has demonstrated a great ecological plasticity in adapting to environmental changes, if compared with other waders. When man transformed the species' prime habitats, natural marshes and coastal or river flooded meadows, it started breeding on arable land, particularly during the last two centuries (Виткаускас, 1977; Hagemeijer, Blair, 1997; Logminas, 1990). Nowadays, lapwings are facing two environmental challenges which are different in origin, but equally unfavorable, i.e. modernization of agriculture in Western Europe (Beintema, Műskens, 1987; Shrubb, 1990) and the overgrowth of traditional anthropogenic habitats with woody vegetation or reeds as a result of cessation of pasturage and haymaking in some countries of Central and Eastern Europe, including Lithuania (Anuškevičius, 1999). Under such circumstances, lapwings can be observed returning to marsh-type habitats (Hagemeijer, Blair, 1997). Occasionally, they can even breed in areas not satisfying their food demands, visiting the feeding grounds that are at some distance from their nests (Виткаускас, 1977; Matiukas, Vaitkus, 1996). However, the number of lapwings has considerably decreased in Western Europe and Lithuania throughout the last 50 years (Logminas, 1990; Hagemeijer, Blair, 1997; Anonymous, 2004; Kurlavičius, 2006).

A decline in the number of many European wader populations is considered to be caused primarily by changes in agricultural grassland management (Chamberlain et al., 2000; Wilson et al., 2001). The populations that decline in numbers due to drainage or the use of fertilizers may become more vulnerable to the effect of predation (Eliot, 1985; Berg et al., 1992; Seymour et al., 2003).

Investigations of particuliarities of lapwing breeding ecology and threats for its populations in different regions and habitats over Lithuania are necessary in order to prepare effective management and protection measures.

The main purpose of this study was to examine lapwing breeding peculiarities in seasonally flooded meadows of the Nemunas River delta. Lapwing breeding in colonies was studied and compared for (i) colony size, (ii) nest site characteristics, (iii) beginning of clutch incubation, and (iv) nest fate.

STUDY AREA

Our investigation was carried out in seasonally flooded meadows of polders of the Nemunas River delta (Šilutė District, Klaipėda County, Lithuania; central point 55°18'N, 21°20'E). The territory of the Nemunas Delta Regional Park (total area 26600 ha) annually holds over 1000–1500 lapwing pairs (Jusys, 1999), while the total Lithuanian breeding population of lapwings is estimated at about 18000–20000 pairs (Kurlavičius, 2006). The Nemunas River delta is the key breeding site for lapwing and other wader species in the Baltic region (Švažas et al., 1999, 2003; Kurlavičius, 2006). The study area is a wide floodplain fed by river spring floods, distinguished by a high ground water level and ability to retain soil moisture and temporary water pools for a long time. The main agricultural activities are cattle grazing and mowing, preventing the area from overgrowing with reeds, shrubs and trees. Plant succession is also hindered by regular floods and ice-drifts. Floods last for 60 days on average, with water depth up to 2–3 m and with up to 30000 hectares of land seasonally flooded in the delta area. Water is holding until the middle or end of May, although in some years flooding may persist even longer. In 2006, water was holding nearly until mid-July. As a result of all these circumstances, vegetation remains short until late spring next year. In 2007, spring flood was much less extensive and water retreated from polders 0.5–1 month later. Due to humidity, grass is growing slowly, while cattle grazing and moving take place later than elsewhere in Lithuania.

METHODS

We monitored five colonies both in 2006 and 2007. We saved the same names of colonies despite some shifts in colony site and shape over the two-year study period. In this way we tried to emphasize the tendency of spatial relation between the previous and current year colonies. However, we always used the indications of 2006 and 2007 to differentiate between the colonies of years 2006 and 2007. In 2006, nest-searching started on May 8–12 and nest-control lasted up to May 20–June 10 in particular colonies. In 2007, these dates were May 5–9 and May 28–June 10. Each nest was subsequently monitored (2–4 checks depending on the stage of incubation).

We measured seven nest site characteristics: nest distance to water, to the nearest woody vegetation (shrubs, trees) (m) and to the habitat other than meadow (m), water cover within a 25-m radius around the nest (%), dominant plant height within a 25-m radius around the nest (cm), soil humidity within a 5-m radius around the nest as measured on a three-point scale (1 – a relatively dry substrate, with no water leaking out when stepped on; 2 – a moist substrate with squelching under the feet and water leaking out when stepped on; 3 – flooded substrate in cases when nests were built on tussocks or small islands).

For each nest we recorded the clutch size and the degree of incubation. The latter was determined using a simple water test. As lapwings lay eggs every day on average, we could calculate the beginning of egg-laying by subtracting 5 days from the fixed date of the beginning of incubation. We also estimated nest fate: chicks hatched, clutches abandoned, destroyed by predators or lost for any other reasons. A nest containing many small pieces of eggshells was regarded as a sign of chicks hatched; missing or cut out eggs were understood as destroyed by birds (mainly Corvidae), while bitten-through eggs, large pieces of eggshells, or fresh excrements of predators by nests were the signs of predation by mammals.

To describe and present nest site characteristics in lapwing colonies, we used the mean with standard deviation in complex with the median as a descriptive statistic of central tendency. However, we used the non-parametric Kruskal–Wallis ANOVA test to check some differencies in nest-site median characteristics. Also the Mann–Whitney test was used to check between-year differences in water coverage around the nest. The Wilcoxon test was used to test the statistical significance of differences in incubation dates between 2006 and 2007 breeding seasons.

In 2006, there were some cases when some nest-site characteristics were apparently practically identical and were evaluated roughly (visually) as practically equal. In such cases we presented them as a rough visual average without indicating the standart deviation and the median.

STATISTICA 6 software was used to test the differences.

RESULTS

Sixty-three pairs of lapwings were observed in 5 colonies in 2006. Colony size varied from 12 to 15 nesting pairs in 4 out of 5 colonies. A lower number of pairs (8) bred in the Šyša polder colony 4 (Table 1); 49 nests were found. Colony formation in the Šyša polder colony 3 was more complicated than in other colonies because all the 13 nests were destroyed during grass burning and the newly formed colony was composed of only 5 breeding pairs. Thus, there were 2 colonies in the same place in 2006. However, it was impossible to check whether the replacement colony was formed by birds of the old colony or by new arrivals. Pairs of replacement colony are not included into Table 1.

Seventy-three pairs of lapwings were recorded in 5 colonies in 2007. Formation of collonies in 2007 was simpler than in 2006, because no one colony was destroyed totally. Colony size varied from 11 to 19 pairs (Table 1); 62 nests were detected. In three of 5 colonies, both in 2006 and 2007, their size was nearly identical.

In 2006 the average plant height in the nest sites varied among the colonies within very narrow limits – from approximately 7 cm to 8 cm at the moment of nest finding (Table 2). However, particular nests that were found later (from end-May to early June, in particular replacement nests) were surrounded by higher vegetation (maximum grass height reached 10–16 cm). In 2007, the average plant height was nearly identical to that in 2006 in three colonies (6–8 cm) and less in two colonies (3–4 cm) (Table 2).

In 2006, all nests were built in rather close vicinity to water and were often partially or fully surrounded by water. The mean distance to water varied from approximately 10 to 22 m in different study plots. The difference in medians was 10 to 20 m. These values were smallest for the Šyša 4 polder and largest for the Šyša 2 polder colonies (Table 3). The differences in plant density among the plots by ranks (Kruskal–Vallis ANOVA) were statistically reliable ($H = 11.84$; $df = 4$; $P < 0.05$).

In 2007, the mean distance to water varied from approximately 16 to 51 m in different colonies. The difference in medians was 10 to 50 m. These values were smallest for the Šyša-2

Table 1. **Numbers of breeding pairs in lapwing colonies**

Study year	Colonies					Mean
	Uostadvaris	Šyša 1	Šyša 2	Šyša 3	Šyša 4	±SD
2006	12	15	12	13	8	12 ± 1.40
2007	11	16	11	19	16	14.6 ± 3.54

Table 2. **Dominant plant height (cm) round the nests in 2006 and 2007. Symbol ~ is used in cases of visual estimation of rough average for all nests within a particular colony when plant height was very similar**

Year and statistics	Colonies				
	Uostadvaris polder	Šyša polder 1	Šyša polder 2	Šyša polder 3	Šyša polder 4
2006					
Mean ± SD or rough visual average (~)	~7.00	8.25 ± 0.78	~7.00	7.62 ± 0.96	~8.00
Median	–	7	–	7	–
Nest finding data	05.12	05.21	05.19	05.23	05.18
Sample size	10	12	6	13	8
2007					
Mean ± SD or rough visual average (~)	8 ± 0.72	8.14 ± 2.62	6.77 ± 1.98	3.29 ± 0.84	4.00 ± 0.16
Median	7	8.5	6	3	4
Nest finding data	05.09	0.5.07	05.06	05.09	05.05
Sample size	9	14	9	17	13

Table 3. **Distance of nest (m) from the nearest water in 2006 and 2007**

Year, statistics	Colonies				
	Uostadvaris polder	Šyša polder 1	Šyša polder 2	Šyša polder 3	Šyša polder 4
2006					
Mean ± SD	15.00 ± 7.07	17.73 ± 7.54	21.66 ± 6.83	18.89 ± 5.84	10.63 ± 3.20
Median	15	15	20	15	10
Sample size	6	11	6	9	8
2007					
Mean ± SD	51.11 ± 22.60	32.85 ± 15.02	16.11 ± 10.14	41.17 ± 16.05	21.38 ± 10.48
Median	50	30	10	40	20
Sample size	9	14	9	17	13

Table 4. **Water cover (%) within a radius of 25 m around a nest in 2006 and 2007**

Year, statistics	Colonies				
	Uostadvaris polder	Šyša polder 1	Šyša polder 2	Šyša polder 3	Šyša polder 4
2006					
Rough visual average	~10.00	~30	~0.5	~20	~30
Sample size	10	12	6	13	8
2007					
Mean ± SD	5.55 ± 16.6	8.21 ± 12.49	6.11 ± 13.17	8.52 ± 10.57	25 ± 15.44
Median	0	2.5	0	5	30
Sample size	9	14	9	17	13

Symbol ~ is used when only visually estimated rough average is indicated in cases when water cover was very similar around all nests in a colony

Table 5. **Soil moisture (as measured on a 3-point scale) within a radius of 5 m around a nest in 2006 and 2007**

Year, statistics	Study plots				
	Uostadvaris polder	Šyša polder 1	Šyša polder 2	Šyša polder 3	Šyša polder 4
2006					
Mean ± SD	1.1 ± 0.31	1.08 ± 0.29	1.00 ± 0.00	1.00 ± 0.00	1.5 ± 0.53
Median	1	1	1	1	1
Sample size	10	12	6	13	8
2007					
Mean ± SD	1.22 ± 0.66	1.07 ± 0.25	1.00 ± 1.00	1.05 ± 0.24	1.07 ± 0.27
Median	1	1	1	1	1
Sample size	9	14	9	17	13

polder and largest for the Uostadvaris polder (Table 3). The differences in nest distance to water among colonies by ranks (Kruskal–Vallis ANOVA) were statistically highly reliable ($H = 46.73$; $df = 4$; $P < 0.0001$).

Overall, in 2007 lapwing nests were built further from water than in 2006: mean 32.95 ± 18.96 v.s. 16.75 ± 7.21 and median 30 v.s. 15. The Mann–Whitney test proved this difference to be highly significant ($z = -4.78$, $p < 0.0001$).

In 2006, water coverage within a 25-m radius around the nest was relatively great (10–30%) in 4 out of 5 colonies. However, it was small in the Šyša 2 polder colony (Table 4). Such situation actually explains the already mentioned general proximity of lapwing nests to water: in fact, the earlier overflooded areas were still full of numerous water pools.

In 2007, the water cover around the nests varied extremely (standard deviation values exceeded mean values) within particular colonies (Table 4). Many of nests in 2007 had no water within a 25 m radius at all. The Mann–Whitney test confirmed the overal poor water cover in nest surroundings in 2007 ($n = 62$, mean = 11.12 ± 15.02, median = 2.5) in comparison with that in 2006 ($n = 49$, mean = 19.65 ± 10.48, median = 20) ($Z = 4.19$, $P < 0.0001$).

In 2006, at the time lapwing nests were found, soil surface was already losing moisture (but was not completely dry yet) (Table 5). Excess moisture (squelching under the feet and water leaking out when stepped on) was felt in 6 out of 49 nest sites (12.24%). Almost all such nest sites were in the Šyša polder 4 colony where the measuring of nest site characteristics was carried out earlier than in other study plots.

The situation was similar in 2007 when excess in soil moisture was registered only at 3 of 62 (4.38%) nests, and 1 (1.61%) nest was constructed in grass tussock above water. Each year soil moisture in all colonies was rather similar (both in 2006 and 2007 all colonies had identical medians) (Table 5).

Lapwings nested in open meadows and pastures without trees and bushes within a 25-m radius around the nests. In 2006, the distance to the nearest woody vegetation in different colonies was approximately 600–500 m, and only in one colony this distance was 100–200 m. In 2007, the nearest trees and bushes were as far as 500 m from the nests. The only exception was the Šyša 3 polder (100–200 m).

A gravel road was the only nearest non-meadow habitat to lapwing nest sites in all colonies. As gravel roads stand higher, not all of them become flooded in spring. Also, when flood waters are retreating, roads emerge from water earlier than meadows and occasionally are used by lapwings and other waders for nest building (Mačiulis, 1997). However, it was not the case in our study.

In 2006, the beginning of incubation was established for 32 out of 49 nests (65.31%). The average date of the initiation of incubation in 2006 was April 26 – from April 21 to May 3 in different colonies (Table 6a). Since the most common 4-egg clutch is usually laid within approximately 5 days, the first egg laying can be back-calculated to occur from the middle of the second ten-day period of April to the end of this month. The greatest number of lapwings (more than half of all pairs under control) finished egg-laying and started nesting on April 16–25. The process was still rather intensive until May 10, whereupon it nearly ended.

Table. **6. Beginning of incubation in 2006 (a) and 2007 (b). The most important periods of the beginning of incubation are indicated in bold**

(a)

Date	Colony and % of nests in which incubation started					
	Uostadvaris polder	Šyša polder 1	Šyša polder 2	Šyša polder 3	Šyša polder 4	Total
Apr 16–20	0.00	25.00	**50**	**25.00**	28.57	21.88
Apr 21–25	14.29	**62.50**	0.00	**25.00**	**57.14**	**37.50**
Apr 26–30	0.00	0.00	0.00	0.00	0.00	0.00
May 01–05	**42.85**	0.00	**50**	**25.00**	0.00	18.75
May 06–10	28.57	0.00	0.00	12.50	14.29	12.50
May 11–15	14.29	0.00	0.00	0.00	0.00	3.13
May 16–20	0.00	12.50	0.00	0.00	0.00	3.13
May 21–25	0.00	0.00	0.00	12.50	0.00	3.13
Number of nests	7	8	2	8	7	32
Average incubation date	May 03	Apr 24	Apr 25	Apr 28	Apr 21	Apr 26
(b)						
Apr 6–10		21.42	11.11		8.33	8.47
Apr 11–15	11.11	7.14	11.11	6.66	**33.33**	13.55
Apr 16–20		**28.57**	**22.22**	20.00	8.33	**16.94**
Apr 21–25	11.11		11.11	6.66	16.66	8.47
Apr 26–30	11.11		11.11	**33.33**		11.86
May 01–05	**33.33**	7.14	**22.22**	6.66	16.66	15.25
May 06–10	22.22	21.42	11.11	13.33	16.66	**16.94**
May 11–15		14.28				3.38
May 16–20	11.11			6.66		3.38
May 21–25				6.66		1.69
Number of nests	9	14	9	15	12	59
Average incubation date	May 03	Apr 25	April 23	Apr 29	Apr 28	Apr 27

Table 7. **Clutch fate in 2006 and 2007**

Study year and nest fate characteristics	Number and percentage (%) of clutch colonies					
	Uostadvaris polder	Šyša polder 1	Šyša polder 2	Šyša polder 3	Šyša polder 4	Total
2006						
Hatched	3 (30)	11 (91.67)	6 (100)	6 (46.15)	8 (100)	34 (69.39)
Abandoned	0 (0)	1 (8.33)	0 (0)	0 (0)	0 (0)	1 (2.04)
Destroyed by raccoon dogs	6 (60)	0 (0)	0 (0)	0 (0)	0 (0)	6 (12.24)
Destroyed by corvids	1 (10)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2.04)
Destroyed by fire	0 (0)	0 (0)	0 (0)	7 (53.85)	0 (0)	7 (14.29)
Total nests	10 (100)	12 (100)	6 (100)	13 (100)	8 (100)	49 (100)
2007						
Hatched	8 (88.88)	12 (85.71)	8 (88.88)	9 (52.94)	9 (69.23)	46 (74.19)
Destroyed by corvids	1 (11.12)	1 (7.14)	1 (11.12)		1 (7.70)	4 (6.45)
Destroyed by tractor				3 (17.64)		3 (4.83)
Trampled by grazing cattle				1 (5.90)		1 (1.63)
Unknown		1 (7.14)		4 (23.52)	3 (23.07)	8 (12.90)
Total nests	9 (100)	14 (100)	9 (100)	17 (100)	13 (100)	62 (100)

The Kruskal–Wallis ANOVA test showed that differences in the beginning of incubation among separate colonies were not statistically significant ($H = 2.79$; $df = 4$; $P > 0.05$). However, we suppose that this was rather due to small samples because certain apparent differences recorded during our study can be easily logically explained. In case of a long severe flooding, lapwings concentrated on patches of land emerging from water. The earlier beginning of incubation in the Šyša polder colony 4 could be explained by the abundance of small surface rises in this territory. They emerged from water earlier or remained not flooded at all; therefore, lapwings could build nests earlier there. The later beginning of incubation in the Uostadvaris and Šyša 3 polders was caused by replacement clutches. Data on the Šyša polder couldn't be taken into account due to the small sample.

In 2007, the beginning of incubation was established for 59 out of 62 nests (95.16%).

The average date of the initiation of incubation in 2007 was April 27, i. e. from April 23 to May 3 in different colonies (Table 6b). Like in 2006, most frequent records of the beginning of incubation come from the Šyša polder 4. However, the Kruskal–Wallis test showed once again that differences in the beginning of incubation among separate study plots were not statistically significant ($H = 1.11$, $df = 4$, $p > 0.05$). In 2007, first cases of incubation of clutches were recorded earlier than in 2006. Nevertheless, the Wilcoxon test for matched pairs did not reveal statistically significant differences in the overall dynamic of incubation dates between 2006 and 2007 breeding seasons ($Z = 1.77$, $P > 0.05$).

In 2006, the fate of all 49 monitored lapwing nests was determined: chicks were hatched in 69.39% of them. In 2007, this index was 74.19% for 62 nests monitored (Table 7).

In 2006, successful nests accounted for 100% or nearly 100% in 3 out of 5 colonies. The percentage of successful nests in the other two colonies was low (only 30% and 46.15%). The causes of nest loss were specific: nests in the Uostadvaris polder colony were destroyed by raccoon dogs (*Nyctereutes procyonoides*) having their dens in the neighborhood, while nests in the Šyša polder 3 were destroyed during meadow fires (Table 7).

The reaction of lapwings to nest loss slightly differed between the two destroyed colonies. All lapwing pairs of the colony devastated by raccoon dogs left for another place. Permanent destruction of nests (including replacement nests) by raccoon dogs (growing raccoon juveniles were constantly "checking" the territory around their dens) forced birds to permanently leave the territory.

The majority of birds from the colony destroyed by fire did not repeatedly breed in the same place. Only five pairs settled there again and built their replacement nests which could be proved by their late egg-laying started on May 24–26.

It was difficult to determine precisely the output of chicks hatched in successful clutches, which is calculated from the number of eggs laid. However, there are no reasons to assume that it significantly differed from the maximal output, because there was only one record of an unhatched egg (in the Šyša polder 1), and no signs of destruction of part of eggs in nests were recorded.

In 2007, there were no clutches destroyed by mammals and fires as in 2006. A more widespread damage was caused by corvids. In one colony, nests suffered from a tractor. For half of losses the reasons were unknown. In this year, the structure of nest predation was more similar to that in 1990–1992, 1995–1996 (Mačiulis, 1997) than to that in 2006.

DISCUSSION

The size of all lapwing colonies was mostly similar. We cannot explain this phenomenon by any of the circumstances we know at a time.

Although lapwings once suffered from Raccoon Dog, their tactic of breeding in colonies implies that the overall negative impact caused by terrestrial predators is not devastating because lapwings usually cease breeding in colonies in the areas with a hard mammal predation pressure (Thorup, 1998). This is one of indications of favourable breeding conditions for lapwing in floodplains of the Nemunas River delta.

In the floodplains of the Nemunas River delta, the main breeding sites of lapwings were located in apparently rather similar habitats due to landscape homogeneity caused by annual spring floods and agricultural activities (cattle grazing and haymaking). All lapwing nests were built in nearly homogeneously short grass.

However, our field experience shows that colonies were separated by large areas where lapwings nest neither in colonies nor solitary. This may suggest that breeding pairs select some micro-habitats which are preferable for breeding lapwings in floodplains of the Nemunas River delta. Such suggestion is supported by the fact that all nests were found close to water or even surrounded by water.

Water vicinity to nest, nesting ground moisture and average breeding data can differ between years depending on flood characteristics. In spring 2006, the flood started later and lasted longer than usual until mid-July. In 2007, with a less extensive and long-lasting flood, lapwings built their nests on a drier substratum and further from water than in 2006, a year of a high flood. Also, first incubated clutches in 2007 were recorded earlier than in 2006 (despite the practical overlap in average dates). Much more the timing of the breeding season was changed by relatively low or moderate flood levels in 1995–1996 when egg-laying started half a month earlier (Mačiulis, 1997). Thus, the annual duration of spring flood and its extent are the main factors affecting the breeding phenology of lapwings in coastal seasonally flooded meadows. The differences in the beginning of incubation among the colonies in the same year were also related to specific landscape characteristics (terrain elevations early emerging from the flood-water) in particular colonies. Locally, the reason for changes in nesting phenology can be nest failures due to predation or grass burning that led to replacement clutches.

The timing of lapwing breeding phenology in the Nemunas River floodplains is similar to that in the Prypiat River floodplain in Belarus in 2006, with the main egg-laying period continuing from 12 to 22 April (Pinchuk, pers. comm.). The different situation was reported from the continental part of Lithuania in 2003 when 46% of 83 monitored clutches were initiated already late in March, while in the other nests egg-laying started in early April (Švažas, Rumbutis, 2004). Similarly, in the Kaliningrad region of Russia the main egg-laying period has recently been recorded during the last decade of March – first decade of April (Лыков, 2004). Therefore, delayed breeding initiation is characteristic of lapwings inhabiting the areas of Central Europe affected by regular large-scale spring floods. It is worth noting that in the 1970s the peak of egg-laying of lapwings in the continental part of Lithuania was registered since mid-April (Виткаускас, 1977; Logminas, 1990), i. e. about three weeks later than in recent (Švažas, Rumbutis, 2004) years. Such significant shifts in the breeding phenology of lapwings may be caused by the global climate change. However, the lack of similar investigations in the past does not allow to make a similar comparison for lapwings breeding in the Nemunas floodplains.

Nest loss impact on the local population is sometimes difficult to assess as lapwings usually form replacement clutches after losing their nests (Beintema et al., 1995). Newertheles, the nest loss of lapwings breeding in coastal floodplains in 2006–2007, can be estimated as relatively low, particularly in colonies not affected by grassland fires and predation by raccoon dogs, where the percentage of successfully hatched eggs varied predominantly within 88–100% (Table 7). A high nest success rate (86.6%) was also characteristic of lapwings that nested in seasonally flooded meadows of the Nemunas River delta in 1990–1992 and 1995–1996 (Mačiulis, 1997). Results of our investigation differ from results obtained in continental regions. Very low nest success (15.7%) was identified for lapwings breeding in the inland part of Lithuania (mostly in agricultural habitats). Similarly in SW Belarus in 2006, 100% of first clutches located on arable land were destroyed.

The major reasons of nest loss in Nemunas River floodplains were different from reasons reported from other areas. First of all, nest destruction during early spring agricultural works, which is the factor deciding very high rates of nest losses (up to 80–100%) in the inland part of Lithuania (Виткаускас, 1977; Švažas, Rumbutis, 2004) and Belarus (Pinchuk, pers. comm.), was of low importance in our study area. Also, destruction of part of clutches by corvids in the Nemunas River floodplains (Table 7; Mačiulis, 1977) is much more less prominent here than in agricultural landscapes of continental Lithuania (Švažas, Rumbutis, 2004) and Kaliningrad region of Russia (Лыков, 2004) in which it sometimes accounts for nearly 20–30% of clutch or egg losses. Absence of bushes and trees in the neighbourhood of lapwing colonies (vantage points and nesting sites for corvids) presumably attribute to the low rates of nest predation of this kind. Nest loss due to racoon dog predation and grass burning was also a specific characteristic of the Nemunas River floodplains.

We conclude that difficult to access (due to dampness or large areas covered by flood waters) and open nesting habitats of lapwings in the floodplains of the Nemunas River delta were better protected from avian and mammal predators, trampling by cattle and from agricultural activities than typical breeding habitats of lapwings located on agrolandscape, particularly on arable land.

Therefore, the floodplains of the Nemunas River delta provide exceptionally favourable nesting habitats for the population of lapwings. The breeding density of lapwings in the floodplains of the Nemunas River delta is the highest in Lithuania (Jusys et al., 1999; Kurlavičius, 2006). It is one of the key breeding grounds of this species in the Baltic region.

The results of this study have revealed certain specific features characteristic of lapwings breeding in seasonally flooded meadows. They have also enabled to suggest certain conservation and management measures for improving lapwing breeding habitats in this key breeding site.

The obtained data, which reveal the importance of water / land mosaic for lapwing breeding may be used for improving its nesting conditions in seasonally flooded coastal meadows. A system of artificial gently sloping shallow depressions and elevations may be created in the sites particularly important for nesting lapwings and other wader species. Such specially developed areas would mitigate the negative effects of both extreme floods and droughts (these phenomena are becoming more frequent under conditions of the global climate change) on all wader species breeding in the floodplains of the Nemunas River delta.

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PEMPĖS (*VANELLUS VANELLUS*) VEISIMOSI EKOLOGIJA NEMUNO ŽEMUPIO UŽLIEJAMOSE PIEVOSE

Santrauka

Tyrimai vykdyti Nemuno žemupio užliejamų pievų pempių kolonijose, įsikūrusiose penkiose vietose. 2006 ir 2007 m. čia perėjo 63 ir 73 pempių poros, rasti 49 ir 62 lizdai. Pempės perėjo palyginti monotoniškame kraštovaizdyje, atvirose žema žole (paprastai <8 cm aukščio) apaugusiose buveinėse. Pagrindiniais perėjimo sąlygų skirtumais tarp atskirų kolonijų buvo sezoninė ir metinė pavasarinių potvynių dinamika, plėšriųjų žinduolių veikla ir žolės deginimas. Pempės perėjo palyginti arti vandens (dažniausiai už 10–20 m), visų pirma anksčiau iš vandens iškylančiuose pievų paviršiaus paaukštėjimuose. Ilgai išliekanti drėgmė ir vėlesnės ganymo datos, derlinga dirva, santykinai nedidelė plėšrūnų daroma žala sudaro optimalias perėjimo sąlygas šiai rūšiai perėti užliejamų pievų buveinėse. Remiantis tyrimų rezultatais, siūlomos gamtotvarkinės priemonės, siekiant pagerinti pempių ir kitų sėjikinių paukščių perėjimo sąlygas Nemuno žemupio užliejamų pievų buveinėse.

Raktažodžiai: pempė, užliejamos pievos, lizdo vietos charakteristikos, lizdo likimas, polderiai