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CHANGES OF NESTING BIRD FAUNA AT THE ENGURE RAMSAR SITE, LATVIA, DURING THE LAST 50 YEARS

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Bird fauna of Lake Engures, Latvia, and its surroundings has been studied since 1948. Altogether 186 nesting species have been recorded, and major quantitative changes (vanishing, decline, increase, appearance) have been observed in at least 71 (38.2 %) of these species. The number of species with negative trends (44) exceeds that with positive trends (27). Habitat succession was found as the most important cause for negative alterations, while shifts of breeding range were the most important cause for positive alterations. Species of southern origin prevailed among newcomers, while those of northern origin—among vanished species. Especially pronounced changes were observed beginning from 1992/1993 till the late 1990s when breeding duck numbers declined from 2620 to 1000 pairs and Black-headed Gull numbers from 34,000 to 6000 pairs. Causes for the changes are discussed.

Key words: *Latvia, Engure Ramsar Site, breeding bird fauna, quantitative alterations, range shifts, habitat succession, predation.*

INTRODUCTION

Presently, when human impact on nature has increased tremendously, it is very important to assess changes in natural processes and to distinguish those changes which are caused by current human activities from those which result from long-term climatic and successional alterations. In relation to that, the few continuously investigated territories acquire special importance, as far as information about their flora, fauna, and economic use of territory stretches far into the past. Lake Engures (previously called Lake Engure in the literature and official documents published in English) and its surroundings, which corresponds to the territory of Engure Ramsar Site (ERS; Convention on Wetlands of International Importance Especially as Waterfowl Habitat, was adopted in 1971 in Ramsar, Iran; Latvia joined the Convention in 1995), can be considered as one such area. The first scientific publication dealing with Engure birds is dated from 1898 (Löwis, 1898). More complete investigations on Engure birds were carried out in the 1920–1930s (Transehe, 1942). Since 1948, ornithologists have visited the lake annually, and since 1958, stationary ornithological investigations have been established.

The aim of this paper is to provide insight into changes of bird fauna of the area that have occurred during the last half of the century, focusing the main attention on species that have experienced major quantitative changes or have vanished or appeared as newcomers, as well as giving the reasons for these alterations.

MATERIALS AND METHODS

Study site. Lake Engures, a remnant of the ancient Litorina Sea, formed about 4000 years ago. At the beginning of the 19th century, its area was assessed as 90 km². In 1842, the lake water level was lowered (by connecting it with the sea), diminishing its area by twice. Most recently, the area has been estimated as 41 km². The purpose of lowering of the water level was to obtain new areas for agriculture, a venture which actually failed. Now, the lake is nearly completely surrounded by forest (pine at the eastern, and mainly mixed forest at the west coast) which has invaded coastal meadows formed after lowering of the water level. According to very approximate estimates ca 40 % of the lake's area is covered with emergent vegetation: mainly common reed *Phragmites australis*, narrow-leaved cattail *Typha angustifolia*, and bulrush *Scirpus spp.* There are six islands, three of them covered with forest. Depth does not exceed 2.1 m, but large areas have a depth of only 20 cm. The bottom of open water areas is covered mostly by charophytes *Charales*. Three small rivers and several drainage management ditches flow into the lake. A more complete description of the Lake Engures and its surroundings is given in Vīksne (1997).

Various changes in habitats, economic use of the area and legislative status of the lake have occurred during last 50 years, the most important of which for birds are listed below.

• Establishment of an ornithological reserve on the lake in 1957, thus preserving the main nesting sites from disturbance during the breeding period.

• Appearance of two introduced mammal predators – Raccoon Dog *Nyctereutes procyonoides* and American Mink *Mustela vison.*

• Intensive predation control till the early 1990s in the central part of the lake after establishment of the ornithological reserve.

• Decrease of areas covered with meadow vegetation due to ceasing of grazing and hay collection on the coast and islands, its replacement by reeds and forest.

• Growing together of separate stands of emergent vegetation in huge continuous massives dominated by common reed.

• Increase of disturbances, mainly in the surrounding of the lake, due to improvement of road network and, recently, year–round forestry activities.

• Change of socio-economic system since 1990 which essentially has reduced the availability of anthropogenic food for the Black-headed Gull in fishing harbours, canneries, and mink farms.

All available published and unpublished materials dealing with bird fauna of the ERS territory were used. Methods applied in these studies were different. Conventionally these studies can be divided in several groups:

Study group 1. Studies based on many-year survey of the territory during irregular excursions provide information mainly about relative abundance, sometimes absolute abundance, and relate mostly to the period before our detailed studies (Transehe, 1942) or the very beginning of this period (Mihelsons, 1960).

Study group 2. Stationary investigations of waterbird population ecology since 1958, by 5–10 ornithologists on the lake during the whole breeding period. Annual duck, wader, and larid nest counts were carried out in the framework of this study on islands (20 ha) and emergent vegetation census plots (20–110 ha) (more detailed description of methods is given in Михельсон и др., 1968; Blums et al., 1997; 1998). Periodical (since 1992 annual) censuses of larids were conducted on the whole lake (Виксне и др., 1981; Viksne et al., 1996; 2000). Surveys of the entire lake area were carried out to study newcomer species or to conduct census of Mute Swan, including by aerial counts (e.g. Lipsbergs, 1971a; Липсберг и Приедниекс, 1975; Lipsbergs, 1990). Coot nest counts in 1960s covered 20 % of suitable habitats (Блум, 1973). During all these studies, suitability of areas outside census plots for waders and ducks was assessed, thus together with census plot data, providing a basis for population estimates.

Study group 3. Work on ERS breeding bird atlas in 1995–1999 mapped the presence of species in 1×1 km squares (for methods see Priednieks et al., 1989). This work provided comparative materials, especially important for areas surrounding the lake. Data on sea-shore birds were taken from Opermanis et al., 1996.

Estimation of quantitative changes in single species or by certain types of habitats was facilitated by the fact that the author has participated or studied birds at the ERS every year since 1951. To compare changes that have occurred in different habitats, aerial photos taken in 1956, 1972, 1981, and 1994 were used. Possible causes of quantitative changes are given in Table 1. If there were several such causes and all of them seemed to be important, they are shown in Table 1, but for different analyses usually the first (most important) were used.

RESULTS

Data on bird species which have been recorded nesting in the territory of the ERS and have experienced quantitative alterations are summarised in Table 1.

Major changes in the bird populations (vanishing, decline, increase, appearance) have been observed in 71 (38.2 %) of 186 bird species recorded in the territory of the ERS during 1948–1999. Among them, positive trends (increase, appearance) at the end of this period have been observed in 27 (14.5 %) of species and negative trends (vanishing, decline) in 44 (23.7 %) of species (Table 2). As seen in Table 2, the relative number of species which experienced alteration differs by taxonomic groups. Of orders represented in ERS bird fauna by 10 or more species, alterations occurred more often in Anseriformes, Charadriiformes as well as Falconiformes. These differences may be deceptive, as far as no special investigations on dynamics of forest birds have been carried out. It should be noted that the number of species vanished and those that have appeared and established as breeding birds is very similar (10 and 11, respectively), while the number of declining species (34) exceeds that of increasing (21) ones. If newly appeared (newcomer) species are excluded, the latter figures are 33 and 10, respectively. Special attention should be paid to the fact that among declining species, 9 (20.5 %) showed stable positive trends during the observation period, and the decline started only at the very end of this period.

Quantitative changes of species populations and their supposed causes are given in Table 3. Habitat changes and range shifts are the most important causes of alterations.

Among species experiencing a negative change in population size, the main cause is successional change of habitats (45.5 %) and predation (13.6 %). Including also species which have declined or vanished due to disturbance and food, local circumstances were responsible for alterations in 68.2 % of species, while causes laying outside the ERS as general breeding range shifts were responsible for 13.6 % of the observed changes.

Among species having experienced positive trends, habitat succession was responsible in 18.5 % and adaptations of birds to new breeding habitats in 14.8 % of species.

Excluding species with unknown causes of population change, the role of external and internal causes differs sig-

Table 1

NESTING BIRD SPECIES OF THE ENGURE RAMSAR SITE, LATVIA, THAT UNDERWENT QUANTITATIVE CHANGES DURING 1948–1999 (numbers of breeding pairs are shown; other symbols are explained below)

Species	1948–1963	1964–1979	1980–1995	1996–1999	Changes	Causes
1	2	3	4	5	6	7
PODICIPEDIFORMES						
Black-necked Grebe *Podiceps nigricollis*	<10		?	?	D	?
Slavonian Grebe *Podiceps auritus*	100		<10	<10	D	R
Red-necked Grebe *Podiceps grisegena*	10–20		600	<600?	I	H?
Great Crested Grebe *Podiceps cristatus*	500	250	500	<500?	DI	?
PELECANIFORMES						
Cormorant *Phalacrocorax carbo*	0	0	(2)	(<15)	NE	R
CICONIIFORMES						
Great White Egret *Egretta alba*	0	(1)		(1)	NE	R
Grey Heron *Ardea cinerea*	0	100	200–300	<300	NI	A
ANSERIFORMES						
Mute Swan *Cygnus olor*	10–12	85	70–100	70–100	I	Pr
Greylag Goose *Anser anser*	0	single	>35	35	NI	Pr
Shelduck *Tadorna tadorna*	0	single	5–8	5–8	NI	R?
Pintail *Anas acuta*	10	several	0	0	V	R
Shoveler *Anas clypeata*	25–40		60	10–15	ID	P
Teal *Anas crecca*	++	++	+	+	D	P?
Mallard *Anas platyrhynchos*	500	600–1000	1200	500	ID	P,H
Garganey *Anas querquedula*	100–150	100	50	25	D	H
Gadwall *Anas strepera*	0	15	>20	10	NID	P
Pochard *Aythya ferina*	200–300	<1300	900–1000	300	ID	P,H
Tufted Duck *Aythya fuligula*	100–150	300	250–300	140	ID	H,P
Scaup *Aythya marila*	<5	0	0	0	V	R
Ferruginous Duck *Aythya nyroca*	0	<5	<5	?	NE	R
Red-creasted Pochard *Netta rufina*	0	(1)	0	0	NE	R
Common Scoter *Melanitta nigra*	(1)	0	0	0	NE	?
Goosander *Mergus merganser*	<10	<15	single	single	D	R?
Red-breasted Merganser *Mergus serrator*	<10	single	single	0	V	R?
FALCONIFORMES						
Marsh Harrier *Circus aeruginosus*	>5-10	15–20	30	30	I	H
Hen Harrier *Circus cyaneus*	2?	0	0	0	V	R?
Spotted Eagle *Aquila clanga*	1-2	0	0	0	V	D
Kestrel *Falco tinnunculus*	several	?	?	?	V	?
GALLIFORMES						
Black Grouse *Tetrao tetrix*	100		<15	<15	D	D,P
Hazel Grouse *Bonasa bonasia*	>30		<30	<30	D	P?
GRUIFORMES						
Crane *Grus grus*	3–5		8–15	8–15	I	A
Corncrake *Crex crex*	tens–hundreds		20–30	20–30	D	H
Little Crake *Porzana parva*	single		20–30	20–30	I	R?
Spotted Crake *Porzana porzana*	tens–hundreds		10–20	10–20	D	H
Moorhen *Gallinula chloropus*	single		>100	<50	ID	H?
Coot *Fulica atra*	800–1200	1700	1000	<1000	ID	H,P
CHARADRIIFORMES						
Oystercatcher *Haematopus ostralegus*	0	<3	<3	<3	NI	A?
Lapwing *Vanellus vanellus*	hundreds		<100	<50	D	H
Ringed Plover *Charadrius hiaticula*	5–10		(single)	(single)	D	H?
Black-tailed Godwit *Limosa limosa*	<12	30	10–15	<10	ID	H,P
Curlew *Numenius arquata*	single	0	0	0	V	H?

Changes: D, declined; V, vanished; ID, increased, then declined; DI, declined, then increased; NI, newcomer increasing; NE, newcomer nesting episodically; I, increasing. **Causes:** H, habitat changes; R, range shifts; D, disturbance; P, predation; A, adaptation to new habitat; F, food; Pr, protection; ?, unknown/uncertain.

In comparison with related species: + rare species, ++ relatively common species; +++ very common species. Irregular nesting cases are given in brackets.

Table 1 (continued)

1	2	3	4	5	6	7
Redshank *Tringa totanus*	hundreds	50	<20	<15	D	H,P
Green Sandpiper *Tringa ochropus*	hundreds		tens	tens	D	?
Wood Sandpiper *Tringa glareola*	single		0	0	V	H?
Common Snipe *Gallinago gallinago*	hundr.–thous.		100-200	100-200	D	H
Dunlin *Calidris alpina*	<10	0	0	0	V	H
Ruff *Philomachus pugnax*	tens–hundreds	40	10-15	single	D	H,P?
LARIFORMES						
Herring Gull *Larus argentatus*	0	several	40	40	NI	A
Black-headed Gull *Larus ridibundus*	200–4000	26000	34000	6000	ID	F,H,P
Black Tern *Chlidonias nigra*	125–670	120	100	50–120	D	?
Caspian Tern *Sterna caspia*	0	(1)	0	0	NE	?
COLUMBIFORMES						
Collared Dove *Streptopelia decaocto*	+	+	+	+	NI	R
STRIGIFORMES						
Eagle Owl *Bubo bubo*	<5	4–5	1–2	1–2	D	D,F
CAPRIMULGIFORMES						
Nightjar *Caprimulgus europaeus*	+++	++	++	++	D	?
CORACIIFORMES						
Roller *Coracias garrulus*	+++		+	0	V	?
PICIFORMES						
Middle Spotted Woodpecker *Picoides medius*	0	0	?	<5	NI	R
PASSERIFORMES						
Yellow Wagtail *Motacilla flava*	hundreds		tens	tens	D	H
Meadow Pipit *Anthus pratensis*	+++		+	?	D	H
Red-backed Shrike *Lanius collurio*	+++		+	+	D	?
Whinchat *Saxicola rubetra*	++		+	+	D	H
Northern Wheatear *Oenanthe oenanthe*	++		+	+	D	?
Bearded Tit *Panurus biarmicus*	0	several	200–400	200–400	NI	R
Savi's Warbler *Locustella luscinoides*	0	several	300–500	300–500	NI	R
Sedge Warbler *Acrocephalus schoenobaenus*	hundreds		1500	1500	I	H
Reed Warbler *Acrocephalus scirpaceus*	hundreds		1200	1200	I	H
Great Reed Warbler *Acrocephalus arundinaceus*	thousands		1000	1000	D	H
Blyth's Reed Warbler *Acrocephalus dumetorum*	0	+	+	+	NI	R
Penduline Tit *Remiz pendulinus*	several?	10-15	20	20	NI	R,H
Reed Bunting *Emberiza schoeniclus*	hundreds		1500	1500	I	H
Starling *Sturnus vulgaris*	+++		++	++	D	H
Raven *Corvus corax*	+		++	++	I	F

nificantly (χ^2=6.115; P<0.05) in species having experienced negative and positive changes. Consequently, different changes in ecosystems, both having occured naturally or due to human activities (or inactivity) mostly have led to a decline of local populations.

DISCUSSION

Possible causes of quantitative changes of species populations are given in Table 1. In most cases they do not exceed the level of "the best guess" and are not supported by specific studies. For most species, even when one cause was considered as major and indicated in Table 1, the actual changes result from interactions of several factors (causes), with varying roles in different periods. Nevertheless, it seems useful to discuss the supposed causes to aid the understanding of processes occuring in ERS bird fauna.

General changes of breeding range. Global warming is well known in the 20th century, and effects have been observed also in Latvia (Treiliba, 1995). As a result of warming, the southern borders of breeding ranges of northern species have receded to the north–north-east while the northern borders of breeding ranges of southern species have expanded in the same direction (Žalakevičius, 1998). This general regularity can be seen also in ERS bird fauna data (Table 4).

Species of southern origin prevail among newcomers, while northern species prevail among those which have ceased nesting in ERS during the last 50 years (χ^2=7.9; P<0.05). Among 12 newcomer species which have established stable nesting populations (have become regular breeders), seven are of southern origin (Greylag Goose, Gadwall, Collared Dove, Middle Spotted Woodpecker, Bearded Tit, Savi's

Table 2

QUANTITATIVE CHANGES IN DIFFERENT ORDERS OF BIRDS AT THE ENGURE RAMSAR SITE IN 1948–1999

Order	Number of species			Negative trend			Positive trend			
	total	quantitative changes		V	D	Total	I	NI	NE	Total
		n	%							
Podicipediformes	5	4	80		2	2	2			2
Pelecaniformes	1	1	100						1	1
Ciconiiformes	6	2	33					1	1	2
Anseriformes	19	17	89	4	7	11	1	2	3	6
Falconiformes	14	4	29	3		3	1			1
Galliformes	4	2	50		2	2				
Gruiformes	7	6	86		4	3	2			2
Charadriiformes	14	11	79	2	8	8		1		1
Lariformes	8	4	50		2	2		1	1	2
Columbiformes	5	1	20					1		1
Cuculiformes	1	0	0							
Strigiformes	6	1	17		1	1				
Caprimulgiformes	1	1	100		1	1				
Apodiformes	1	0	0							
Coraciiformes	3	1	33	1		1				
Piciformes	9	1	11					1		1
Passeriformes	82	15	18		7	7	4	4		8
Total	186	71		10	34	44	10	11	6	27
% of species total			38.2	5.4	18.3	23.7	5.4	5.9	3.2	14.5

V, vanished; D, declined to the end of period; I, increased; NI, newcomer, increased; NE, newcomer, nested episodically

Table 3

NUMBERS OF BIRD SPECIES HAVING EXPERIENCED QUANTITATIVE CHANGES AT THE ENGURE RAMSAR SITE IN 1948–1999 AND THE CAUSES OF THOSE CHANGES

Changes observed	Possible causes								Total
	range shifts	habitat changes	predation	protection	adaptation to new habitat	disturbance	feeding conditions	unknown	
Vanished	4	3				1		2	10
Declined to the end of the period*	2	17	6			2	1	6	34
Negative changes, total	6	20	6	0	0	3	1	8	44
Increased to the end of the period	1	5		1	1		1	1	10
Newcomer, increased	7			1	3				11
Newcomer, nested epizodically	4							2	6
Positive changes, total	12	5	0	2	4	0	1	3	27
Total	**18**	**25**	**6**	**2**	**4**	**3**	**2**	**11**	**71**

* Including one newcomer species (Gadwall)

Warbler, and Penduline Tit), and five species, according to the position of their breeding ranges, cannot be considered as northern or southern (Shelduck, Grey Heron, Herring Gull, Oystercatcher, and Blyth's Reed Warbler). There are more southern species also among those newcomers which nested only episodically (Great White Egret, Ferruginous Duck, Red-crested Pochard); wide-spread species (Cormorant, Caspian Tern) and northern species (Common Scoter) are less represented. In contrast, of ten species which have ceased nesting (vanished) in ERS, six are northern (Pintail, Scaup, Red-breasted Merganser, Hen Harrier, Wood Sandpiper, and Dunlin) and only one (Roller) is of southern ori-

Table 4

ORIGIN OF NEWCOMER AND VANISHED BIRD SPECIES AT THE ENGURE RAMSAR SITE IN 1948–1999

Species	Northern*	Southern	Intermediate	Total
Newcomers	1 (5.6 %)	10 (55.5 %)	7 (38.9 %)	18
Vanished	6 (60.0 %)	1 (10.0 %)	3 (30.0 %)	10
Total	**7**	**11**	**10**	**28**

* Northern, Southern, and Intermediate means that the main breeding range of the species lies correspondingly to the North, or South of Latvia, or it expands to both sides of Latvia

gin, while the intermediate group includes three species (Curlew, Kestrel, and Spotted Eagle). Range shifts probably can explain also the decline of Slavonian Grebe and Goosander, as well as the increase of Little Crake. Undoubtedly, range shifts have played a role in the decline or increase of some other species, for which other reasons were considered to be more important. Therefore we believe that the role of gradual range shifts is rather underestimated.

Successional changes of habitats is the main factor which has caused vanishing of species or a decline of their populations in ERS (20 of 44, or 45.5 %). The most important habitat change is a decrease of the meadow area due to ceasing of grazing and hay collection, as well as alteration of the structure of meadow vegetation on islands due to special management measures targeted to ducks. In comparison with the period before 1957 when these islands were overgrazed, short-grass areas have declined and long-grass (abundant last-year grass in spring) areas have increased. All these changes have negatively influenced waders: Dunlin, Curlew, and Wood Sandpiper have vanished, Lapwing, Redshank, Snipe, Ruff, and recently also Black-tailed Godwit have strongly declined. We suppose the loss of meadow areas is the reason for the decline in Garganey, Corncrake, Spotted Crake, Yellow Wagtail, Meadow Pipit, and Whinchat populations, as well as for Starling which depends upon short-grass meadows as feeding areas.

Other important changes of habitats deal with the amalgamation of separate stands of emergent vegetation, and overgrowing of cattail mats with reeds. Many birds avoid nesting in continuous mats of emergent vegetation far from open water, and their nests are concentrated in a 10–20 m wide belt along the periphery or in internal open water pools. Thus, the number of nesting birds depends on the length of mat-open water border, which declines when separate stands grow together. This is the likely reason for the decline of Coot and Great Reed Warbler, and could be also partly responsible for the decline of Mallard, Pochard, and Tufted Duck. In the case of the latter species, changes of vegetation structure has a more complicated influence: huge relatively dry reed-beds become suitable for permanent dwelling of American Mink, and due to this, Black-headed Gull colonies abandon the site. The Tufted Duck also leaves these sites, as it prefers to nest in gull colonies (which provide effective protection from aerial predators).

Successional changes of habitat have been recognised as a responsible factor less often for increasing species (5 of 27; 18.5 %) than for declining ones. Excluding probable cases (Red-necked Grebe), successional changes are responsible for a population increase in 14.8 % species, which benefit from the disappearance of meadows growing together of reed-beds, and formation of a continuous area covered with reeds and individual *Salix* shrubs. At different stages of development, this type of vegetation provides suitable conditions for a very limited number of bird species, such as Marsh Harrier, Sedge Warbler, Savi's Warbler, Reed Warbler, and Reed Bunting.

Generally, the current successional changes of the lake ecosystem mostly favour negative alterations in bird fauna both regarding number of nesting species and population size for most species.

Predation is considered as an important cause of the recent decline for several duck species, and also for the Coot and Black-headed Gull populations. Since the late 1980s to early 1990s, the total number of breeding ducks (all species combined) has declined 2.6 times, including Shoveler 4 times, Pochard 3.3 times, Mallard 2.4 times, etc. (Viksne *et al.*, 2000). Unfortunately, this data is not conclusive, but sufficient evidence exists to support this claim:

1. A highly significant ($r=-0.858$; $P<0.01$) decline of breeding duck numbers on islands has occurred since the all-time high in 1993, prior to which most species fluctuated or increased. Nesting success had the same decline ($r=-0.746$; $P<0.05$), while in 1958–1993 it showed a significant ($r=0.37$; $P<0.05$) increase (Blums *et al.*, 1993).

2. Abandonment of colony sites on emergent vegetation mats by Black-headed Gull due to appearance of American Mink. These sites were also suitable for duck nesting. In such areas, nesting duck numbers decreased ca. 10 times and their nesting success declined from 60–80 % to 0–15 %.

3. Ability of American Mink to kill a major part of incubating females at least for some duck species: for instance, in 1994 when ca. 30 % of Shoveler females nesting on the lake were killed on nests by this predator.

Since nearly all species considered as declining due to predation are game birds, it seems very possible that the low nesting success can lead easily to overhunting which adds to the predation effect. Very likely, the gradual decline of nesting success was promoted by reduction of predation control since the early 1990s, both concerning area controlled and number of predator species.

Changes of feeding conditions likely influenced many species, but lack of specific studies makes this difficult to prove. An exception is the Black-headed Gull, for which the population growth from 200 to 34,000 pairs during 1948 to 1986 coincided with switching to anthropogenic food which was unlimitedly available in fishing harbours, canneries, and mink farms. In the 1990's when offer of anthropogenic food was very limited or was lacking, the numbers of the Black-heated Gull decreased to 600 pairs in 1999. Changes of feeding flight pattern after introduction of some limitations in sea fishery also provide evidence of the dependence of the Black-headed Gull on anthropogenic food (Viksne *et al.*, 1996). It is not excluded that the decline of the Black-headed Gull as a prey species has also played a certain role in the decline of the Eagle Owl.

Among the food sources of different birds on Lake Engures, chironomids *Chironomidae* deserve special attention. According to unanimous visual estimates by ornithologists, chironomids have declined since the end of 1950s. This observation has been confirmed by hydrobiologists who found

the lake "very rich" in chironomids in the 1950s (Спурис, 1960) and only "intermediate" in the 1990s (E. Parele, personal communication).

Adaptations to new habitats have been the reason for growth of populations of four species — Common Crane (nesting in forests in addition to previously inhabited bogs and fens), Grey Heron (nesting in reed-beds which was not known previously in the northern part of its range; Lipsbergs, 1971b), Oystercatcher (nesting on grass covered lake islands instead of sea shore), and Herring Gull (nesting on an overgrown coastal lake in addition to traditional raised bog pools).

Protection, i. e. establishment of a nature protection regime on the lake in 1957 has influenced positively all bird species, and together with vegetation control on islands and predation control, has promoted growth of breeding duck populations and their nesting success (Mihelsons, 1960; Михельсон и др., 1968; Blums et al., 1993). Likely, limiting the presence of humans during breeding season facilitated also growth of larid populations and the Mute Swan, the first breeding attempts of which failed in the 1930s due to human disturbance (Transehe, 1939). The population growth of the Greylag Goose (Bauga, Lipsbergs, 1995; Viksne, 1995) started after prohibition of spring geese hunting in 1980s (hunting was allowed only outside the lake, where birds flew for grazing).

Increase of disturbance mostly influenced birds nesting outside Lake Engures. Disturbance was promoted also by improvement of roads, and, especially during the last decade, intensive forestry activities conducted throughout the year. Disturbances have been the major reason for the vanishing of Spotted Eagle, decline of Eagle Owl and the many-fold decline of Black Grouse. Likely, illegal shooting is still a limiting factor for the large raptors.

Reasons not known. The changes observed in birds populations cannot be explained for about ten species. The population decline in several of them (Black Tern, Nightjar, Roller, Red-backed Shrike) has been observed in many countries (Tucker and Heath, 1994) and may be related to habitat degradation. For the latter three species, the reason may be decreasing of open areas, especially covered with low vegetation which have been observed also in ERS. However, these species are long-distance migrants, and their numbers could be influenced by various factors during migration and at wintering grounds. There are also no ideas about reasons for the changes of the number of Great Crested Grebe and Kestrel.

The analysis of reasons of quantitative changes of ERS breeding birds is complicated by the numerous factors, the relative importance of which changes with time, and it is difficult and very subjective to choose one as the most responsible. Also, some underestimated local and more general factors could be involved. There is no doubt, for example, that the manyfold decrease of meadows has caused a corresponding decline of meadow dwellers. However many of the species continue to decline also in the remaining suitable habitats. In the case of waders on islands, probably increased chick mortality due to predation by American Mink could be important, but also the general decline of wider geographical populations reported in many species (Tucker and Heath, 1994) could be an obstacle to maintain a small local population. The decline of nesting Ruff in its remaining habitat coincides also with a gradual decline of passage migrants.

In general, it can be concluded that the number of nesting bird species of ERS bird fauna, i. e. its diversity, has not changed since vanished species are replaced by others. At the same time, a decline of populations has been observed in a large number of species, and the causes of these declines stem mostly from changes in the lake ecosystems. Negative quantitative changes are becoming more apparent recently since the early 1990s in common species, the populations of which were stable or growing during nearly the whole investigation period since 1950s (ducks, Black-headed Gull). The decline of the latter species has had far-reaching consequences for species which prefer nesting in gull colonies.

The author tends to believe that changes in predation pattern caused by the appearance of American Mink has been the "crucial push" to acceleration of the recent population decline both in groups where the decline was started as a consequence of habitat succession (waders, ducks) and where the decline was started as a response to deterioration of feeding conditions (Black-headed Gull). The role of American Mink is not restricted with killing of a specific number of birds, as it seems to induce major alterations in the whole ecosystem, and, probably, also causing overexploitation of game bird populations.

Investigation of the impact of predators is considered a priority in further studies.

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AVIFAUNAS PĀRMAIŅAS ENGURES RAMSĀRES VIETAS TERITORIJĀ PĒDĒJO 50 GADU LAIKĀ

Engures ezera un tā apkārtnes avifauna pētīta no 1948. līdz 1999. gadam. Konstatētas pavisam 186 ligzdojošas sugas, no tām ievērojamas kvantitatīvas izmaiņas (izzušana, skaita samazināšanās vai palielināšanās, agrāk neligzdojušu sugu ligzdošana) novērotas vismaz 71 (38,2 %) sugai. Sugu skaits, kurām novērotas negatīvas izmaiņas (44), ir lielāks par to sugu skaitu, kurām konstatētas pozitīvas izmaiņas (27). Negatīvo izmaiņu svarīgākais cēlonis ir ligzdošanas biotopu sukcesionālās izmaiņas, pozitīvo — sugu ligzdošanas areālu robežu pārbīdes. Starp jaunatnācējiem pārsvarā ir dienvidnieciskas izcelsmes sugas, savukārt izzudušās sugas galvenokārt ir ziemeļnieciskas izcelsmes. Sevišķi lielas skaita pārmaiņas novērotas 90. gadu vidū un beigās, kad dažādu sugu ligzdojošo pīļu skaits samazinājies no 2620 līdz 1000 pāriem un lielā ķīra skaits — no 34000 līdz 6000 pāriem. Analizēti iespējamie izmaiņu cēloņi.