

Control of Eurasian Watermilfoil in NNR Břehyňský Fishpond near Doksy, Czech Republic

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INTRODUCTION

The National Nature Reserve (NNR) and Czech Ramsar site, Břehyňský fishpond near Doksy, N. Bohemia, Czech Republic, belongs to the most important wetlands in the Czech Republic and has a great botanical and ornithological value (Hudec et al. 1993). Unlike most Czech fishponds, its inflowing waters, forest canals and springs from needle-leaved wetland forests, are unaffected by agriculture. This mesotrophic pond has always been used for extensive fish production and has never been fertilized though many metric tons of milled limestone were applied in the 1970's and 1980's to increase total alkalinity (TA) of originally soft dystrophic water. In the 1980's, species-rich communities of aquatic macrophytes (incl. critically endangered *Najas minor* (L.) All. and *N. marina* L.) occurred in the fishpond with water transparency to the bottom. As a result of fishpond liming and increases in TA, internal eutrophication took place in the first half of the 1990's, which was accompanied by an excessive development of Eurasian watermilfoil (*Myriophyllum spicatum* L.). In the second half of the 1990's, the situation became critical with over 70% of the fishpond area overgrown by medium to very dense stands of Eurasian watermilfoil as a result of which the diversity of aquatic macrophytes declined markedly. In 1997, the Agency for Nature and Landscape Conservation of the Czech Republic proposed control measures to reduce the excessive watermilfoil stands using grass carp (*Ctenopharyngodon idella* Val.) and fishpond drawdown. The results of these measures are described in this note.

MATERIALS AND METHODS

The NNR, Břehyňský fishpond (50°35'N, 14°42'E; 275 m a.s.l.) has a cadastral area of 92 ha and an open water area of ca. 60 ha. Its maximum depth is 2.1 m but the prevailing depth is between 1.0 and 1.7 m. Fine-structured organic sediment of black color is 30 to 60 cm deep. In the 1997 summer season, almost all open area within the water depth of 1.1 to 1.7 m was overgrown by watermilfoil. A linear transect across the fishpond was marked at 60-m intervals using wooden rods in 1997. The marks Nos. 1, 3, and 4 on the transect corresponded to distances from the shore of 60, 180, and 240 m, respectively, and dense watermilfoil stands occurred there in summer 1997 (Table 1). The 1997 season was used as control, preceding the introduction of grass carp. In February 1998, a metallic wire enclosure (20 × 15 m; mesh size 5 cm) was established in a very dense watermilfoil stand, ca. 50 m from the mark No. 1. Its purpose was to protect the enclosed watermilfoil stand from grazing by grass carp. In April 1998, 5.3 metric tons of 3-year-old, 30 to 40-cm-long grass carp were introduced to the fishpond to control watermilfoil. Thus, the initial fish density was about 150 fishes ha⁻¹ or 90 kg ha⁻¹. The control effect of grass carps was investigated for two seasons. The fishpond was completely fished out and drained in mid-October 1999 and was refilled at the end of February 2000. The biomass density of watermilfoil stands was estimated twice in each of the 1997-2000 seasons during the last of June and the first of August. Sampling was done with a simple rotary-scythe sampler (Howard-Williams and Longman 1976) at marks of the transect, in the wire enclosure, and ca. 1 m from the enclosure. A small boat was used for sampling biomass. Two parallel samples (each from 0.1 m²) of watermilfoil were collected randomly at the transect marks, while usually three parallel samples were taken both inside and outside the wire enclosure. In the 2000 season after the

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TABLE 1. MEAN EURASIAN WATERMILFOIL BIOMASS ($G M^{-2} \pm 1 SE$ WHEN APPLICABLE) BEFORE, DURING GRASS CARP STOCKING, AND FOLLOWING DRAWDOWN IN BŘEHYŇSKÝ FISHPOND, CZECH REPUBLIC.

Sampling place	Dry weight	
	19-27 Jun	28 Jul-9 Aug
1997—before grass carp introduction		
1	108	762
3	292	640
4	325	357
1998—1st season of grass carp introduction		
1	1080	1010
3	1060	646
4	611	1120
IN ^a	1870 \pm 120	1530 \pm 294
OUT ^b	1780	1680 \pm 195
1999—2nd season of grass carp introduction		
1	364	417
3	380	472
4	343	508
IN ^a	723 \pm 63	1110 \pm 189
OUT ^b	614 \pm 173	657 \pm 189
2000—season after drawdown without grass carp		
1	0.00 \pm 0.00	0.00 \pm 0.00
3	0.00 \pm 0.00	0.00 \pm 0.00
4	0.94 (7.1)	2.27 (2.33)
IN ^a	0.90 (4.8)	0.27 (1.1)
OUT ^b	0.02 (0.12)	—

^aInside the wire enclosure.

^bOutside the wire enclosure.

^cMaximum values are shown in parentheses for 2000.

drawdown, with the watermilfoil stands having markedly declined, 6 to 10 parallels were sampled at each sampling place. Dry weight of the samples were determined after drying at 80°C. Mean values and SE intervals are shown when possible, but maximum values are shown for the 2000 season instead as that year's data have a non-normal distribution.

RESULTS AND DISCUSSION

In the 1997 to 1999 seasons, mean DW of ca. 400 to 1300 g m⁻² (maxima ca. 2000 g m⁻²) was estimated in dense watermilfoil stands in Břehyňský fishpond (Table 1). No evident controlling effect of grass carp on watermilfoil stand density was observed in 1998 and 1999. It follows clearly from the data that the summer density of the stands is controlled rather by other factors (water level and spring course of water temperature) than by grazing by grass carp, even when grass carp was over 60 cm long and weighed 2.7 kg, with a stocking density of at least ca. 250 kg ha⁻¹ in 1999 (cf. Zweerde 1990). Thus, the evident grazing effect of grass carp on Eurasian water-

milfoil, which was confirmed by analyses of fish stomachs both in 1998 and 1999, led to only slight damage to the stands. Grazing was counterbalanced by rapid plant regeneration. Moreover, during the 1998 and 1999 seasons, water transparency always exceeded 1.2 m. However, grass carp visually reduced valuable stands of *Nymphaea candida* Presl and *Myriophyllum verticillatum* L. in the fishpond in 1999. Thus, the use of grass carp in the NNR proved to be questionable or desired effect on Eurasian watermilfoil was not achieved and valuable macrophyte species were essentially destroyed. For these reasons, grass carp are no longer recommended for use in nature reserves.

On the other hand, the drawdown during a freezing winter period led to a crucial reduction of Eurasian watermilfoil stands (Table 1). Mean biomass density of Eurasian watermilfoil at all sampling sites following the drawdown was only 1% of the previous values, or less. Only three moderately dense stands of Eurasian watermilfoil, which together occupied less than 1 ha, were found in the fishpond in 2000. They occurred in very shallow depressions (5 to 10 cm) in which the winter stands were partly protected from freezing temperatures. In the fishpond in summer 2000, the total watermilfoil biomass reached only ca. 0.2 to 0.5% of that of the previous summer (1999). The spring decomposition of the large amount of dead biomass resulted in a decrease in water transparency to 80 to 84 cm in June 2000, which afterwards increased to 96 to 117 cm in August. In 2000, the stands of *Nymphaea candida* recovered completely, those of *M. verticillatum* started recovering, and the diversity of submerged macrophyte species increased as well (data not shown). This suggests that winter drawdown could be used as a control of Eurasian watermilfoil (Smith and Barko 1990) without harmful impact to nature reserves and repeated after a period of a few years when watermilfoil stands become dense again.

ACKNOWLEDGMENTS

The methodical help of Ms. Irena Pípalová, M.Sc., throughout this study is gratefully acknowledged. Thanks are due to Dr. Jan Květ for correction of the language. Thanks are also due to the Agency for Nature and Landscape Conservation of the Czech Republic for organizing and supporting this study.

LITERATURE CITED

- Howard-Williams, C. and T. G. Longman. 1976. A quantitative sampler for submerged aquatic macrophytes. *J. Limnol. Soc. S. Afr.* 2: 31-33.
- Hudec, K., Š. Husák, J. Janda and J. Pellantová. 1993. Survey of aquatic and wetland biotopes of the Czech Republic (summary report). Czech Ramsar Committee, Třeboň. 32 pp.
- Smith, C. S. and J. W. Barko. 1990. Ecology of Eurasian watermilfoil. *J. Aquat. Plant Manage.* 35: 55-64.
- Zweerde, W. van der. 1990. Biological control of aquatic weeds by means of phytophagous fish, pp. 201-221. *In*: A. H. Pieterse and K. J. Murphy, eds. *Aquatic weeds. The ecology and management of nuisance aquatic vegetation.* Oxford Univ. Press, Oxford.