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Breeding ecology of the Great Crested Grebe *Podiceps cristatus* in northeastern Slovenia

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The paper presents the results of breeding ecology of the Great Crested Grebe (*Podiceps cristatus*) on Dravsko polje in northeastern Slovenia. Up to 44 pairs breed on Dravsko polje, mainly in the Raèki ribniki-Požeg Landscape Park. This represents about 15% of the entire breeding population in Slovenia. The highest breeding density was 7 pairs/10 ha. There were significant differences in breeding densities between localities. Correlation between the lower nest diameter and the nest-height was significant, whereas correlation between the upper nest-diameter and nest-height was not significant. The relationship between breeding pairs of the Little Grebe *Tachybaptus ruficollis* and the Great Crested Grebe was positive but not significant.

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1. Introduction

The Great Crested Grebe (*Podiceps cristatus*) is distributed throughout Europe, however, it is the most common in the northern part of Europe (Cramp & Simmons 1977, Fjeldsa & Lammi 1997). It breeds on various inland waters. Studies about breeding biology and ecology of the Great Crested Grebe are numerous from those regions (e.g. Cramp & Simmons 1977, Glutz von Blotzheim *et al*. 1987 and references therein). On the other hand the data from other regions are scarce, especially for more southern localities (e.g. Sarrocco 1986).

The aim of this paper is to provide information on the breeding ecology of the Great Crested Grebe from the southern part of its distribution.

2. Study area

The work was done on Dravsko polje in northeastern Slovenia (46º27'N, 15º41'E). This is a plain of about 210 km^2, between 240 and 270 m a.s.l., consisting of agricultural areas, forests, mainly small settlements and various waterbodies. The climate is continental, with about 1000 mm of precipitation, concentrated mainly in spring and autumn (Furlan 1990). The area belongs to the sub-Pannonic phytogeographical area (Marinèek 1987).

The most important waterbodies for breeding of the Great Crested Grebe are Raèe ponds, reservoirs Požeg and Medvedce, gravel pit Hoèe, clay pits Pragersko and Gaj. Raèe ponds and reservoir Požeg are parts of the Landscape Park Raèki ribniki - Požeg. Raèe ponds (fishponds complex) consist of three ponds,

cover 33 ha and are managed for semi-intensive fish-farming. The emergent vegetation consists mainly of Typha angustifolia and runs mostly along the northern shore of Veliki ribnik. The other dominant plant species are *Nymphoides peltata*, *Polygonum amphibium* and *Trapa natans*. Reservoir Požeg covers 35 ha and includes 3 islands. The western part of the shoreline is overgrown with *Typha angustifolia*, *Phragmites australis*, *Juncus* spp. and *Carex* spp. Reservoir Medvedce is the biggest waterbody on the Dravsko polje and covers 155 ha. It was filled with water in 1993 (Vogrin 1996, Vogrin & Vogrin 1999). Most of the shoreline is covered by a narrow belt of *Carex* spp. and *Juncus* spp. Inside of the reservoir there was also a lot of dead trees and bushes. Gravel pit Hoèe, clay pits Pragersko and Gaj are the deepest waterbodies on Dravsko polje, with depths between 4 and 10 m. Water vegetation is absent on these localities.

Raèe ponds, reservoirs Medvedce and Požeg are managed for semi-intensive fish-farming. Gravel pit Hoèe, clay pits Pragersko and Gaj are used for a variety of recreational activities, e.g. recreational fishing, windsurfing, swimming.

3. Methods

This paper is based on studies of numbers, breeding, distribution and breeding biology of the Great Crested Grebe, in the period between 1986 and 1997 (except years 1988-1989 and 1994). In order to detect pairs and breeding attempts, waterbodies on Dravsko polje were monitored from May to September. During this period all waterbodies suitable for breeding of Great Crested Grebes were visited at 5-15 day intervals. Breeding was considered to have taken place if nests, incubating birds, eggs or youngs were detected.

Searching for nests was performed only on Raèe ponds and was carried out 2-5 times in a breeding season (May-July). Attempts were made to find all nests, by carrying out a systematic search of the vegetation throughout the ponds (see also Vogrin 1999).

Nests were measured to the nearest 0.5 cm. Lower nest diameter was measured at the water level and the water depth was measured near the nest.

Data (nest measurements) were log-transformed to normalise their distribution for parametric analyses (Pearson's correlation). Kruskall-Wallis test was performed on non-transformed data. Statistical analyses were carried out using the SPSS statistical package and according to Sokal & Rohlf (1995).

4. Results and discussion

4.1. Breeding densities

Breeding population of the Great Crested Grebe on Dravsko polje is increasing (Fig.

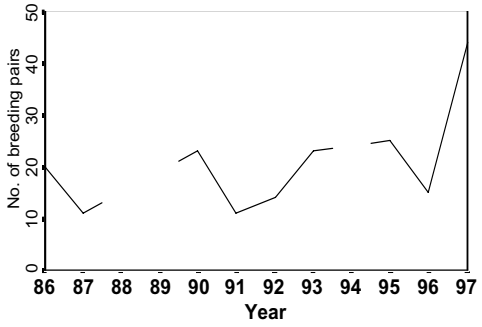

Fig. 1. The number of breeding pairs of the Great Crested Grebe on the Dravsko polje, NE Slovenia between 1986-1997.

1). According to data from Geister (1995) and taking into account that increase in breeding density occurs elsewhere, about 15% of Slovenian population of the Great Crested Grebe breeds on Dravsko polje.

An increase of breeding populations of the Great Crested Grebe was found elsewhere (e.g. Cramp & Simmons 1977, Sarrocco 1986, Walravens *et al*. 1990, Dvorak *et al*. 1993, Fjeldsa & Lammi 1997), however in some areas, the number of breeding pairs decreased (Musil 1995). The main reason of their increase is prohibition of hunting, eutrophication of water and creations of new waterbodies (Cramp & Simmons 1977, Goc 1986).

The number of breeding pairs fluctuates from year to year (Fig. 1). The same pattern was found also by Stanevièius (1994) on Lithuanian lakes. Since in all years the fish stock in all waterbodies were about the same, food supply could not be the reason for such fluctuations. The main reasons, at least in my study area, are probably cutting of vegetation, increasing of recreational activities and empty ponds during breeding seasons. Moreover, on Raèe ponds breeding sometimes being delayed by unfavourable environmental conditions, mainly by the absence of water.

The highest densities I found during the study were 6.6 pairs/10 ha in 1987 on clay pit Gaj and 7 pairs/10 ha in 1997 on the Veliki ribnik - Raèe ponds. These breeding densities approached values reported by £awniczak (1982), Cempulik (1985), Jermaczek and Jermaczek (1987), Kupczyk (1987), Dvorak *et al*. (1993), Mackowicz and Krajewski (1993), Trnka (1995), Witkowski *et al*. (1995).

The smallest water body where the Great Crested Grebe breed measured 4 ha

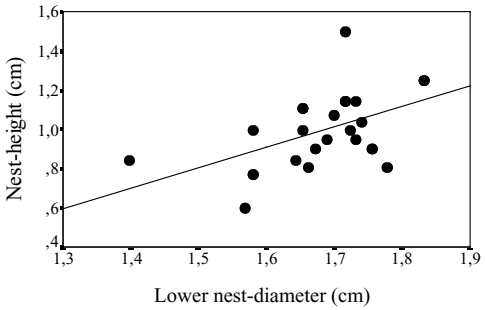

Fig. 2. The relationship between the lower nest-diameter and the nest-height in the Great Crested Grebe *Podiceps cristatus* on the Dravsko polje (logarithmic value).

(gravel pit). According to data from literature (Cramp & Simmons 1997, Fuchs 1978), the Great Crested Grebe could breed also on a water surface measured about 1 ha.

Breeding density varied greatly among localities. I compared three localities, where the Great Crested Grebe breeds regularly. Differences among localities were highly significant (Kruskal-Wallis test, Chi-square=9.42, df=2, P<0.001).

Breeding density of the Great Crested Grebe on Dravsko polje was not dependent on the size of the area (r=0.67, P>0.05, n=7), that is in contradiction with the results of Goc (1986). Such differences can be hardly explained, however the small sample size could be one of the reasons. The other reason could be the presence of people (fishermen) at smaller waters, which could affect the breeding densities of waterbirds (Bossert 1992, Keller 1992a, Ingold *et al*. 1992).

In 1995 and in 1997 I found that some pairs did not breed on Raèe ponds. Those specimens were probably young birds, mainly males (Cramp & Simmons 1977). Compared with data obtained in Northern and in Central Europe (e.g. £awniczak

1982, Goc 1986, Moskal & Marsa³ek 1986, Stanevièius 1994, and references therein) colonial nesting was very rare and occured only once (Vogrin 1989).

4.2. Nest - measurements

During the investigation 32 nests were measured (Tab. 1). The water depth near the nests was similar to those in Poland ponds (£awniczak 1982). The correlation between the log-transformed data of lower nest-diameter and nest-height was significant ($r=0.51$, $P<0.05$, $n=25$; Fig. 2), whereas correlation between the upper diameter and nest-height was not significant ($r=-0.14$, $P>0.05$, $n=25$). Since nest-height is important to prevent egg losses (Keller 1992a), lower nest-diameter must be broader to secure safety building. Compared with data from Switzerland (Keller 1992b) nests of the Great Crested Grebe are broader and higher in my study area.

4.3. Inter-specific relationship

It is well known that Great Crested Grebes tend to nest in the neighbourhood of Coots (*Fulica atra*), mainly to increase antipredator protection (see Goc 1986, Stanevièius 1994 and references therein). According to this hypothesis, I tested the relationship between the densities of species. The correlation coefficient was positive but not significant ($r=0.36$, $P>0.05$, $n=8$). However, it would be much better to compare breeding success of Great Crested Grebes near and away from Coot nests (see for example Goc 1986). On the other hand, we must also take into account the predation by Coots on grebe eggs (Goc 1986).

Tab. 1. Size of the nest and water-depth in cm at the nest of the Great Crested Grebe *Podiceps cristatus* on the Dravsko polje.

	Lower diameter	Upper diameter	Nest-height	Water-depth
Mean	47.5	26.5	11.5	50.0
SD	9.2	4.8	5.8	7.8
Min.	25.0	17.0	4.0	38.0
Max.	68.0	32.0	32.0	61.0
N	32	27	26	29

I also compared the relationship between densities of the Great Crested Grebe and the Little Grebe (*Tachybaptus ruficollis*). Both species are syntopic on most of waterbodies on the study area. After Cramp & Simmons (1977), Glutz von Blotzheim et al. (1987) the Little Grebe is a zoophagous bird, it feeds mainly on insects and larvae, crustaceans, amphibian larvae and small fish, whereas the Great Crested Grebe is mainly ihtiophagous. We can assume competition between the two species both for food and for nest sites. Surprisingly, the relationship between both grebes are even positive but not significant ($r=0.62$, $P>0.05$, $n=8$). As already Newton (1998) pointed out, it seems that similar species responds in similar way to the same environmental factors.

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Összefoglalás

A búbos vöcsök *Podiceps cristatus* költésökológiája ÉK Szlovéniában

Az ÉK Szlovéniai Dravsko síkságon (210 km^2) egyes években 44 pár búbos vöcsök fészkelt, elsõsorban a Raèki ribniki-Požeg Tájvédelmi Parkban, ami a szlovén állomány mintegy 15%-t teszi ki. A legnagyobb sûrûség 7 költõ pár/10 ha volt. Az egyes területeken a költõ párok denzitása eltérõ volt. A fészek magassága és alsó átmérõje között szignifikáns korreláció volt, a fészek magassága és felsõ átmérõje között viszont nem. A kisvöcsök (*Tachybaptus ruficollis*) és búbos vöcsök költõ párjainak a száma között nem szignifikáns, pozitív korreláció volt.

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