

## A SURVEY OF INSHORE 0+ JUVENILE FISH COMMUNITY IN THE NOVÉ MLÝNY LOWLAND RESERVOIR, CZECH REPUBLIC

Pavel JURAJDA<sup>1</sup>, Martin REICHARD<sup>2</sup> and Eva HOHAUSOVÁ<sup>1</sup>

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<sup>1</sup>Institute of Landscape Ecology, Academy of Sciences of the Czech Republic, Brno

<sup>2</sup>Department of Zoology and Ecology, Faculty of Science, Masaryk University, Brno

### Abstract

A survey of 0+ juvenile fish in a newly created lowland reservoir, Nové Mlýny, Czech Republic, was conducted during the middle of July 1995. Fish were sampled by beach seine at 24 sites in three types of nearshore habitat; concrete stepped embankment, stony rip-rap and sandy-gravel beach. The most common species was asp, *Aspius aspius* (63.9%) followed by roach, *Rutilus rutilus* (21.8%) and ide, *Leuciscus idus* (9.0%). Other species represented <3% of dominance. Beach stations were significantly preferred by 0+ juvenile fish ( $p < 0.001$ ) during the daytime, with a CPUE of 31.4 specimens per 1 m net. An almost 15 times lower density of fish was registered at concrete steps and stony rip-rap embankment types, however with a more homogenous distribution of juveniles. Contrary with large rivers a single synchronic survey strategy of 0+ juvenile fish does not describe representatively natural recruitment success in large shallow reservoir.

**Key words:** 0+ juvenile fish, inshore nursery habitat, reservoir, Nové Mlýny, Czech Republic

### Introduction

Lakes with more complex habitat structure in terms of substrate, macrophytes and depth gradient may represent a more diverse habitat for fish. A complex habitat could affect the abundance and diversity of food items, spawning sites, or cover. To understand the role of spatial heterogeneity in the functioning of natural communities, it is necessary to quantify that heterogeneity and relate it to other determinants of community structure (Benson & Magnuson 1992).

Three shallow man-made lakes at Nové Mlýny in the Southeast of the Czech Republic were the subject of ichthyological interest after their creation (Lusk 1981, Libosvářský 1991). Studies of adult fish have been conducted on the fecundity, growth, diet, migration and fisheries management. The results of these studies are summarised by Prokeš & Baruš (1994) and Lusk et al. (1994). Autecological studies of juvenile fish concerned to growth (Prokeš 1985, 1993, Prokeš & Horáková 1988) or diet (Kokeš & Sukop 1984, Kokeš 1993). These studies were conducted on the upper Mušov and especially middle Věstonice Reservoir connected with their tributaries. Information about the ecology of juvenile stages are especially crucial in the lower Nové Mlýny Reservoir, which has no tributary and the shoreline is formed mostly by an artificial embankment. Although other studies have been carried out

in Nové Mlýny, none surveyed the juvenile fish community, which reflects the success of natural reproduction (Nielsen et al. 1986). Littoral juvenile fish assemblages have been intensively studied previously, especially in a deep valley reservoirs in accessible sites (Vostrádovský 1965, Černý & Pivnička 1973, Kubečka & Švátora 1993). This study is a survey of summer 0+ juvenile fish assemblages along all available types of inshore habitat in the Nové Mlýny Reservoir.

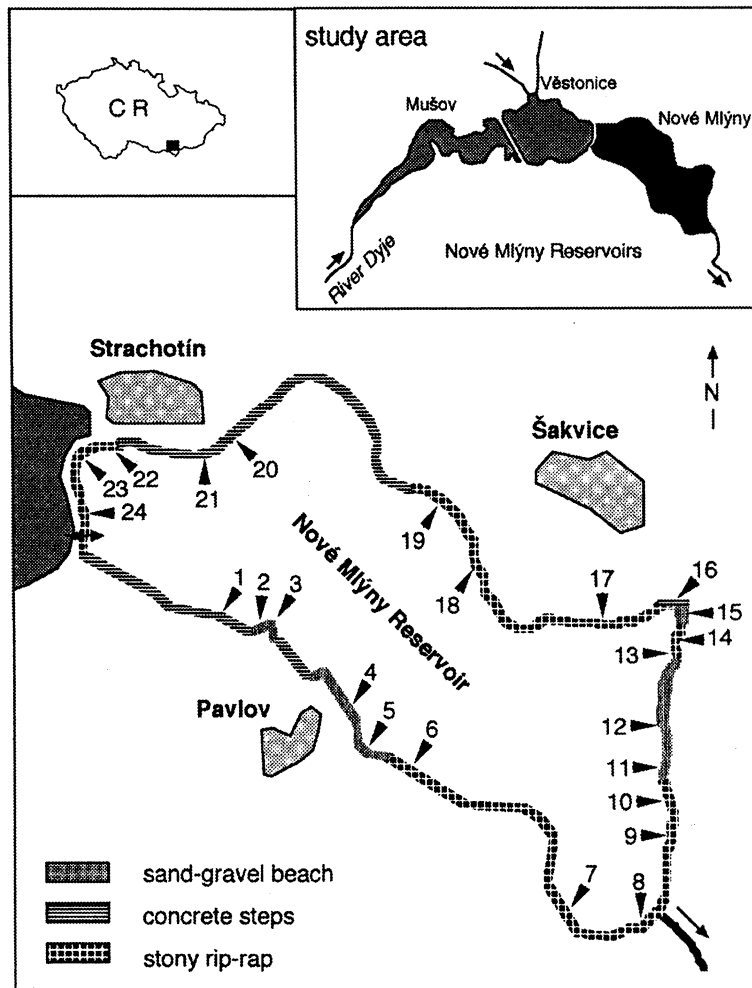
### Study Area, Material and Methods

The lowland reservoir system of Nové Mlýny (161 - 171 m above sea) was built on the River Dyje (Danube basin) in south Moravia in the Czech Republic. The reservoir system consists of three reservoirs; Mušov (528 ha), Věstonice (1 031 ha) and Nové Mlýny (1 668 ha). Nové Mlýny was the last reservoir to be created and has been operating since 1989. Nové Mlýny has a maximum volume of  $93.4 \times 10^6 \text{ m}^3$  and an average depth of 5.1 m. Unlike the two other reservoirs in the system, Nové Mlýny has no tributary, excepting an inlet from the Věstonice Reservoir (Fig. 1). Almost 95% of the shoreline of Nové Mlýny is man-made, formed by three types of shoreline: 1) 30% - concrete stepped embankment (steps of 40 cm width, 10 cm height), 2) 60% - stony rip-rap (20 - 80 cm diameter stony embankment) covered in places by a thin layer of asphalt, and 3) 10% - shallow sand-gravel beach intensively used for recreation (Fig. 1). For a detailed description of the study area see Pellantová & Franek (1994).

Juvenile fish were sampled on July 17th 1995 at 24 representative sampling sites along the reservoir shoreline. Four sites were sampled along concrete steps, 7 along sand-gravel beach and 13 along stony rip-rap (Fig. 1). Juvenile fish were sampled using a beach seine (length 7 m, depth 1 m, mesh size 0.5 mm). After capture, all juvenile fish were fixed in 4% formaldehyde. Fixed fish were identified in the laboratory, measured (standard length to nearest 0.01 mm) and weighed (wet weight to nearest 0.01 g). A chi-square test ( $\chi^2$ ) was used to compare habitat use by juveniles. Catch data are expressed as catch per unit effort (CPUE) for 1 m of beach seine. Index of dispersion (ID = variance/mean) was used for a description of juvenile distribution.

### Results

A total of 267 0+ fish were caught in 16 from 24 sampled sites. The relative frequency of fish occurrence (i.e. number of samples in each habitat type with fish) at the concrete step sites was 50%, in sandy beach sites 85% and along stony rip-rap 62%. The mean abundance of fish (CPUE) at beach sites were 31.4 inds. (SD = 43.7), concrete steps 2.0 (SD = 3.4) and stony rip-rap 2.9 (SD = 3.7), with a significant preference by juveniles for the beach sites ( $\chi^2 = 294.6$ ,  $p < 0.001$ ). The distribution of juveniles along the concrete steps and stony bank were homogeneous (ID = 5.6 and ID = 4.8 respectively) compared with rather clumped assemblages along beach sites (ID = 61.3). A significant preference was found for juveniles in sheltered beach sites (lagoons) (13.5 inds.) compared to beach sites along straight shorelines (2.2 inds) ( $p < 0.001$ ). A similar pattern was not observed along the two remaining shoreline types ( $p > 0.05$ ).



**Fig. 1.** Schematic map of the Nové Mlýny Reservoir with character of shoreline and numbered sampling sites.

Nine fish species were recorded from the juvenile samples from two families (Cyprinidae, Percidae). Asp, *Aspius aspius* (L.) were the most dominant species (63.9% of all catch) and frequent (present in 42% of sampled sites) followed by roach, *Rutilus rutilus* (L.), forming 21.8% of all catch and recorded at 33% of sampled sites. The same frequency of occurrence was observed for ide, *Leuciscus idus* (L.) but with lower dominance (9.0%). Other species were found only occasionally and did not represent 5% of juvenile fish assemblage (Table 1).

### Discussion

The adult fish community in Nové Mlýny is composed of at least 25 species, with dominant silver bream, *Blicca bjoerkna* (L.), roach and bream, *Abramis brama* (L.)

**Table 1.** The qualitative (d - dominance in %) and semi-quantitative (CPUE) abundance of the 0+ juvenile fishes along three types of shoreline habitat at the Nové Mlýny Reservoir surveyed on July 17, 1995.

site species	concrete steps		stony rip-rap		beach		Total	
	d	CPUE	d	CPUE	d	CPUE	d	CPUE
<i>Aspius aspius</i>	50.0	0.14	56.4	0.24	65.4	2.94	63.9	1.01
<i>Rutilus rutilus</i>	12.5	0.04	30.7	0.13	20.4	0.92	21.8	0.35
<i>Leuciscus idus</i>	12.5	0.04	7.7	0.03	9.1	0.41	9.0	0.14
<i>Blicca bjoerkna</i>	12.5	0.04			2.3	0.10	2.3	0.04
<i>Abramis brama</i>	12.5	0.04	2.6	0.01	0.5	0.02	1.2	0.02
<i>Pseudorasbora parva</i>			2.6	0.01	0.5	0.02	0.8	0.01
<i>Alburnus alburnus</i>					0.5	0.02	0.4	0.01
<i>Chondrostoma nasus</i>					0.5	0.02	0.4	0.01
<i>Stizostedion lucioperca</i>					0.5	0.02	0.4	0.01
number of species	5		5		9		9	
size of catch	8		39		220		267	
Total CPUE		0.29		0.43		4.49		1.59

(Prokeš & Baruš 1994, Lusk et al. 1994). Our single sampling of juvenile fish revealed only nine species of the adult dominant fish, only roach were well represented in our juvenile survey. However, we did catch one adult spiralin, *Alburnoides bipunctatus* (Bloch). This species was not discovered by Prokeš & Baruš (1994) neither Lusk et al. (1994), and may have originated from the middle reservoir tributaries (Table 2). Evidence for the downstream displacement of fish from the middle reservoir was documented by Pavlov et al. (1987), with silver bream, bream, roach and rudd (*Scardinius erythrophthalmus*) being the most numerous species. It appears that silver bream as a phytophilic spawner migrate upstream (when the water level is high) to spawn in suitable tributaries of the middle reservoir and drift downstream as older juveniles.

The sampling efficiency is rather variable with different sampling methods and effort on the large water bodies, such as Nové Mlýny Reservoir. Compared with a single survey in large rivers, where the relatively high water velocity forces most of the juvenile fish inshore, shoreline sampling for species richness in large standing water bodies may give rise to underestimates.

Beach seine nets are most efficient on flat structured substrates (D a u b l e & G r a y 1980, F r a n k i e w i c z et al. 1986). Thus, the use of beach seines in reservoirs is limited to suitable substrates (K u b e č k a & P i v n i č k a 1991, Š v á t o r a 1992). However, beach seining is commonly adopted even along structured shorelines (B e n s o n & M a g n u s o n 1992, B r y a n & S c a r n e c c h i a 1992), and rarely with correction for variable capture efficiency (P i e r c e et al. 1990).

The smallest catches in the present study were found along the concrete stepped habitat. This habitat may be the most efficient for sampling fish by seining. Capture efficiency was probably lowest along stony rip-rap in comparison with the other habitats sampled. The combining beach seining with electrofishing on stony rip-rap may give better results (see B a g g e & H a k k a r i 1985).

The larvae of many lacustrine fishes may move into the pelagic zone of large lakes for weeks or months before returning to the littoral zone where they reside

**Table 2.** Comparison of the species richness of adult and juvenile fish surveys in the Nové Mlýny Reservoir (1 - L u s k et al. 1994, 2 - P r o k e š & B a r u š 1994, 3 - this study).

year of sampling	1990 <sup>1</sup>	1992 <sup>2</sup>	1993 <sup>2</sup>	1995 <sup>3</sup>
age group	adult	adult	adult	0+
species/method	gill nets	gill nets	gill nets	beach seine
<i>Esox lucius</i>	+	+		
<i>Rutilus rutilus</i>	+	+	+	+
<i>Leuciscus cephalus</i>	+			
<i>Leuciscus idus</i>	+	+		+
<i>Scardinius erythrophthalmus</i>	+	+		
<i>Aspius aspius</i>	+			+
<i>Tinca tinca</i>	+			
<i>Chondrostoma nasus</i>				+
<i>Pseudorasbora parva</i>				+
<i>Alburnus alburnus</i>	+	+		+
<i>Blicca bjoerkna</i>	+	+	+	+
<i>Abramis brama</i>	+	+	+	+
<i>Abramis ballerus</i>	+	+		
<i>Carassius carassius</i>	+		+	
<i>Carassius auratus</i>	+			
<i>Cyprinus carpio</i>	+		+	
<i>Silurus glanis</i>	+			
<i>Perca fluviatilis</i>	+		+	
<i>Stizostedion lucioperca</i>	+			+
<i>Gymnocephalus cernuus</i>	+			
hybrids			+	
number of species	18	8	7	9

as juveniles (M a t ě n a 1995, P o s t et al. 1995, M o o i j 1996). The seasonal changes of species composition of the littoral fry assemblages were described also by M a t ě n a (1995a). He found a higher affinity of 0+ rudd for the littoral zone in late summer. In a study of reservoirs in the Great Britain D u n c a n & K u b e ě k a (1995) showed that from mid July, fewer juvenile fish occur in the littoral during the day than at night. They attributed this distribution to a relatively poor food supply in the littoral compared with the zooplankton-rich open waters and absence of shelter from adult fish predation. Similarly, in the present study we did not show that juvenile moved back inshore. One explanation for this differences might be because M a t ě n a (1995) and P o s t et al. (1995), sampled in deep valley reservoirs, whereas the present study was conducted in a shallow lowland reservoir. Juvenile fish may remain longer offshore in the shallow reservoirs such in Nové Mlýny. Compared with M a t ě n a (1995a), who found a predominance of perch (*Perca fluviatilis*) over roach during the daytime, we did not catch any perch whereas roach was the second most abundant species.

The results of the present study show, that in contrast with large rivers (S c h i e m e r et al. 1991, P e ň á z et al. 1991, J u r a j d a 1995), a single survey of 0+ juvenile fish does not describe representatively natural recruitment success in large shallow reservoirs. Reservoirs may need different sampling strategies with several types of sampling methods to provide reliable estimate of juvenile abundance and distribution (B r y a n & S c a r n e c c h i a 1992).

The higher abundance of fish found at beach sites (Table 1) shows the importance of this habitat as nursery habitat for juvenile fish in an impounded

reservoir. Low availability of this habitat in the present study site may lead to high density of juvenile fish which might increase density dependent mortality. The stabilised stretches of the lake shoreline do not seem to represent nursery habitat for 0+ juvenile fish in the Nové Mlýny Reservoir in the summer months. Increasing the shallow beach areas in revitalisation projects may increase the abundance of juvenile fish.

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*Authors' addresses:*

Pavel JURAJDA,  
Eva HOHAUSOVÁ,

*Institute of Landscape Ecology, Academy of Sciences of the Czech Republic, Květná 8,  
603 65 Brno, Czech Republic; e-mail: jurajda@brno.cas.cz.; hohausova@brno.cas.cz*

Martin REICHARD,

*Department of Zoology and Ecology, Faculty of Science, Masaryk University, Kotlářská 2,  
611 37 Brno, Czech Republic; e-mail: reichard@brno.cas.cz*