

Can poor foraging habitat (an inundated opencast sulphur mine) be attractive to the great crested grebe (*Podiceps cristatus*)?

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**Abstract**

During investigations of an inundated opencast sulphur mine (an open, deep water habitat with a relatively small littoral area) only five species of breeding water birds were recorded. The density of breeding great crested grebes *Podiceps cristatus* was relatively high (c. 1.0-1.1 pairs 10 ha<sup>-1</sup> of water, and 1.6-1.8 pairs ha<sup>-1</sup> of the macrophyte area) although fish density was very low. High water transparency probably compensated for low prey density, because potential prey could be readily detected. Most of the fish were small and occurred in the upper layers of the water column (they could not live below 10 m where the water was anoxic), so were readily available and easily caught by the grebes.

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## INTRODUCTION

Habitat features and food availability are fundamental factors affecting the occurrence of aquatic macro-fauna. Water birds choose habitats with good food availability, this being particularly important during the breeding season. In grebes, the primary factor determining habitat selection has been shown to be food supply (Ulfvens 1988), although availability of breeding sites is also important.

The structures and densities of water bird communities have been widely studied in different man-made environments in Central Europe (ponds, dam reservoirs, gravel pits, etc.), particularly with reference to water chemistry. Large and deep anthropogenic water bodies have been formed in inundated regions where open cast mine activity has terminated, although waterbirds in these environments have not often been studied (Horstman et al. 1998). The establishment of an inundated opencast sulphur mine raised the possibility of determining the numbers of breeding birds in relation to specific features of this environment.

## MATERIALS AND METHODS

Piaseczno reservoir, located near Tarnobrzeg (South-East Poland) was formed after exploitation of sulphur from the site had ceased. The total area of the reservoir is ca. 63 ha and it has a maximum depth of ca. 21 m. The reservoir is meromictic and oligotrophic with a relatively shallow littoral zone (to 2 m depth) extending over an area of 9.3 ha. Most of the shoreline is steep and covered by flooded willows and shore vegetation of shrubs and trees. Submerged macrophytes (*Phragmites* and *Typha* sp.) are restricted to certain parts of the reservoir, existing in an area that in total comprises about 3.8 ha. The length of shoreline with macrophytes present is ca. 2 km. There are three small islands in the northern part of the reservoir.

Bird counts and observations for the whole reservoir were carried out from the shore in 2000-2001, using 10×50 binoculars and a 40×60 telescope. Observations were made on a total of twelve days during the breeding period and post-breeding. The breeding population was determined by the number of territorial pairs or occupied nests.

## RESULTS AND DISCUSSION

Only five water bird species were observed breeding at the inundated opencast sulphur mine in the Piaseczno during the study. The species and numbers of breeding birds observed in 2000 and 2001 were: great crested grebe

(*Podiceps cristatus*) (6 and 7 pairs respectively), mallard (*Anas platyrhynchos*) (1-2 pairs), coot (*Fulica atra*) (1 pair), kingfisher (*Alcedo atthis*) (1 pair), and marsh-harrier (*Circus aeruginosus*) (1-2 pairs). With the exception of the great crested grebe the observed number of breeding species was small. The great crested grebe is frequently a dominant breeding species of gravel pits in Slovakia (Kalivodová and Feriancová-Masárová 1998), although it comprising more than 10% in water bird communities was recorded in only 4 of 14 gravel pits in Slovakia (Kalivodová and Feriancová-Masárová 1998). Piaseczno reservoir does not seem to provide good habitats or food source for water bird species. The area of the littoral zone and that covered by macrophytes is not large. Organic matter in the sediments is very low and, typical for oligotrophic lakes, it has low primary production (Szarek-Gwiazda et al. 2006). Benthic communities are very poor and mussels were not found at all (Dumnicka and Galas 2006).

The density of great crested grebes reached 1.0-1.1 pairs 10 ha<sup>-1</sup> of water or 1.6-1.8 pairs ha<sup>-1</sup> of the area covered by macrophytes in both studied seasons. The breeding was successful for this species. The mean number of observed fledglings in July was 0.8 young pair<sup>-1</sup> (SD=1.33, N=6) in 2000 and 2.9 young pair<sup>-1</sup> (SD=1.07, N=7) in 2001. Occurrences of 1.5-3.0 pairs 10 ha<sup>-1</sup> have been recorded in many large lakes in Europe (Hagemeijer and Blair 1997), while populations densities have been observed to be lower (generally below 0.7 pair 10 ha<sup>-1</sup>) in 14 of 22 artificial water bodies (fish ponds and gravel pits) studied in southern Poland (Skórka and Wójcik 2000, Wiehle et al. 2002), despite apparently much better breeding habitats and food conditions there compared to Piaseczno reservoir.

The high number of breeding great-crested grebes at Piaseczno reservoir cannot be explained by a high density of fish prey for this species, because fish density and biomass were very low. Hydroacoustic surveys in Piaseczno reservoir have shown very scarce fish populations in the pelagic waters (280 fish ha<sup>-1</sup> in spring and 530 fish ha<sup>-1</sup> in autumn) (Godlewska and Jelonek 2006). The ichthyofauna consisted of only 7 common species, dominated by roach (*Rutilus rutilus*) (Amirowicz unpubl. data). Small fish (less than 10 cm in length) dominate in Piaseczno reservoir (Godlewska and Jelonek 2006), these being easily caught and handled by the grebes, which are able to catch fish 3-21 cm long (Cramp and Simmons 1977).

Light penetrates to 8-10 m in Piaseczno reservoir (Żurek 2006). Median transparency of the water, during the period without ice cover, was relatively high and calculated to be 3.5 m. It is known that the detection volume of diving birds is a hemisphere with a radius determined by the water transparency (Eriksson 1985). When transparency is high, potential prey can be detected from much greater distances than in poor visibility. The fact that this inundated

opencast sulphur mine is deep and has low turbidity probably accounts for it resembling Fennoscandinavian, deep lakes in which the great crested grebe is the most numerous water bird (Hagemeyer and Blair 1997). In Piaseczno reservoir the great crested grebes, whilst hunting, usually put their heads into the water, with their eyes below the surface, to detect their prey before diving. The same behaviour was observed for the black-throated diver *Gavia arctica* in Piaseczno reservoir in the autumn. This indicates that the high water transparency helps them in catching their prey. Hanzák (1952) wrote that great crested grebes behave like this only in windy weather, but low density of fish may also be a reason for such behaviour. The low density of fish cannot be compensated by increasing transparency for “surface plungers”, such as gulls or terns, which search for fish from above. Common terns (*Sterna hirundo*) and gulls (*Larus ridibundus*, *Larus canus*, *Larus argentatus/cachinnans*) did not breed at the Piaseczno reservoir during the course of this study, but visited for foraging or resting. The maximum number during one count was 3 individuals for terns and 96 for gulls.

The relatively high density of great crested grebes breeding in this inundated opencast sulphur mine might also be explained by another factor. The hypolimnion of Piaseczno reservoir contains H<sub>2</sub>S and the monimolimnion is saline and also contains H<sub>2</sub>S (Żurek 2006). The upper oxygenated layer is thick, but below it the water is anoxic (Żurek 2006), and hence fish inhabit the water layer above 10 m. This availability of fish in the surface waters makes them a more accessible food source for birds. The environmental factors that cause low densities of fish in Piaseczno reservoir are hence offset to some extent by their visibility and restricted movements within the water column.

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