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Reproduction and feeding success of the Red-necked Grebe *Podiceps grisegena* at fish ponds, SE Poland

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Abstract. Investigations were carried out in three fish-pond complexes in 1993–1999. Clutches were initiated 21 April–9 July (mean 11 May). The average clutch size was 3.83 ± 0.44. In total 66.3% breeding pairs reared fledglings (n = 163). The population studied had a higher hatching success (83.4%) compared to data reported in literature but fledging success (1.29 young per breeding, and 1.94 per successful pair) was lower than those documented in Sweden and Russia. 22.3% of dives observed during foraging bouts were successful. Ponds, which seemed suitable for breeding, were less frequently occupied by breeding pairs when stocked after mid-May than ponds stocked earlier. The proportion of nests which produced fledglings was lower in ponds used for recreation than in ponds without such activities. Removal of littoral vegetation using heavy machinery was responsible for destroying of nearly one third of clutches initiated after 15 June.

Key words: Red-necked Grebe, *Podiceps grisegena*, breeding success, foraging success, fish ponds

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INTRODUCTION

The Red-necked Grebe *Podiceps grisegena* is a species breeding mainly on small, shallow, eutrophic waterbodies (Wobus 1964). In Europe the most important nesting habitat are fish-ponds. However, there are few quantitative data on the reproductive performance of the species in this habitat (Markuze 1965, Vlug 1993). The objectives of this study were to assess the value of cultured fish-ponds for breeding grebes and to examine the effects of human management on reproductive performance.

STUDY AREA AND METHODS

The study was carried out at three fish-pond complexes: Garbów, Piaski and Samoklęski (51°08'–27'N, 22°23'–54'E) in Lublin Province, SE Poland. 39 ponds (186.9 ha of water surface) suitable for breeding of grebes were investigated during the seasons of 1993–1999 (Garbów and Samoklęski) and 13 ponds (Piaski, 111.4 ha) in 1995–1999. The ponds ranging from 0.5 to 23 ha were stocked mainly with Common Carp *Cyprinus carpio*. Among the monitored ponds, 10 were open to recreational activities (bathing, canoeing) besides normal fish stocking.

Nests were searched for and visited at 1–4 day intervals during egg laying and hatching periods, and every 2–7 days during mid-incubation. Because grebes often build more than one platform before initiating a clutch, a platform with at least one egg recorded was defined as an occupied nest. For nests found after the clutch was completed, the laying date was back-calculated from the observed hatching date, assuming 24 days for the usual incubation length in the study

area (Kloskowski 1999). The means were calculated only for nests found during the laying phase. Clutches destroyed at an early stage when apparently not completed were also excluded from the calculation of clutch size. After nest leaving the families were observed at 3–6 day intervals to determine the number of survived chicks. As in all observed families parents left the territory before the young, a fledgling was defined as a young which has survived till at least one parent departed the nesting pond. Because re-nesting pairs sometimes changed their territory (pond) and only some breeding birds were individually colour-ringed after trapping into submerged nets (1996–1999), in each pond complex clutches laid in territories established after the first unsuccessful pair left its original territory were assumed to be replacements.

Foraging bouts of adult grebes were recorded for 15 successful breeding pairs between 1995–1999. The observed birds were either colour-ringed and marked with a small patch of dye on the back of the head or occupied distinct territories so their identity could not be mistaken. The observations were made between the third and sixth week after chick hatching. Sequences of dives were recorded from a shore by video camera supplied with 12× video lens. All foraging bouts recorded were dives for food for the young. Later durations of dive were measured to the nearest 0.1 s using a stopwatch and then prey category (invertebrates, amphibians, fish) was determined.

RESULTS

Laying phenology

In total 140 first clutches, 52 replacement clutches and 4 second clutches were recorded. The estimated number of breeding pairs was 163, because it was assumed that some later clutches were replacements for undetected first breeding attempts. The mean date of the first egg in the first clutches was 11 May (median = 10 May). First replacement clutches were laid in the last decade of May. All clutches started after 1 June were classified as re-nesting. The range of the first egg dates calculated for the whole study period was 67 days (Fig. 1). Time of fish stocking affected the probability of a pond occupation by at least one breeding pair. Territories were established by grebes less frequently on the late stocked (after 15 May) ponds (G-test with William's correction, $G/W/ = 1042.1$, $df = 1$, $p < 0.001$). The calculation includes only ponds occupied at least once over the study period; in the successive years different ponds were among those late stocked.

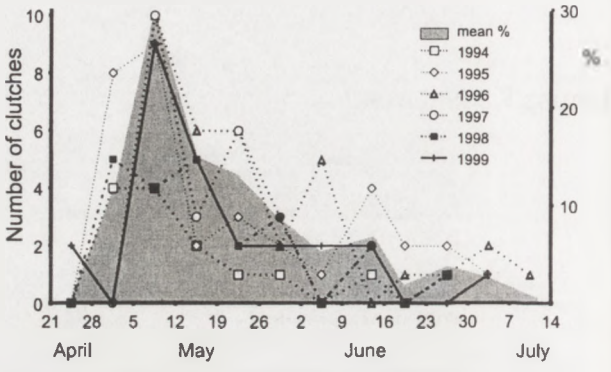

Fig. 1. Numbers of clutches initiated per one-week-period (1994–1999) and the mean percentages of laid clutches relative to the total number of clutches over the six years. Included are only clutches detected during egg-laying period or back-calculated from the observed hatching date, when the latter was determined to one day (n = 154).

Clutch size

The mean size of first clutches was 3.89 ± 0.87 (n = 80, range 1–6), and of replacement clutches 3.68 ± 0.67 (n = 28, range 2–5). All nests with less than three eggs (n = 3) were detected after the end of laying, thus they might have undergone partial clutch destruction. The differences in size between first and replacement clutches were not significant ($t = 1.15$; $df = 106$, ns).

Nest losses and chick mortality

Of the active nests 50 (25.5%) were destroyed before hatching of any egg. Known causes of nest loss were human disturbance, avian predation (by corvids, Marsh Harrier *Circus aeruginosus*), destruction of eggs by Coot *Fulica atra*, inviability of eggs and abandonment due to aggression of Great-crested Grebe *Podiceps cristatus* or lowering of the water level. Five out of 17 clutches initiated after 15 June were destroyed during routine removal of littoral vegetation by heavy machinery. Two incubating grebes were killed by avian and mammalian predators, presumably White-tailed Eagle *Haliaeetus albicilla*, Polecat *Mustela putorius* or Otter *Lutra lutra*.

Chick mortality was the highest in the first week after hatching and no cases of young death were re-

corded among chicks older than four weeks (Fig. 2). However, as nest visits in the hatching period may cause disturbance resulting in desertion of viable eggs and losses of newly hatched chicks, data presented in Fig. 2 were collected for only 57 nests.

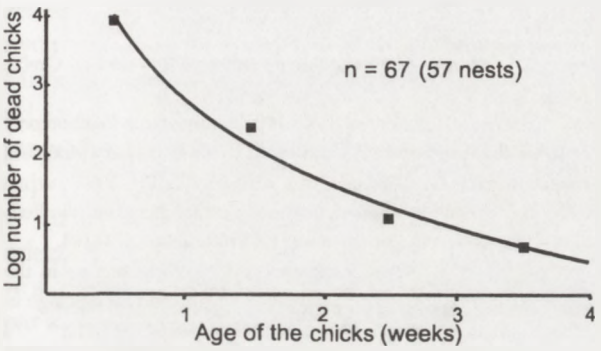

Fig. 2. Relationship between chick mortality and their age.

Reproductive success

Data on hatching success (defined as percentage of pairs with at least one chick hatched) and the average number of fledglings per number of breeding pairs and per number of successful pairs are presented in Table 1. Overall, 108 pairs (66.3%) successfully reared at least one fledgling (only 2 of them twice in the same season). First clutches produced on average 1.11 ± 1.19 fledglings per active nest (n = 140), while replacement clutches and second broods 0.96 ± 1.11 (n = 56). Number of fledglings per successful pair was 1.92 ± 0.96 from first clutches (n = 82) and 1.93 ± 0.77 from replacements and second clutches (n = 28). These differences were not significant (t = 0.81, df = 194, ns and t = –0.13, df = 108, ns, respectively). Among 108 nests discovered during the laying phase only in 9 (8.3%) all eggs produced fledglings. The mean period of parental care (at least one parent feeding the young) was 47.4 ± 8.3 days (n = 33), calculated only for families where the dates of egg hatching and abandoning the young were determined to one day. Only 20 out of 50 breeding attempts (40%) on fish-ponds used for recreation produced at least one fledgling. The proportion of successful clutches on the ponds without pressure of recreation: 90 out of 146 clutches (64.6%) was significantly higher ($G/W/ = 7.02$, df = 1, $p < 0.01$).

Feeding success

Of the 1257 dives recorded, 281 were successful (22.3%). Mean duration of dive was 26.3 ± 14.9 s. Of the 263 identified prey fish composed 49%, amphibians (mainly tadpoles) 27% and invertebrates 24%.

DISCUSSION

The population studied reached a higher hatching success in comparison with data from other studies on reproductive performance in the Red-necked Grebe (Table 1). It resulted from the relatively low rate of nest losses and the high incidence of re-nesting (see Riske 1976, De Smet 1987). However, production of fledglings per breeding pair and per successful pair was only intermediate compared to data from NW Germany, Russia and Sweden and data on the North American subspecies *P. g. holboellii* (Table 1). This discrepancy between the relatively high hatching rate and only medium fledging success can be ascribed not only to chick mortality, but also to low egg hatchability rate in the study area (Kloskowski 1999).

The role of food supply in the reproductive success remains ambiguous, as Common Carp may be both

Table 1. Basic breeding parameters for Red-necked Grebes in Europe and North America. Sample size in parentheses. Study area and source: 1 — Estonia (Onno 1960), 2 — Volga delta (Markuze 1965), 3 — West Ukraine (Buchko et al. 1995), 4 — Schleswig-Holstein/Germany (Vlug 1993), 5 — Skane/Sweden (Ahlen 1970), 6 — Pine Lake, Alberta (Riske 1976), 7 — Duck Lake Nesting Area, British Columbia (Ohanjanian 1986), 8 — Northwest Territories/Canada (Fournier & Hines 1998), 9 — Alberta potholes (Riske 1976), 10 — SW Manitoba (De Smet 1987).

	Mean clutch size	Hatching success (%)	Young/ successful pair	Young/ breeding pair
Present study	3.83 (108)	83.4 (163)	1.94 (108)	1.29 (163)
Europe	3.55 (44)[1]	80.0 (360)[2]	2.80 (288)[2]	2.24 (360)[2]
	3.20 (254)[2]	39.0 (2945)[4]	1.53 (1149)[4]	1.57 (28)[5]
	4.09 (23)[3]			0.60 (2944)[4]
North America	3.97 (73)[6]	24.6 (207)[6]	1.39 (51)[6]	0.34 (207)[6]
	3.38 (57)[7]	65.1 (63)[9]	1.85 (56)[10]	0.94 (114)[10]
	4.38 (80)[8]	50.9 (110)[10]	1.99 (513)[8]	1.44 (711)[8]

prey and food competitor of grebes (Vlug 1993). Diving success is usually assumed to correlate with prey availability in the given habitat (Lammi & Ulfvens 1988). Mean dive duration was similar to those reported by other authors (Hancock & Bacon 1970, Simmons 1970). Studies on foraging behaviour of Great-crested Grebes feeding young reveal a wide range (12%–80%) of diving success (Lammi & Ulfvens 1988, Gwiazda 1997). Moreover, the data are difficult to compare as the prey brought to water surface by Great-crested Grebes consisted exclusively of fish, while in the present study fish made up less than half of prey in terms of numbers.

Among factors associated with human use of the carp ponds — which are likely to inversely influence the breeding success of grebes — are removal of littoral vegetation during the incubating period, parallel use of fish-ponds for recreation and flooding of a part of the ponds after most of the breeding pairs have already established territories or laid eggs, which limits the number of available territories. Also, due to delay in starting the first clutches, pairs exposed to clutch failure have less time to renest. Sometimes, a part of wintering ponds were drained for harvesting or fish translocation as late as the last decade of April, after some pairs had already built the nests.

Both delay in fish stocking and combining fisheries with recreational use are among possible preventive measures against Cormorants *Phalacrocorax carbo* (Kirby et al. 1996). Still, in areas where the impact of Cormorants is unimportant, it would be advisable to curtail such practices as detrimental to grebes.

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STRESZCZENIE

[Rozród i sukces łowiecki perkoza rdzawoszyjego na stawach rybnych w południowo-wschodniej Polsce]

Badania nad ekologią rozrodu perkozów rdzawoszyich gniazdujących na stawach rybnych prowadzone były w latach 1993–1999 w kompleksach hodowlanych Garbów i Samoklęski oraz w sezonach lęgowych 1995–1999 w Piaskach (woj. lubelskie). Wyszukiwano i kontrolowano gniazda, a następnie, do końca okresu opieki rodzicielskiej, prowadzono regularne obserwacje par z wyklutymi młodymi. Ponadto za pomocą kamery video rejestrowano cykle nurkowania w poszukiwaniu pokarmu przez ptaki dorosłe z 15 par karmiących młode. Ogółem zaobserwowano 140 prób pierwszych

lęgów, 52 zniesienia powtórne i 4 próby drugich lęgów. Składanie jaj rozpoczynało się w ostatniej dekadzie kwietnia, a ostatnie zniesienia stwierdzono w pierwszej połowie lipca (Fig. 1). Średnia wielkość zniesienia wynosiła 3.83 ± 0.44 jaja. Pierwsze zniesienia i zniesienia uzupełniające nie różniły się istotnie wielkością. 50 zniesień (25.5%) zostało zniszczonych bądź porzuconych przed wykluciem się przynajmniej jednego jaja. Mimo to, wskutek lęgów uzupełniających, procentowy udział par, którym udało się doprowadzić do wyklucia przynajmniej jednego młodego, wyniósł 83.4%. Był on najwyższy w porównaniu z wynikami innych badań w Europie i Ameryce Pn., natomiast produktywność mierzona liczbą młodych, które osiągnęły niezależność w stosunku do liczby par lęgowych (średnio 1.29) lub par z sukcesem lęgowym (średnio 1.94) była pośrednia między danymi dla populacji w Niemczech północnozachodnich a populacji gniazdujących w południowej Szwecji i w delcie Wołgi (Tab. 1). Sytuacja ta była łącznym efektem śmiertelności młodych i niewykluwania się jaj. Śmiertelność młodych była najwyższa w pierwszym tygodniu po wykluciu, natomiast nie stwierdzono strat wśród młodych, które ukończyły 4 tygodnie (Fig. 2). Tylko w 8.3% gniazd liczba jaj odpowiadała liczbie podlotów. Ptaki dorosłe opiekowały się potomstwem przez średnio 47 dni po wykluciu. Średni czas nurkowania w celu zdobycia pokarmu (26.3 s) nie odbiegał od wyników zebranych w innych częściach Europy. 22.3% nurkowań z 1257 zarejestrowanych kończyło się schwytaniem ofiary. Stawy zarybiane w drugiej połowie maja, lub później, były rzadziej zajmowane przez pary lęgowe. Sukces rozrodczy był istotnie niższy na stawach używanych oprócz hodowli ryb do celów rekreacyjnych w porównaniu ze stawami niedostępnymi do publicznego użytku. Maszynowe usuwanie trzcin spowodowało zniszczenie prawie 1/3 zniesień rozpoczętych po 15 czerwca.