

# FISH COMMUNITY OF A HEAVILY MODIFIED URBAN STRETCH OF THE RIVER SVRATKA: FISH RESCUE TRANSFER PRIOR TO THE INITIATION OF FLOOD PROTECTION CONSTRUCTIONS

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## Abstract

Here, we present the results of a large-scale fish rescue prior to the building of flood protection structures along a stretch of the River Svratka running through Brno city centre (Moravia, Czech Republic). During this demanding and unique event, 5,861 fish, with a total weight of 1,951 kg, were caught and successfully transferred downstream. A total of 21 species of fish were recorded, of which two were protected species and two non-native to the Czech Republic. The dominant species caught (i.e. > 10%) were chub (*Squalius cephalus*), nase (*Chondrostoma nasus*), roach (*Rutilus rutilus*) and vimba bream (*Vimba vimba*), making up 85% of the catch. While this stretch of the Svratka supported a type-specific fish community dominated by rheophilic species, the occurrence of many species was supported through stocking by the Moravian Anglers Association. The length-frequency distribution of individual fish species suggests there has been a lack of recruitment over a relatively long period. This is most likely linked with hydropeaking from the Brno reservoir water power plant, with daily sharp fluctuations in flow in a river channel lacking shallow bankside areas and refuges with slow-flowing water preventing fish fry survival.

Keywords: fish survey and transfer, Danube basin, urban river, hydropeaking, fish recruitment

## INTRODUCTION

Between January 2022 and October 2023, construction work is taking place in the main channel of the River Svratka passing through the city of Brno (Moravia, Czech Republic) as part of the project “Implementation of flood control measures in the city of Brno - stages VII and VIII” under the investment plan “Nábřeží Svratky Brno” (“Svratka Embankment Brno”), the main goal of which is to increase flood protection to urban developments near the river and the adjacent roads. An integral part of this project will be the construction of revitalising elements supporting aquatic biodiversity within the new river channel. Prior to the start of construction, the project plan

requires that all fish from this stretch be caught and transferred to a new site downstream of the section affected by construction.

While the River Svratka has been the subject of numerous research studies, the majority of these have been toxicological studies focusing on pollutant concentrations in water or sediment (e.g. Nekvapil *et al.*, 2009; Dvořák *et al.*, 2014) and fish tissues (e.g. Lána *et al.*, 2010; Harkabusová *et al.*, 2012) and/or hydrobiological surveys focused on the effect of hydropeaking on macrozoobenthic community (Brabec, 1998, 2000). Relatively few ichthyological studies have been carried out, and these have mainly been centred on the trout fishing grounds upstream (r. km 67–111; Lusk, 1978; Grmela and Spurný, 2010). Only one previous

published study, that by Lusk (1980) using data from the late 1960s, provides information on the fish community of the River Svratka within the city of Brno. Consequently, the fish rescue required as part of the construction plan implementation provides an ideal opportunity to obtain new and valuable data on the fish community along the urban stretch of the River Svratka and to compare this with the only previous sampling in the 1960s.

## MATERIALS AND METHODS

### Study Area

The fish rescue took place along the urban stretch of the River Svratka between river kms 37.50–39.99, a 2.9 km long section with an average width of 25 m throughout, giving a total area of ca. 7.25 ha. Movement of fish was prevented at the downstream end by a newly created dam (r. km 37.03; 49°10'59.071"N, 16°36'25.856"E, see description below) and at the upper end by a low cascade weir (r. km 39.96; 49°11'2.857"N, 16°34'21.883"E).

The lower stretch of the section (ca. 1.7 km) was bounded by steep concrete walls and has a flat, homogeneous riverbed. At the time of sampling, the river width was ca. 30 m, river depth ca. 40–60 cm and flow rate ca. 2.02 m<sup>3</sup>/s. Deeper pools with a depth > 1 m were only found at two sites (49°10'59.753"N 16°36'18.894"E and 49°11'5.282"N 16°36'3.464"E). The upper stretch of the section (ca. 1.2 km) had a natural-like character characterised by a variable width (18–25 m) and depth (20–80 cm). Most of this section was fast flowing with rapids and riffles and had a heterogeneous gravel bottom with stone and boulder steps.

The whole section forms part of the Svratka 3 non-salmonid fishing ground (no. 461 139) managed by the local offices (Brno 1) of the Moravian Angling Union (MRS). As part of their management plan, various rheophilic fish species, along with common carp (*Cyprinus carpio*) and tench (*Tinca tinca*), are stocked into the river each year in accordance with the MRSs obligation to restock its fishing waters.

### Fish Sampling

Fish catches took place between 26 and 27 March 2022, prior to the spawning season (April to May) and before to the start of intensive construction work. Owing to the width of the river and the length of section being cleared, the fishing was undertaken by a large team of professional fisheries experts comprising members of the Institute of Vertebrate Biology of the Czech Academy of Science, the Department of Zoology, Fisheries, Hydrobiology and Apiculture of Mendel University in Brno, and members of the MRS.

Fish were caught by electrofishing, a commonly used method for safely sampling fish in running waters (CEN, 2003). As this section of the Svratka has a channel width of up to 30 m, two FEG1500

petrol-powered backpack units (EFKO, Germany) and three SEN and LENA battery backpack units (Bednář, Czech Republic) were used simultaneously. Each fishing group consisted of an anode operator (in the case of an FEG1500 unit also of the unit carrier) followed by several assistants with hand nets and buckets to catch and temporarily hold the fish caught. The fishing groups stretched across the entire river profile and advanced by wading upstream in parallel. The groups were accompanied by two boats that continuously carried fish to cages located in the stream flow along the banks.

Owing to the large numbers of fish handled and the need to treat them as gently as possible, a representative sample for each species was measured for total length (TL) and weighed to the nearest gram, after which all other fish were counted and weighed in groups by species and size categories. After recording, the fish were placed in oxygenated transport tanks and transported to the release site downstream (49°10'12.974"N, 16°37'17.153"E). This section was selected as it provided suitable habitat for the fish species caught, including shallow rapids in the upper part that could serve as spawning grounds for rheophilic fish species.

To prevent spontaneous upstream movement of fish, it was necessary to create a transverse dam in the lowest part of the section, before the fish catch commenced. This dam was built of rough stones with large pipes inserted to transfer the river's discharge. A high flow velocity in the tubes (> 3 m/s) and the falling water levels created enough of a barrier to prevent fish from returning to the section during construction work. Downstream migration of fish from the upper stretch above the weir was not considered likely due to a change in stream character above the weir (slow flowing and deeper) and the subsequent change in fish community structure.

After the completion of the works, the barriers to fish movement will be removed and fish will be allowed to recolonise the, now improved, stretch naturally.

## RESULTS

In total, 5,861 fish were caught, comprising 21 species from six families, more than half of which were rheophilic species, i.e. fish typical of riverine habitats (Tab. I).

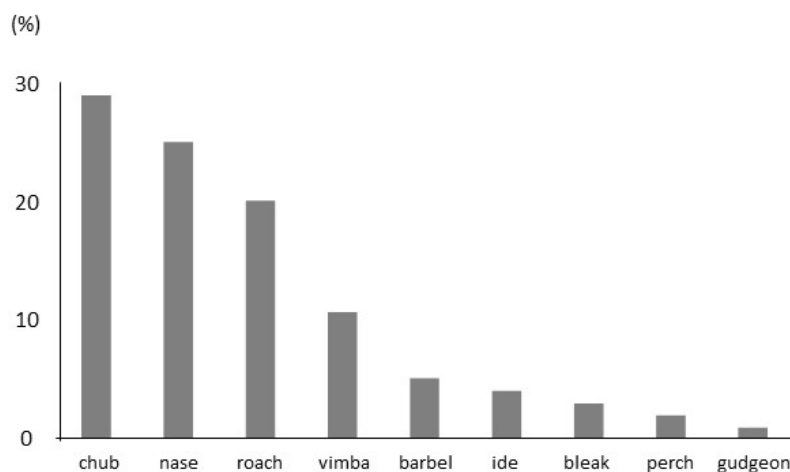
Overall, the catch was dominated by chub (29%), followed by nase (25%), roach (20%) and vimba bream (11%), with barbel (*Barbus barbus*), ide (*Leuciscus idus*), bleak (*Alburnus alburnus*) and perch (*Perca fluviatilis*) representing between 2 and 5%. Other species were occurring only sporadically (Fig. 1). Total fish density reached 808 ind/ha and total relative biomass 269 kg/ha (Tab. II). The total biomass of fish caught was 1,951 kg, with nase (48%) and chub (24%) clearly dominant (Fig. 2).

I: List of fish species registered in the section of the River Svatka on 26 and 27 March 2022, classified into ecological (Schiemer and Waidbacher, 1992) and reproductive (Balon, 1975) guilds

Common name	Scientific name	Ecological guild	Reproductive guild
Brown trout	<i>Salmo trutta</i>	rheophilic A	lithophilic
Rainbow trout	<i>Oncorhynchus mykiss</i>	rheophilic A	lithophilic
European grayling	<i>Thymallus thymallus</i>	rheophilic A	lithophilic
Pike	<i>Esox lucius</i>	eurytopic	phytophilic
Common roach	<i>Rutilus rutilus</i>	eurytopic	phyto-lithophilic
Chub	<i>Squalius cephalus</i>	rheophilic A	lithophilic
Ide	<i>Leuciscus idus</i>	rheophilic B	phyto-lithophilic
Rudd	<i>Scardinius erythrophthalmus</i>	limnophilic	phytophilic
Asp	<i>Aspius aspius</i>	rheophilic B	lithophilic
Nase	<i>Chondrostoma nasus</i>	rheophilic A	lithophilic
Gudgeon	<i>Gobio gobio</i>	rheophilic B	psamophilic
Stone moroko	<i>Pseudorasbora parva</i>	eurytopic	phyto-lithophilic
Barbel	<i>Barbus barbus</i>	rheophilic A	lithophilic
Bleak	<i>Alburnus alburnus</i>	eurytopic	phyto-lithophilic
White bream	<i>Abramis bjoerkna</i>	eurytopic	phytophilic
Common bream	<i>Abramis brama</i>	eurytopic	phyto-lithophilic
Vimba bream	<i>Vimba vimba</i>	rheophilic A	lithophilic
Eel	<i>Anguilla anguilla</i>	eurytopic	pelagophilic
European perch	<i>Perca fluviatilis</i>	eurytopic	phyto-lithophilic
Zander	<i>Sander lucioperca</i>	limnophilic	phytophilic
Common bullhead	<i>Cottus gobio</i>	rheophilic A	speleophilic

Two species registered as specially protected animals in Notice 395 of the Ministry of the Environment of the Czech Republic under Act No. 114/1992 Sb. on nature and landscape protection, were confirmed in the monitored section, ide (subject to stocking) and the common bullhead (*Cottus gobio*), both classified as endangered species. The presumed occurrence of

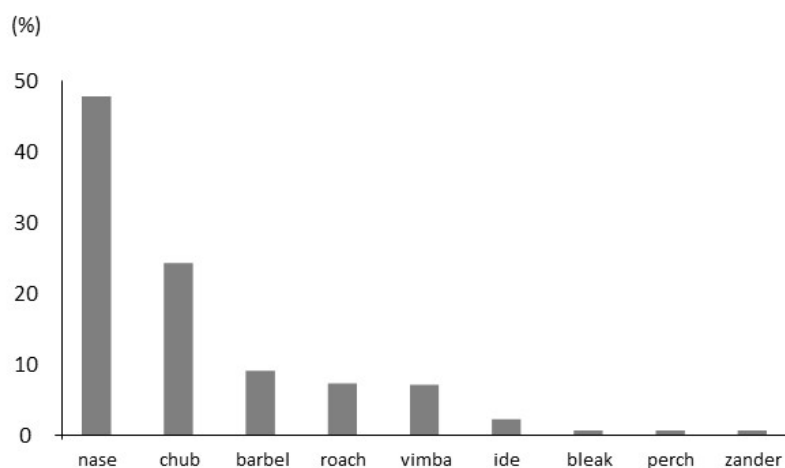
spirlin (*Alburnoides bipunctatus*) was not proven, and burbot (*Lota lota*) were also not caught, despite being stocked by the MRS. Two species non-native to the Czech Republic were caught, represented by a single rainbow trout (*Oncorhynchus mykiss*) originating from MRS stocking, and one stone moroko (*Pseudorasbora parva*).



1: Relative abundance (in %) of the most numerous (> 0.5%) fish species caught along the River Svatka monitoring stretch (26–27 March 2022)

## II: Abundance and biomass of fish species caught along the River Svatka monitoring stretch (26–27 March 2022)

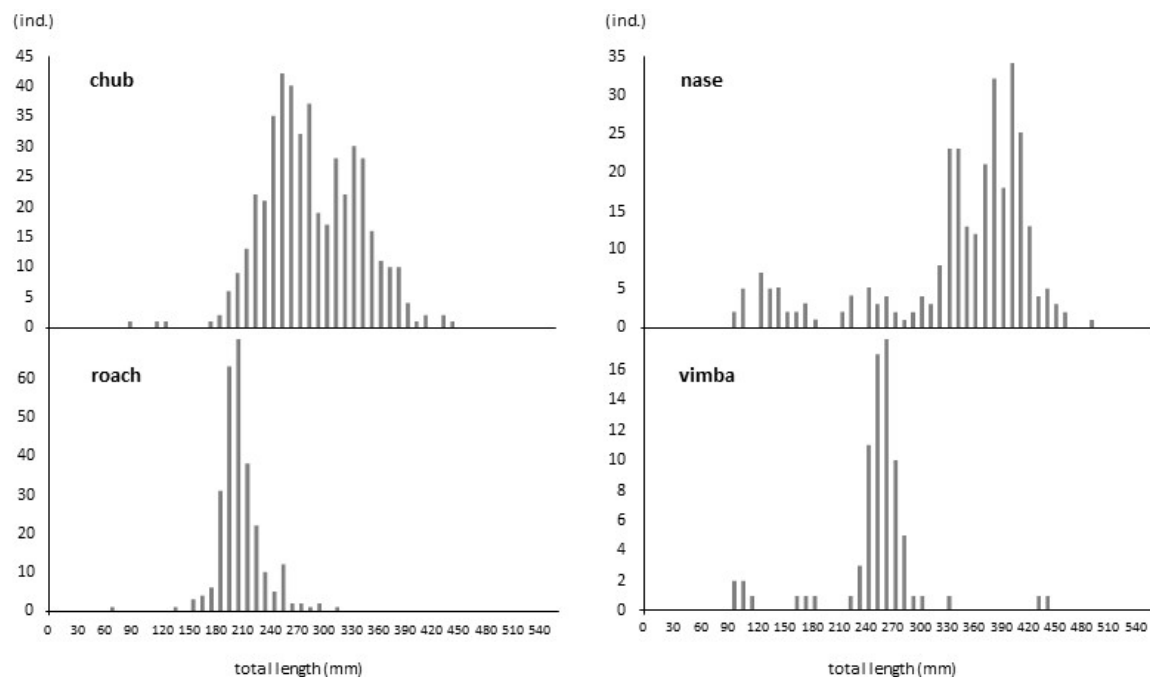
Species	Abundance		Biomass	
	(ind)	(ind/ha)	(kg)	(kg/ha)
<i>Salmo trutta</i>	5	0.69	1.61	0.22
<i>Oncorhynchus mykiss</i>	1	0.14	0.40	0.06
<i>Thymallus thymallus</i>	1	0.14	0.20	0.03
<i>Esox lucius</i>	1	0.14	0.20	0.03
<i>Rutilus rutilus</i>	1,175	162.07	140.58	19.39
<i>Squalius cephalus</i>	1,697	234.07	472.93	65.23
<i>Leuciscus idus</i>	233	32.14	41.93	5.78
<i>Scardinius erythrophthalmus</i>	2	0.28	0.17	0.02
<i>Aspius aspius</i>	2	0.28	0.49	0.07
<i>Chondrostoma nasus</i>	1,468	202.48	930.76	128.38
<i>Gobio gobio</i>	49	6.76	2.32	0.32
<i>Pseudorasbora parva</i>	1	0.14	-	-
<i>Barbus barbus</i>	294	40.55	176.35	24.32
<i>Alburnus alburnus</i>	169	23.31	11.78	1.62
<i>Abramis bjoerkna</i>	7	0.97	1.54	0.21
<i>Abramis brama</i>	9	1.24	7.65	1.06
<i>Vimba vimba</i>	622	85.79	137.16	18.92
<i>Anguilla anguilla</i>	3	0.41	1.63	0.22
<i>Perca fluviatilis</i>	112	15.45	11.15	1.54
<i>Sander lucioperca</i>	9	1.24	11.75	1.62
<i>Cottus gobio</i>	1	0.14	0.01	< 0.01
Total	5,861	808.41	1,950.60	269.05



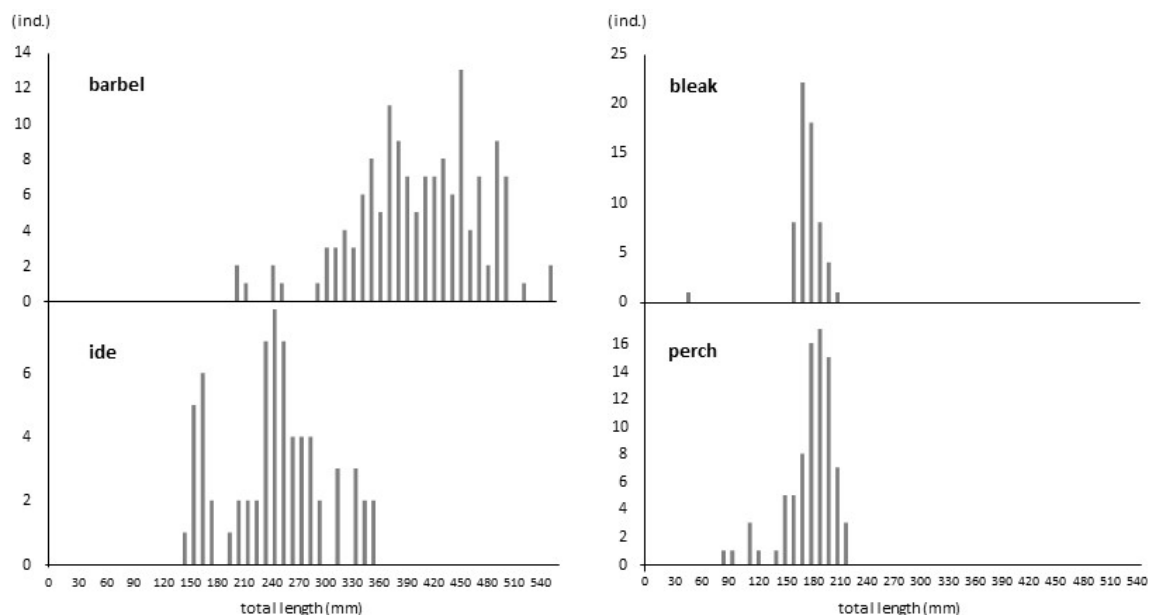
2: Relative biomass (in %) of the most numerous (> 0.5%) fish species recorded along the River Svatka monitoring stretch (26–27 March 2022)

Length-frequency distributions of the abundant fish species caught indicate an almost complete absence of the recruitment (i.e. younger age categories), suggesting a very low natural reproduction success rate (Figs. 3 and 4).

In the case of roach, bleak and perch, the populations comprised just one or two age categories, with only exceptional occurrence of younger individuals (Fig. 4). Likewise, the barbel population was dominated by individuals > 30 cm TL (Fig. 4). Similarly, low numbers



3: Length-frequency distribution of dominant fish species (chub, nase, roach and vimba bream) along the River Svratka monitoring stretch (26–27 March 2022)



4: Length-frequency distribution of barbel, ide, bleak and perch along the River Svratka monitoring stretch (26–27 March 2022)

of young were also recorded for chub, nase and vimba bream, with just three one-year-old chub documented along the entire monitoring section, most fish being between 20 and 40 cm TL (Fig. 3). The few one-year-old nase, vimba bream and chub recorded were all found in a shallow lagoon below the upstream weir, which probably provides a certain refuge for small individuals during hydropeaking events. Elsewhere, most of the monitoring section is bordered by vertical walls with no slow-flowing shoreline sections to provide fry refuges.

## DISCUSSION

While we recorded 21 fish species in the River Svratka section sampled, only eight (chub, nase, roach, vimba bream, barbel, ide, bleak and perch) were abundant, these making up 98% of the entire fish community by both abundance and biomass, with other species occurring only sporadically. Apart from vimba bream and bleak (see below), a very similar situation was recorded in the late 1960s, when the greater part of the fish community was made up

of a similarly species (Lusk, 1980). The vimba bream was not recorded at all by Lusk (1980) and there is no evidence to suggest that the species occurred in this section up to 1991 (Lusk, unpublished data). Its present occurrence is thanks to fisheries management efforts to repatriate the species to the river through artificial stocking, with several thousand fingerlings having been released into the section over recent years. Most individuals caught during the fish rescue ranged between 25.0 and 29.0 cm TL, with younger (one-year-old) or older individuals occurring only rarely. This corresponds with the stocking of a single age-class, probably in 2018.

Eight other species recorded during the fish rescue were not documented in the late 1960s by Lusk (1980), i.e. brown trout (*Salmo trutta*), rainbow trout, grayling (*Thymallus thymallus*), pike (*Esox lucius*), rudd (*Scardinius erythrophthalmus*), stone moroko, common bream (*Abramis brama*), white bream (*Abramis bjoerkna*). Like the vimba bream, also brown trout, rainbow trout and grayling are all subject to fisheries management, with populations in the river maintained artificially by stocking. In this survey, most brown trout had a mean size of ca. 35 cm TL, suggesting they originated from stocking between 2019 and 2020, when fish of ca. 25 cm were released.

While a few individuals of tench and spirin were recorded in the study stretch in the late 1960s

(Lusk, 1980), neither species was recorded in the present survey. However, both tench and common carp (also not caught in the study stretch) are now stocked as part of fisheries management measures in the slower river section above the weir (i.e. just upstream of the survey area). We also failed to catch any burbot in the present survey, despite 4,500 one-year-old fish having been stocked over 2019 and 2020. A similar situation occurred during a survey of the upstream section of the Svratka (below Kamenomlýnská weir 49°11'54.655"N 16°34'0.08"E) in 2017, when just one fish was recorded, despite previous stocking (Jurajda *et al.*, 2017).

Though nine bullheads were detected during the survey of Lusk (1980) in 1969, none were recorded during surveys in 1976 and 1991 (S. Lusk, unpublished data). In the present survey, however, we recorded one adult specimen of this protected species, measuring 7 cm TL. These low numbers suggest that the River Svratka only supports a very small population of bullhead in the section monitored. In comparison, the ide, another protected species, occurred in relatively high numbers (233 ind.) and in several size categories. However, most of these fish are the result of regular stocking, with ca. 6,000 one-year-old fish (ca. 12 cm TL) being stocked by the MRS each year.

## CONCLUSION

During this unique fish rescue, 5,861 fish, with a total weight of 1,951 kg, were caught and successfully transferred downstream. While the River Svratka in the section under study supports a fish community with a predominance of rheophilic species, many of these are artificially maintained through stocking for fisheries purposes. Current fish density and biomass levels (808 ind/ha; 269 kg/ha) are around half those recorded in the 1960s (Lusk, 1980). Length-frequency distributions for the abundant fish species (roach, chub, ide, nase, barbel, bleak, vimba bream, perch) indicate that most populations consist of just a few size/age categories, with a predominance of older fish, the younger size/age categories being completely missing in some cases, even in stocked species. This indicates that there has been a lack of natural reproduction in the study area for some time and/or low survival of fish fry when breeding is successful. The most likely explanation for this is the present hydropeaking regime at the Brno reservoir water power plant, with river flows increasing from 2.02 m<sup>3</sup>/s<sup>-1</sup> to 16–18 m<sup>3</sup>/s<sup>-1</sup> within 24 hours (www.pmo.cz). As much of the channel downstream of the power plant lacks shallow bank areas and refuges with slow-flowing water, fish fry are likely to be swept downstream. As such, it appears that the power plant is playing a crucial role in the failure of natural reproduction and/or survival of younger age groups along the downstream section of the River Svratka; however, to date, there have been no official studies monitoring fry fish survival along the affected stretch. Consequently, we recommend that such studies be undertaken as a matter of urgency.

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