ISSN 1392-1657

NEST-SITE SELECTION BY MARSH HARRIER (*CIRCUS AERUGINOSUS*) IN THE SHORE BELT OF HELOPHYTES ON LARGE LAKES

Vitas STANEVIČIUS

Institute of Ecology of Vilnius University, Akademijos 2, LT-08412 Vilnius-21, Lithuania. E-mail: vitass@takas.lt

Abstract. Nest-site selection by Marsh Harrier (*Circus aeruginosus*) was investigated on Lakes Meteliai and Obelija in 1983–1986 and Lake Žaltytis in 1984–1986 in southern Lithuania. Fifty five breeding pairs were detected and 49 nests (89.1%) were found. With regard to the potential breeding habitat, Lakes Meteliai and Žaltytis represented extreme structural types, whereas Lake Obelija – the intermediate type. Despite these differences, most nest-site parameters of the three lakes did not differ or differed slightly. The most similar was the depth. Only the most dissimilar lakes differed according to nest-site vegetation density and height, the latter varied according to the dominant helophytic species on the lake. Distances from nests to water and shore were not statistically significant – nests were built in the middle of the emergent vegetation belt. While selecting nest-sites, pairs gave preference to patches larger in area and diameter. Nest-site selection peculiarities are explained by birds' balanced efforts to protect clutches from terrestrial mammalian predation and the destructive impact of hydrodynamic processes.
Key words: Marsh Harrier, nest-site selection, shore belt, helophytes, patch, terrestrial predators, hydrodynamic processes

Introduction

Selection of the breeding habitat, reaction to its changes and predation threats are justified in relation to assessment of cost-benefits (Hakkarainen & Korpimaki 1996). To protect nests and clutches, birds breeding in wetlands have to respond to the entire complex of environmental conditions (Burger 1974, 1985). Breeding Marsh Harriers (*Circus aeruginosus*) are negatively affected by water level fluctuations and waves (Witkowski 1989). Building nest closer to the shore, where wave impact is neutralised by the barrier of emergent vegetation, would be a natural alternative, but still related to other threats. Lakeside water is shallow and the nest can become an easy prey to predators. Moreover, as the warm season progresses, water level in wetlands usually comes down. As the result of this, nests can appear on the dry land. Also, the location of the nest itself – at the intersection of water and the shore – is in the high threat zone, because the majority of mammalian predators are the most active in ecotones (Paton 1994; Andren 1995).

In my study, I attempted: (i) to test if the environment of Marsh Harrier nests reflected local peculiarities of emergent vegetation of different lakes, (ii) to examine the hypothesis that birds in their nest-site selection balance between the probability of nest depredation by mammals from the shore side and nest destruction by waves or disturbance by anglers – from the water side, and (iii) to check if nest-site selection is associated with the diameter and size of the patch.

Study area

Research was conducted in 1983–1986 on Lakes Meteliai (54°18'N, 23°47'), Obelija (54°18'N, 23°50'E) and Žaltytis (54°25N, 23°24'E). Lakes Meteliai and Obelija are situated at a 1.1 km distance from each other, while Lake Žaltytis is located 20–23 km further. All the lakes are large water bodies in southern Lithuania, with the area and the coast line of 1,288 ha and 18.8 km, 575 ha and 11.1 km, 260 ha and 10 km; the length and the average width – 6.8 km and 1.9 km, 4.4 km and 1.2 km, and 4.2 km and 0.8 km; the average depth – 6.8 m and 4.4 m, 1.7 m, respectively.

Potential breeding habitats

A well-developed shore belt of helophytes is important characteristics of lakes. It is also a breeding habitat of Marsh Harrier. In 1984–1986, the total plant area covered with previous year helophytes of Lakes Meteliai, Obelija and Žaltytis was 61 ha, 16 ha and 30 ha, respectively. However in 1983, the total area of helophytes on

Lake Meteliai, due to strong ice-break storms was less in comparison with that of other research years. Lake Meteliai was dominated by reed (*Phragmites communis*) (90%), Lake Obelija accounted for 62% of reed in the total area of emergent vegetation, whereas Lake Žaltytis – 50%. Virtually, the remaining share goes to cattail (*Typha angustifolia*). Another very important structural difference of helophytic zone was the disproportion between shallowly (0–20 cm) and fully (21–120 cm) flooded overgrowth of different lakes. The share of a shallow-dry substratum was the least on Lake Meteliai – 16%. No larger it was on Lake Obelija (18%), whereas on Lake Žaltytis it was the biggest (50%). The latter lake was predominated by reeds growing on a relatively dry and firm, though floating, substratum. The shore belts of emergent vegetation of the lakes were also represented by a different spatial structure. Those of Lakes Meteliai and Obelija were divided into differently-sized patches, more or less detached by water, whereas on Lake Žaltytis patches were far less isolated from one another. In 1984–1986, the average size of patches on Lake Meteliai ranged from 0.94 ± 1.13 to 1.24 ± 1.92 ha (60 in number), whereas that on Lake Obelija – from 0.47 ± 0.34 to 0.57 ± 0.37 ha (33 in number). The weighted average of the diameter of patches was 64 m and 33 m, respectively. The largest share of patches (from the water side) was often occupied by sparse (<40 stems/m^2) or highly sparse (<20 stems/m^2) vegetation. The average area of patches of Lake Žaltytis basically remained the same during the whole study period and was equal to 0.71 ± 0.63 ha (around 50 in number). On this lake, the major share of patches was composed of the vegetation growing on a dry or shallowly flooded (≤20 cm) substratum.

The totality of all the above characteristics accounted for the essential structural differences in emergent vegetation zones between Lake Žaltytis on the one hand and Lakes Obelija and Meteliai on the other hand. Far less differences existed between Lake Meteliai and Lake Obelija.

Surrounding landscape

Lakes Meteliai and Obelija are surrounded by a heterogeneous landscape – natural lakeside or cultural (irrigated in some places) meadows, open and overgrown wetlands, and cultivated lands. Quite long shoreline sections of the two lakes (accordingly around 1/3 and 1/4) border damp mixed deciduous and coniferous forests. In the adjacent landscapes with morenic formations, loam soil prevails. To the east of Lake Obelija, between cultivated lands and pastures in deep terrain depressions, fens overgrown with trees and bushes are common. Lake Žaltytis is surrounded by extensive areas of well-watered reed-sedge marshes, in some places covered with trees and bushes, and interspersed with raised-bog fragments. Immediately outside the marshes, vast areas of cultural meadows stretch in three directions, whereas mostly arable fields lie in the west. In the east, approximately 0.5–1 km away, a large stand of the deciduous Bukta Forest appears. The lake is located in the region of fertile clay and loam soil, where agriculture is one of the most intensive in the country.

Potential nest predators

On the lakesides, among all potential terrestrial nest predators the following species were observed: wild boar (*Sus scrofa*), stoat (*Mustela erminea*), European polecat (*M. putorius*), pine martin (*Martes martes*), American mink (*M. vison*), badger (*Meles meles*), fox (*Vulpes vulpes*) and a racoon dog (*Nyctereutes procyonoides*). In general, the latter is especially frequent in the neighbourhood of Lithuanian wetlands (Maldžiūnaitė 1974; Prūsaitė 1988). On the study site, European polecat, racoon dog and American mink were common at the lake shores (D. Vencius, pers. comm.). American mink often robbed Marsh Harrier nests located on Lake Žuvintas not far from the study areas (A. Pranaitis, pers. comm.). On Lakes Meteliai and Obelija, American mink got caught in the traps set for muscrat (*Ondatra zibethica*; D. Vencius, pers. comm.).

Foxes also often occur in the environs of the study lakes. Foraging or resting at night boars were detected in the reeds of Lake Meteliai. Among avian nest predators, common breeders are Hooded Crow (*Corvus corone*) and Magpie (*Pica pica*), the latter being very common in adjacent landscapes. Single Raven (*Corvus corax*) pairs also breed in the environs of the three lakes.

Material and methods

Nests were found performing total counts on water bird nests in emergent vegetation belt. Emergent vegetation was inspected twice every season (in the second half of May and in late May – the first half of June). The inspection was performed by boating with the help of a long pole. If shallow places prevented from boating, vegetation was investigated on foot. Thus all vegetation at lake edges was searched.

1:5000-scale aerophotos made in April 1985 were used for nest mapping. Before then, nests found in 1983–1984 were indicated on the approximate emergent vegetation zone schemes made during field studies and later transported on cartoschemes created on the basis of aerophotos. Height of the vegetation surrounding the nest-site was measured with a graduated pole, taking water level as the datum-point. Height value was estimated by averaging heights of the tallest 10 plants around the nest-site. Which plant species in mixed reed-cattail beds was to be measured for height depended on the density of different plant species: if the density of reeds exceeded 20 stems/m^2, reeds were measured, if the density was lower – cattails were measured. For evaluation of vegetation density, the corresponding principle was observed: stems on a higher layer were calculated if their density was not less than 20 stems/m^2.

Density was measured employing a 1 × 1 m foldaway wire frame. The same height-measuring graduated pole was applied to measure depth. The distance from the nest-site to water was estimated visually or measured in boat lengths. Separate areas of emergent vegetation patches were measured with planemeter on aerophotos. Every year, changes in vegetation area and configuration were evaluated and adequate corrections were made in the basic aerophotoscheme of 1985. Non-parametric tests (Mann-Whitney U-test, Chi-Square test for proportions (contingency table), Wilcoxon test for matched pairs) were used. Statistical tests were performed using the software package Statistica (StatSoft, Inc. 1999). Results of the tests were considered significant at a $p < 0.05$ two-tailed significance level.

Results

In total 49 Marsh Harrier nests were discovered, which made up 89.1% of nests for 55 breeding pairs of the study period (Table 1). In 1983–1986, on Lake Meteliai 16 nests were found, whereas on Lake Obelija – 14. In 1983–1986, on Lake Žaltytis 19 nests were discovered. Most likely a certain unknown number of nests had been built in practically impenetrable watery marshes that surround the southern and northern side of Lake Žaltytis. Nearly all nests were discovered in the second half of May and contained a completed clutch. Once detected nests were not further monitored. Since not all nest-site characteristics were evaluated each year, differently-sized samples (indicated in each specific case) were employed for tests.

Table 1. Numbers of breeding pairs and nests (in brackets), found on Lakes Meteliai, Obelija and Žaltytis in 1983–1986.

	Žaltytis	Meteliai	Obelija
1983		4 (4)	4 (3)
1984	5 (5)	5 (5)	4 (4)
1985	5 (5)	5 (3)	4 (3)
1986	9 (9)	6 (4)	4 (4)
Total	19 (19)	20 (16)	16 (14)

During the study period, breeding local Marsh Harrier populations were relatively stable. The only exception was Lake Žaltytis in 1986, when for unknown reasons the number of breeding birds was twice the number of birds that had bred before (Table 1). In the absolute majority of cases, birds used to build nests in the same places of the emergent vegetation belt from year to year.

Nest-site characteristics

Irrespective of differences in plant area and configuration of patches, species composition, water depth and growing substrata of Lakes Meteliai, Obelija and Žaltytis, Marsh Harrier nests were located in places representing mostly similar nest-site characteristics. Averages of the five nest-site characteristics are indicated in Table 2. The comparison of differences in the medians of these five nest-site characteristics between the three lakes revealed that only two cases of 15 proved to be significant. Namely, plant density in 13 nest-sites on Lake Meteliai was significantly greater than that in nine nest-sites on Lake Žaltytis (Mann-Whitney $U = 21.5$; $p < 0.05$) and the median of plant height in 16 nest-sites on Lake Meteliai was significantly greater than that in 17 nest-sites on Lake Žaltytis ($U = 48.5$; $p < 0.01$).

Height differences in vegetation surrounding the nest on individual lakes partially can be explained by the domination of reed (higher plant species) or cattail (lower plant species).

To test the aforementioned correlation, Lakes Meteliai and Obelija (share of reedbeds accordingly 60% and 75%) were nominated as one joint ‘reed lake’. In contrast, Lake Žaltytis was attributed to the category of a

Table 2. Nest-site characteristics ($\bar{X} \pm SD$) on Lakes Žaltytis, Meteliai and Obelija.

	Žaltytis	Meteliai	Obelija
Water depth, cm	52.8 ± 13.9 n = 17	51.3 ± 20.9 n = 16	43.2 ± 25.1 n = 15
Distance to open water, m	26.3 ± 11.2 n = 17	31.0 ± 15.9 n = 16	22.9 ± 7.6 n = 15
Distance to shore, m	23.0 ± 23.3 n = 9	34.5 ± 17.5 n = 10	19.2 ± 12.0 n = 9
Plant density, stems/m^2	55.4 ± 18.5 n = 9	72.8 ± 18.2 n = 13	65.4 ± 29.3 n = 14
Plant height, cm	153.0 ± 51.4 n = 17	198.0 ± 39.4 n = 16	178.0 ± 49.8 n = 15

nominal 'cattail lake', because pure cattail and mixed reed-cattail overgrowth made up 72% of the total emergent vegetation area.

Consequently, on the 'reed lake' 18 nests occurred in reed stands and 12 nests – in cattail stands, whereas on the 'cattail lake' five nests – in reed stands and 13 nests – in cattail stands. However, Chi-Square test with Yates correction did not confirm association of nest-site selection with domination of particular plant species ($\chi^2 = 3.48$, df = 1, $p = 0.062$). This might have happened due to slight proportional differences in reed and cattail covers on different lakes rather than the absence of the above association.

This assumption is confirmed by the comparison of nest distribution on Lakes Meteliai and Obelija (joint 'reed lake'), and Lake Žuvintas ('cattail lake' with 80% of cattails and 20% of reeds). The 1986–1990 data reported by Pranaitis and Baublys (1991) allowed to extract the data for the Chi-Square analysis. The total sample of Lakes Meteliai and Obelija consisted of 18 nests in the reed stand and 12 nests in the cattail stand versus the sample of 25 nests in the reed stand and 73 nests in the cattail stand on Lake Žuvintas. This time the association of nest distribution in vegetation with a dominant plant species on the particular lake was evident ($\chi^2 = 10.75$, df = 1, $p < 0.001$).

Nest position

The Wilcoxon test for matched pairs is a sensitive test among other non-parametric tests (Fowler & Cohen 1990). It was used to test differences between the nest distance to open water and to the dry rigid bank for each nest. The analysis revealed that no differences were found for all three lakes (Table 3).

Therefore, we can claim that breeding pairs avoid to build nests either at inner or outward edges of the shore vegetation belt, they rather choose the middle section of the belt.

Selection between differently-sized patches

On Lake Žaltytis, the average area of nest patches only slightly exceeded the average area of two neighbouring non-nest patches, whereas on Lakes Meteliai and Obelija it was nearly five and two times larger, respectively (Table 4).

The Wilcoxon test for matched pairs did not confirm statistically significant differences between the medians of the occupied and unoccupied patch area and diameter on Lake Žaltytis ($p = 0.94$), while such differences were confirmed on Lakes Meteliai and Obelija (accordingly, $p < 0.0001$, $p < 0.05$). However, the attention should be drawn to the fact that patches of emergent vegetation on Lake Žaltytis are much less isolated

Table 3. Comparison of Marsh Harrier nest distances (m) to water and shore.

	N	Nest distance to water			Wilcoxon test for matched pairs		Nest distance to shore		
		Mean	SD	Range			Mean	SD	Range
Žaltytis	9	31.6	±9.9	20–51	Z = 1.4808	p = 0.1386	23.1	±23.2	6–80
Meteliai	10	38.3	±12.1	20–60	Z = 0.6115	p = 0.5408	34.7	±17.5	15–70
Obelija	9	22.7	±7.4	7–40	Z = 0.5331	p = 0.5939	20.0	±13.0	0–37

Table 4. Size (X ± SD) of the occupied and unoccupied plant patches on Lakes Žaltytis, Meteliai and Obelija.

	Žaltytis	Meteliai	Obelija
Patch size, in ha:			
patches with nests	0.93 ± 0.57	3.83 ± 3.66	0.90 ± 0.35
patches without nests[a]	0.89 ± 0.55	0.81 ± 0.27	0.54 ± 0.11
Sample size	n = 16	n = 13	n = 15
Wilcoxon test for matched pairs	Z = 0.0710 p = 0.94	Z = 34.809 p = 0.0005*	Z = 25.558 p = 0.0105*
Patch diameter, in m:			
patches with nests	46.3 ± 21.7	73.94 ± 26.74	53.60 ± 17.79
patches without nests[a]	38.85 ± 16.35	51.95 ± 10.69	32.40 ± 6.40
Sample size	n = 17	n = 19	n = 15
Wilcoxon test for matched pairs	Z = 19.645 p = 0.0494*	Z = 26.559 p = 0.0079*	Z = 29.534 p = 0.0031*

[a] *– size of two neighbouring patches without nests are averaged; * – p < 0.05*

by surrounding open water. Therefore, from the methodical point of view, this lake is not the best place to investigate whether the area of patches is associated with nest-site selection and for this reason it cannot be asserted that the results obtained on Lake Žaltytis contradict those from Lakes Meteliai and Obelija. It is natural to expect that nest-site selection in a linear vegetation belt, which is so typical of Lake Žaltytis, is determined by the diameter of an individual patch rather than its area. It is not accidental that Marsh Harrier gave preference to wider fragments of vegetation belt on the latter lake, though such correlation on Lakes Meteliai and Obelija was more statistically significant than that on Lake Žaltytis ($p < 0.01$ and $p < 0.01$ versus $p < 0.05$, respectively). The same as in the case of patch area, the relation of patch width to nest-site selection on Lake Žaltytis is less apparent because of a low spatial heterogeneity of the shore vegetation belt.

Discussion

Opportunist or specialist?

The analysis of my data revealed that, despite differences in plant area, species composition, stem density, water depth and growing plant substrata between Lakes Meteliai, Obelija and Žaltytis, there are certain general requirements for the environment of a Marsh Harrier nest-site on these lakes. This can be interpreted as an indirect confirmation that Marsh Harrier is not a strong opportunist with respect to nest-site selection. For this reason structural characteristics of lake vegetation is little reflected in nest-site characteristics. However there are some exceptions. Namely, the nest distribution pattern in vegetation of a different height was subject to the share of tall (reeds) and low (cattail) helophytes in the emergent v̄egetation on each lake and differences in vegetation density between Lakes Meteliai and Obelija, and Lake Žaltytis account for analogical differences in nest-surrounding vegetation density of these lakes. Such response to vegetation height is also typical of other birds breeding in wetlands: Coots and Great Crested Grebes (Nedzinskas 1993; Stanevičius 2002).

In large reed stands of Lake Meteliai, vegetation is better protected from the wave impact and ice formations, therefore even stems of several previous plant generations survive. Accordingly, the vegetation density on the latter lake in general and at Marsh Harrier nest-sites specifically is comparatively high. Meanwhile, dense reed stands on Lake Žaltytis grow only on dry and relatively firm floating structures of shore substrata, where Marsh Harriers, most probably feeling insecure, practically do not breed. Helophytes emerging from the water of this lake are sparse, thin-stemmed and stem-broken, but nearly all nests can be found there. As a result, stem density of vegetation surrounding Marsh Harrier nests on Lake Žaltytis is lower than that on Lake Mateliai. Consequently, Marsh Harrier has to adapt to conditions on a particular lake. Marsh Harrier, better than other species of European harriers, has adapted to breed and hunt in thick wetland helophytes (Schipper 1977, 1978). On the other hand, there is abundant evidence about Marsh Harrier breeding in other than helophytic environment, for example, in alfalfa or winter crops (Bock 1978; Krug 1980; Witkowski 1989; Pranaitis & Baublys 1991). Thus, differences in vegetation density at nest sites may be large. This brings to conclusion that vegetation density can have a wide range if the nest-site environment meets other important nest-site selection requirements. On the whole, according to the results of my study, Marsh Harrier is neither a strict specialist nor opportunist in terms of its nest-site selection.

Nest-site position

A Marsh Harrier nest is a big and therefore conspicuous construction. Unconcealed clutch is easily noticeable because of big light-coloured eggs. On the other hand, the review of literature sources by Buczek and Keller (1995) suggests that Marsh Harrier nest losses (from 3% to 40%) are significantly less in comparison with documented nest losses of other water birds, sometimes standing at 80%. It seems that a lot depends on the ability of the species to protect its nest from predators, and primarily from the avian ones. However, Marsh Harrier cannot defend its nests from bigger mammalian predators (e.g. boars or foxes). This is evidenced by relatively heavy losses incurred from avian predators on water bodies and from mammals on shallow marsh-like wetlands (Buczek & Keller 1995; Witkowski 1989). It is a common knowledge that former flourishing populations became extinct in the wetlands, where water level had become too low for protection of nests from terrestrial mammalian predators (Dijkstra & Zijlstra 1997). However, on deep wetlands, egg-laying sites can be flooded and nests devastated by waves (Witkowski 1989). Consequently, Marsh Harrier has no immunity from nest-site selection hardships experienced by other wetland-nesting birds, namely the necessity ‘to maximize the potential for finding a cover and protection from floods and predators’ (Burger 1985).

Results of my research support this conclusion. It was established that there were no statistically significant differences between nest distances to water and the shore. This leads to assumption that breeding birds attempt to lay eggs in the furthest location from both edges – approximately in the middle of the emergent vegetation belt. This is a logical behaviour, when simultaneously attempts are made to minimise the threat caused by wave breaking on the one hand and by predators on the other hand. It is important to note, that nests built in the central and well flooded part of thick overgrowth are more difficultly accessible not only for terrestrial and also water mammals, for example American mink (A. Pranaitis, pers. comm.). Results of my work are also in agreement with the opinion of other authors about greater nest losses in ecotones (one of them is the water-land margin) in general (Paton 1994; Andren 1995) and Marsh Harrier nest losses in habitats, in particular insufficiently protected by water (Dijkstra & Zijlstra 1997). For example, Witkowski (1989) explains the tendency to build nest in reed islets far from the shore as anti-predator behaviour against boar-induced threat. Practically, all most often reported in literature terrestrial predators (Bengston 1967; Creutz 1968; Thiollay 1970; Bock 1979; Underhill-Day 1984; Bavoux *et al*. 1989; Witkowski 1989; A. Pranaitis, pers. comm.) were observed on lakes under investigation.

In addition to destructive hydrodynamic processes, nests built close to open water can be disturbed by fishermen or holiday makers. Literature records that corvids more often prey on Marsh Harrier nests that are left unattended by disturbed females (Underhill-Day 1984; Bavoux *et al*. 1989; Witkowski 1989; Buczek & Keller 1995). Therefore disturbance factor may be an additional incentive for birds to build nests further from open water. And indeed, during my field study, no nesting Marsh Harrier female was scared away by boating along the emergent vegetation edge. They rose from their nests only if I deeply penetrated the overgrowth – what fishermen and holiday makers seldom do – or approached close to the nest. So practically, nests on Lakes Meteliai, Obelija and Žaltytis were built at a distance that ensured sufficient safety from harsh disturbance.

The conclusions about the attempts of this species to find an optimal balance between hydrodynamic processes and predator-induced threats support a fundamental statement that, generally, breeding animal behaviour can be understood as a system of trade-offs evolved to maximize the fitness of an organism (Krebs & Davies 1993).

Role of a patch size and diameter

My research implies that birds preferred larger patchesof vegetation. In my opinion, larger patches attract pairs by a greater possibility to provide a more secure nest-site than the smaller ones. Specifically, they leave sufficient space for birds to retract from the wave-disturbed lake edge and not to approach too close to the shore, where the nest could be exposed to terrestrial predators. Furthermore, some minimal vegetation density is essential for support of the nest construction. Of course, such nest building possibilities exist only in places where sufficiently dense vegetation remained after the winter. The significance of dense vegetation in large deep wetlands was pointed out by other authors too, for example by Ripfel and Sezemsky (1983). Nevertheless, last year's vegetation, as a rule, most often survives exactly in larger and wider patches. Consequently, the tendency to select larger patches, the same as the above-specified tendency to build nest in the middle of helophytic vegetation belt, may be interpreted as the attempts to balance between different threats.

I suppose, there is low probability that territorial antagonism might shape natural preference to larger and wider patches. This assumption is supported by the fact that Marsh Harrier nests on Lakes Meteliai and Obelija are distanced from one another by averagely more than 2 km and 0.9 km, respectively. This is a big distance for the species that can breed in colony-like nest aggregations (Witkowski 1989; Pranaitis & Baublys 1991; Cramp & Simmons 1997).

References

Andren, H. 1995. Effects of landscape composition on predation rates at habitat edges. In: L. Hanson, L. Fahrigg and G. Merriam (eds) *Mosaic landscapes and ecological processes*, pp. 225–255. London: Chapman & Hall.

Bavoux, Ch., Burneleau, G., Leroux, A. and Nicolau-Guillamauet, P. 1989. Le Busard des roseaux *Circus a. aeruginosus* en Charente-maritme (France). III. Alimentation en periode internuptiale. *Alauda* 58: 221–231.

Bengston, S.A. 1967. Observation of the reproductive success of the Marsh Harrier in Skans province. *Oological Record* 2: 23–28.

Bock von, W.F. 1978. Jagdgiebet und Ernahrung der Rohrweihe (*Circus aeruginosus*) in Schlezwig-Holstein. *Journal of Ornithology* 119: 298–307.

Buczek, T. and Keller, M. 1995. Breeding ecology of the Marsh Harrier (*Circus aeruginosus*) in eastern Poland. Part 2. Causes of brood losses. *Acta ornithologica* 29 (2): 67–80.

Burger, J. 1974. Breeding adaptations of Franklin's Gull (*Larus pipixanus*) to marsh habitat. *Animal Behaviour* 22: 521–567.

Burger, J. 1985. Habitat selection in temperate Marsh Birds. In: M.L. Cody (ed.) *Habitat selection in birds*, pp. 253–281. Los Angeles: Academic Press.

Cramp, S. and Simmons, K. 1997. *Birds of Europe, the Middle East and North Africa. I. Ostrich to ducks*. Oxford: Oxford University Press.

Creutz, G. 1968. Gelegestarke und Jungezahl bei der Rohrweihe. *Bonn. zool. Beitr*. 19: 340–345.

Dijkstra, C. and Zijlstra, M. 1997. Reproduction of the Marsh Harrier (*Circus aeruginosus*) in recent land reclamations in the Netherlands. *Ardea* 85 (1): 37–49.

Fowler, J. and Cohen, L. 1990. Statistics for ornithologists. *BTO Guide*: 22.

Hakkarainen, H. and Korpimaki, E. 1996. Competitive and predatory interaction between predators: an observational and experimental study. *Ecology* 77: 1134–1142.

Krebs, J.R. and Davies, N.B. 1993. *An introduction to behavioural ecology*. 3rd ed. Oxford: Blackwell.

Krug, A. 1980. Rohrweihen brüten im Gerstenacker. *Wir und Vögel* 12 (5): 15.

Maldžiūnaitė, S. 1974. Mammals. In: V. Logminas (ed.) *Kretuonas monograph*, pp. 99–105. Vilnius: Periodika. [Maldžiūnaitė, S. 1974. Žinduoliai. V. Logminas (red.) *Monografija* „*Kretuonas*“, pp. 99–105. Vilnius: Periodika.]

Nedzinskas, V. 1993. Birds of Žuvintas Strict Nature Reserve. In: V. Zajančkauskas (ed.) *The Žuvintas Reservation* (*The data of the complex investigations*), pp. 301–430. Vilnius: Academia.

Paton, P.W.C. 1994. The effect of edge on avian nest success: how strong is evidence? *Conservational Biology* 8: 17–26.

Pranaitis, A. and Baublys, G. 1991. On Marsh Harrier (*Circus aeruginosus*) breeding at Žuvintas Nature Reserve. *Acta Ornithologica Lituanica* 4: 107–114.

Prūsaitė, J. (ed.) 1988. *Lithuanian fauna. Mammals*. Vilnius: Mokslas. [Prūsaitė, J. (red.) 1988. *Lietuvos fauna. Žinduoliai*. Vilnius: Mokslas.]

Ripfel, J. and Sezemsky, R. 1983. Zur Siedlungsdichte der rohrweihe (*Circus aeruginosus*) im Schilfgortel des Neusiedlersees. *Ber. Biol. Stat. Neusiedlersee. Biol. Forschungsinst. Burgeland*. 47: 77–91.

Schipper, W.J.A. 1977. Hunting in three European harriers. *Ardea* 65 (1–2): 53–72.

Schipper, W.J.A. 1978. A comparison of breeding ecology in three European harriers. *Ardea* 66 (3): 77–102.

Stanevičius, V. 2002. Nest-site selection by Coot and Great Crested Grebe in relation to structure of helophytes. *Acta Zoologica Lituanica* 12 (3): 265–275.

Thiollay, J.M. 1970. Observations sur l'ekologie d'une population de Busards des roseaux *Circus aeruginosus* en Camarque. *Nos Oiseaux* 30: 214–299.

Underhill-Day, J.C. 1984. The food of breeding Marsh Harrier (*Circus aeruginosus*) in East Anglia. *Bird study* 32: 199–206.

Witkowski, J. 1989. Breeding biology and ecology of the Marsh Harrier (*Circus aeruginosus*) in the Barycz Valley, Poland. *Acta ornithologica* 25 (3): 223–320.

NENDRINĖS LINGĖS (*CIRCUS AERUGINOSUS*) LIZDO VIETOS PASIRINKIMO YPATYBĖS DIDELIŲ EŽERŲ PAKRANTĖS HELOFITŲ JUOSTOJE

V. Stanevičius

SANTRAUKA

Nendrinės lingės lizdo vietos pasirinkimas tirtas 1983–1986 m. Metelio ir Obelijos ežeruose ir 1984–1986 m. Žaltyčio ežere. Tyrimų laikotarpiu čia iš viso perėjo 55 poros, rasti 49 lizdai (89,1%). Potencialus rūšies perėjimo biotopas labiausiai skyrėsi Metelio ir Žaltyčio ežeruose. Obelijos ežeras pagal šį rodiklį užėmė tarpinę padėtį. Nežiūrint skirtumų tarp ežerų, skirtumai tarp daugumos lizdo vietos parametrų mažai skyrėsi visuose trijuose ežeruose. Ypač panašus buvo vandens gylis. Tik labiausiai tarpusavyje besiskiriančiuose ežeruose skyrėsi lizdus supančios augalijos tankis ir aukštis. Pastarasis svyravo priklausomai nuo dominuojančių ežeruose helofitų rūšių. Lizdus paukščiai krovė pakrantės viršvandeninės augalijos juostos viduryje ir pasirinkdavo didesnius bei platesnius jos fragmentus. Lizdo vietos pasirinkimo ypatybės aiškinamos paukščių pastangomis tuo pat metu apsaugoti savo dėtis tiek nuo plėšriųjų sausumos žinduolių, tiek ir nuo griaunamojo hidrodinaminių procesų poveikio.

Received: 22 December 2003
Accepted: 8 September 2004