DOI: 10.17242/MVvK_3.21

HABITAT SELECTION BY WATERFOWL BROODS ON INTENSIVELY MANAGED FISHPONDS IN SOUTH BOHEMIA (CZECH REPUBLIC)

Petr Musil[1], Radka Pichlová[2], Petr Veselý[3] and Jaroslav Cepák[3]

[1] Institute of Applied Ecology, Czech Agricultural University, Kostelec nad Černými lesy, CZ-281 63, Czech Republic
[2] Institute of Botany, Section of Plant Ecology, Academy of Sciences of Czech Republic, Dukelská 145, Třeboň, CZ-379 82, Czech Republic
[3] Department of Zoology, Charles University, Viničná 7, Praha 2, CZ-128 44, Czech Republic

ABSTRACT

The number of occurring waterfowl broods on fishponds in the Třeboň region (South Bohemia, Czech Republic) occurring was recorded in 1992-94. Among 1165 broods of 13 species, Gadwall was the most common. Preference of fishponds with higher water transparency was found in diving ducks which were negatively associated with the age of dominant fish cohort. On the contrary, a positive dependence on age of stocked fish was recorded in Great Crested Grebe broods. The occurrence of Mallard broods was dependent on water surface area and Coot broods prefer relatively isolated fishponds with well developed littoral vegetation.

INTRODUCTION

The breeding numbers of the most abundant duck species and some other waterfowl, which showed increasing trend for several decades, began to decline abruptly in many fishpond regions in the Czech Republic in the early 1980s (see e.g. Musil and Fuchs, 1994, Musil and Šálek, 1994). An increase in fish stock size during the 1970s and early 1980s (Pokorný *et. al.*, 1992) was also considered as a possible hypothesis explaining this phenomenon (Pykal and Janda, 1994).

The negative effect of high fish stocks on waterfowl abundance as well as on their reproduction output was described by Giles (1991, 1994) and Phillips and Wright (1993). The abundance and survival of ducklings seems to be more affected by trophic status of a water body,

rather than that of adult ducks, esp. due to specific food requirements and lower moving ability of the former (Cramp, 1980, Owen and Black, 1990). Intensively managed fishponds provide a suitable model for investigation of fish-waterfowl relationships as well as for general investigations of waterfowl-habitat relationships, which could be used for finding key factors affecting water bird abundance. Therefore we started investigation of habitat selection by waterfowl brood on various types of fishponds in the Třeboň region differing in numerous parametres, including management practices.

STUDY AREA

Fishponds currently existing in the Třeboň region as well as in other parts of Bohemia and Moravia have been created in suitable places since the Middle Ages.

Table 1. Summary characteristics of fishponds under study

fishpond characteristic	range	average	±	st.dev.
water surface area (ha)	0.33 - 149.00	17.72	±	24.31
littoral stands area (ha)	0.11 - 31.28	3.40	±	4.14
littoral stands proportion (%) 1)	1.91 - 63.60	20.22	±	12.96
length of shoreline (km)	0.23 - 7.57	17.36	±	13.11
shoreline development ratio 2)	1.02 - 1.98	1.30	±	0.24
mean water depth (m)	0.20 - 2.50	0.72	±	0.29
proportion open landscape (%)	0.00 - 95.00	15.11	±	23.03
pond isolation index (m) 3)	42.00 - 750.00	247.55	±	189.13
water transparency (m)	0.04 - 1.50	0.40	±	0.30
small zooplankton: length < 0.5 mm (%)	0.00 - 100.00	59.25	±	27.61
middle zooplankton: length 0.5 - 2.0 mm (%)	1.00 - 93.00	31.28	±	20.92
large zooplankton: length > 2.0 mm (%)	0.00 - 95.00	9.64	±	16.60
mean zooplankton length (mm)	0.25 - 2.81	0.64	±	0.40
age of dominant fish cohort (year)	0 - 3	1.45	±	0.94
fish stock abundance (1000)	0.10 - 5787.23	268.29	±	718.96
mean fish body weight (kg)	0.01 - 1.75	0.38	±	0.42
fish stock density (kg/ha)	0.91 - 23607.00	1908.11	±	3106.71

1) littoral stands proportion ... ratio littoral stands area to total area of fishponds

2) Shoreline development ratio ... ratio of the length of the shoreline to the length of the circumference of a circle with water surface equal to that of the lake

3) Pond isolation index ...mean distance from the four nearest neighbouring fishponds

Recently, investigated fishponds represent shallow eutrophic or hypertrophic water bodies with well developed littoral vegetation (see **Table 1** for summary characteristics). Fishponds are surrounded by the mosaic of woods, fields, meadows and villages (Husák and Hejný, 1978, Pokorný *et. al.*, 1994).

METHODS

In total, 314 checks of 64 studied fishponds were carried out in the Třeboň region in 1992 (4 checks of 10 ponds), 1993 (2 checks of 41 ponds) and 1994 (3 checks of 64 ponds). Broods were counted in early morning and late evening. Water transparency (Secchi depth) was measured at each count.

Data were analyzed using Canonical Correspondence Analysis (CCA, program Canoco 3.1, Ter Braak, 1988). The set of variables that explained the species data as sufficiently as the full set was chosen using forward variable selection.

RESULTS

In total, 1165 broods of 13 species were recorded in the study area. Only 1127 broods of 8 most common waterfowl species (i.e. Little Grebe *Tachybaptus ruficollis*, Great Crested Grebe *Podiceps cristatus*, Mallard *Anas platyrhynchos*, Gadwall *Anas strepera*, Pochard *Aythya ferina*, Tufted Duck *Aythya fuligula*, Goldeneye *Bucephala clangula*, Coot *Fulica atra*) were included in further analysis. The highest number of occurring broods as well as the highest brood size were found in Gadwall (**Table 2**).

Seven variables (water surface area, littoral stands proportion, proportion open landscape in the fishpond surroundings, pond isolation index, water transparency, age of the dominant fish cohort, fish stock abundance) were found as the set of variables that best explain the species data. The first ordination axis ($lambda_1$=0.121) was positively correlated with fish stock abundance (r=0.357) and water transparency (r=0.31) and negatively with dominant fish cohort stocked in fishpond (r=-0.304). The second ordination axis ($lambda_2$=0.077) was positively correlated with the proportion of open landscape in the pond surroundings (r=0.35) and negatively with water surface

area (r=-0.284). The first axis accounted for 42.4% of variance in data set was highly significant (Monte Carlo test, $P < 0.01$). Cumulative percentage variance accounted for by the first two axes of species-environmental biplot was 69.5 %.

Table 2. Number of broods and mean brood size of investigated species

Species	Total number of broods	broods per pond mean ± st.dev. (n)		brood size mean ± st.dev. (n)
Tachybaptus ruficollis	13	0.03 ± 0.19	(8)	2.50 ± 1.35
Podiceps cristatus	79	0.25 ± 0.96	(30)	1.95 ± 1.32
Anas platyrhynchos	.109	0.32 ± 0.85	(62)	6.67 ± 4.13
Anas strepera	242	0.70 ± 2.07	(81)	7.30 ± 3.26
Aythya ferina	202	0.62 ± 2.89	(61)	4.92 ± 2.50
Aythya fuligula	150	0.45 ± 1.68	(56)	5.51 ± 3.20
Bucephala clangula	32	0.09 ± 0.51	(15)	4.31 ± 2.60
Fulica atra	300	0.82 ± 2.20	(86)	3.26 ± 1.71

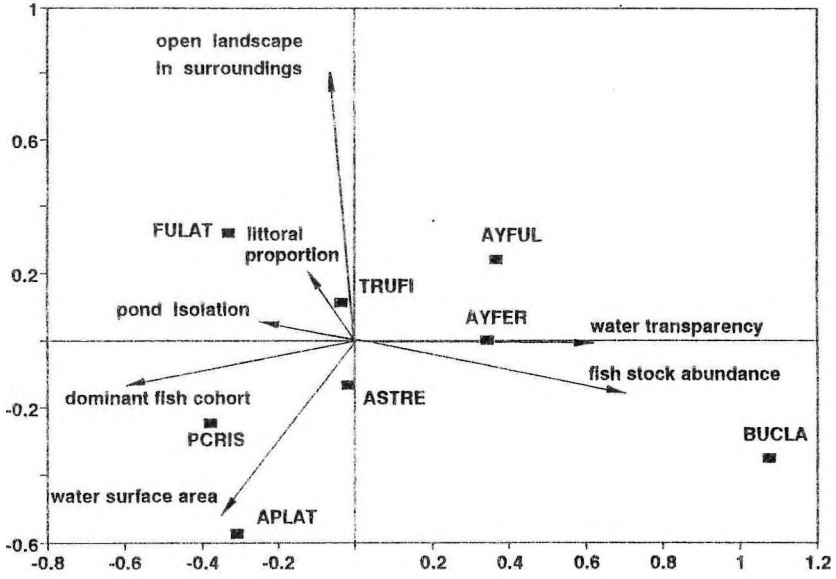

Figure 1: Ordination diagram (CCA) referring to the analysis species-environmental relationships. Species codes: APLAT - *Anas platyrhynchos*, ASTRE - *Anas strepera*, AYFER - *Aythya ferina*, AYFUL - *Aythya fuligula*, BUCLA - *Bucephala clangula*, FULAT - *Fulica atra*, PCRIS - *Podiceps cristatus*, TRUFI - *Tachybaptus ruficollis*.

The number of diving duck broods (Goldeneye, Tufted Duck and Pochard) broods was associated with water transparency. On the other hand, dabbling duck broods do not prefer fishponds with higher water transparency and seem to be more dependent on topical characteristics of fishponds (water surface area - esp. Mallard). Coot broods prefer relatively isolated fishponds with well developed littoral vegetation. Broods of Great Crested Grebe, the only piscevorous species under study, was positively associated with the age of dominant fish cohort. The occurrence of broods of remaining two species (Gadwall and Little Grebe) was not remarkable dependent on any of the investigated environmental variables (see **Figure 1**).

DISCUSSION

The strong positive correlation between the occurrence of diving duck (Goldeneye, Tufted Duck and Pochard) broods and water transparency and fish stock abundance is a consequence of specific trophic conditions of intensively managed fishponds in the Třeboň region. Water transparency can be used as an indicator of the trophic level of water body as well as a physical parameter describing the food availability. Food availability (Gardarsson and Einarsson, 1994) and fish stock (Giles 1991, 1994) appear to be important factors affecting the occurrence and survival of young diving ducks. In Southbohemian fishponds (i.e. hypertrophic water bodies), the competition between fish and waterfowl was recorded only in adult ducks during postbreeding period (Pykal and Janda, 1994, Pykal, this issue).

The results presented in this paper show that the relationship between trophic condition and ducklings occurrence is closer in diving ducks (Goldeneye, Tufted Duck and Pochard) than in dabbling ducks (Gadwall, Mallard). These differences in habitat selection of two duck groups could be causes of different trends in breeding population numbers in Třeboň region. Numbers of diving ducks have been decreasing since the end of the 1970s (e.g. Musil and Fuchs, 1994), whereas the numbers of both dabbling ducks seem to be stable or increasing after 1985. Nevertheless, the negative effect of adult fish density on occurrence of broods also reported by in Mallard from gravel pit lakes in England (Phillips and Wright, 1993). Occurrence of broods of Great Crested Grebe (*Podiceps cristatus*) depends mostly on prey (i.e. fish) availability as well as on water body surface area. These relationships correspond also with studies from another part of the breeding range

(Ulenaers *et. al.*, 1992) and with the study on habitat selection of other piscevorous species on fishponds in investigated area (Musil *et. al.*, 1995).

ACKNOWLEDGEMENT

Our thanks are due to Petr Pyšek for comments on the manuscripts and for improving our English. We thanks Třeboň Fishery co. for providing data on fish stocks. Our thanks are also due to Jan Pokorný, director of *Section of Plant Ecology* of *Institute of Botany* for supporting our field work. The research was supported by grant of the Grant Agency of the Czech Republic (no 204/94/0800) and by grant of the Ministry of Environment of the Czech Republic.

REFERENCES

Cramp, S. and K.E.L. Simmons. (1977). Handbook of the birds of Europe, the Middle East and North Africa. Oxford Univ. Press. 722 pp.

Fott, J., L. Pechar and M. Pražáková. (1980). Fish as a factor controling water quality in ponds. p. 255-261. In: J. Barica and L. R. Mur (eds), Dev. Hydrobiol. 2. 358 pp.

Giles, N. (1991). Fish-removal from lakes increses food for waterfowl. p. 80-86. *In:* C.M. Finlayson and T. Larsson (eds), Proc. International Workshop on Wetland Management and Restoration, Sweden 1990, Swedish Environmental Protection Agency Rep. 182 pp.

Giles, N. (1994). Tufted Duck (*Aythya fuligula*) habitat use und brood survival increases after fish removal from gravel pit lakes. *In*: J. Kerekes and B. Pollard (eds.), Aquatic Birds in the Trophic Web of Lakes. (Dev. Hydrobiol. 96. 524 p.) Hydrobiol. 279/280: 587-592.

Husák, Š. and S. Hejný. (1978). General Characteristics of the Třeboň Basin and Lednice Region. p. 13-22. *In:* D. Dykyjová and J. Kvít (eds). Pond Littoral Ecosystems. Ecological Studies 28. Springer-Verlag, Berlin , Heidelberg, New York. 464 pp.

Kořínek, V., J. Fott, J. Fuksa, J. Lellák and M. Pražáková. (1987). Carp ponds of Central Europe. p. 29-62. *In:* Michael R. G. (ed.), Managed Aquatic Ecosystems, Ecosystems of the World 29, Elsevier. 196 pp.

Musil, P. and Fuchs R. (1994): Changes in abundance of water birds species in southern Bohemia (Czech Republic) in the last 10 years. *In*: J. Kerekes and B. Pollard (eds.), Aquatic Birds in the Trophic Web of Lakes. (Dev. Hydrobiol. 96. 524 p.) Hydrobiol. 279/280: 511-519.

Musil, P., Janda J. and de Nie W. (1995): Changes in abundance and foraging habitat selection in Cormorant (*Phalacrocorax carbo*) in the south Bohemia. Ardea 83 (in press).

Musil, P. and Šálek M. (1994): Changes in abundance of water and wetland birds in South Bohemia during the last decade: summary review. p. 55-60. *In:* Aubrecht, G., G. Dick & C. Prentice (eds). Monitoring of Ecological Change in Wetlands of Middle Europe. Proc. International Workshop, Linz, Austria, 1993. Stapfia 31, Linz, Austria, and IWRB Publ. No. 30, Slimbridge, UK. 224 pp.

Owen, M. and J.M. Black. (1990). Waterfowl ecology. Chapman & Hall, New Yorh. 194 pp.

Phillips, V.E. and R.M. Wright. (1993). The differences in behaviour and feeding success of tame Mallard *Anas platyrhynchos* in the presence of high and low fish populations aat a gravel pit site, with reference to wild brood distribution. Wildfowl 44: 69-74.

Pokorný, J., L. Pechar, J. Koutníková, V. Dufková, G. Schlott and K. Schlott. (1992). The effects on the aquatic environment of fish pond management practices. p. 50-55. *In:* M. Finlayson (ed.) Integrated manag. and conserv. of wetlands in agricult. and forested landscapes. 104 pp.

Pokorný, J., *et. al.* (1994). Monitoring of changes in fishpond ecosystems. p. 37-45. *In:* Aubrecht, G., G. Dick & C. Prentice (eds) 1994: Monitoring of Ecological Change in Wetlands of Middle Europe. Proc. International Workshop, Linz, Austria, 1993. Stapfia 31, Linz, Austria, and IWRB Publ. No. 30, Slimbridge, UK. 224 pp.

Pykal, J. and J. Janda. (1994). Relation between waterfowl numbers on South Bohemian fishponds and fishpond management. Sylvia 30: 3-11.

Pykal, J. (1997): Habitat selection by waterfowl broods on intensively managed fishponds in South Bohemia (Czech Republic). (in this volume)

Ter Braak, C.J.F. (1988). CANOCO-a FORTRAN program for cannonical community ordination by partial detrended canonical correspondence analysis, principal component analysis ans redundancy analysis. Wageningen. 96 pp.

Ulenaers, P.J., J. van Vessem and A.A. Dhondt. (1992). Foraging of the Great Crested Grebe in relation to food supply. J. Anim. Ecol. 61: 659-667.