THE INFLUENCE OF FISHERIES MANAGEMENT ON THE BROWN TROUT POPULATION IN MORAVICE RIVER

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Abstract


In 2013, an ichthyological investigation with focus on the population of brown trout (Salmo trutta m. fario) in Moravice River above Slezská Harta dam reservoir in 6 localities of two salmonid fisheries was conducted (3 locations in fishery Moravice 7 and 3 locations in fishery Moravice 8). Ichthyological investigation in 2013 found abundance of brown trout in fishery Moravice 7 1,621 pcs/ha, in fishery Moravice 8 668 pcs/ha. These results were compared with the results of ichthyological investigations from 2004 (Spurný et al. 2006) and 2012 (unpublished data) that were conducted in the same locations of salmonid fisheries of Moravice 7 and Moravice 8. Over 10 years the size structure of brown trout population has changed, which was shown as higher proportion of juvenile fish in size (TL) to 15 cm. The average abundance of brown trout with TL up to 15 cm reached in fishery Moravice 7 in 2004 15 pcs/ha (Spurný et al. 2006), in 2013 1,039 pcs/ha, in fishery Moravice 8 in 2004 719 pcs/ha and in 2012 2,234 pcs/ha. Change in size structure of population of brown trout in monitored localities between 2004, 2012 and 2013 was evaluated as statistically significant (d. f. 10; F = 12.8; P < 0.05). Ichthyologic investigations in 2004 (Spurný et al. 2006), 2012 (unpublished data) and 2013 determined also abundance of brown trout in fishing size (TL over 25 cm): 54 pcs/ha in 2004 (Spurný et al. 2006), in 2012 (unpublished data) 41 pcs/ha, and in 2013 56 pcs/ha. These values were compared with catches of anglers, and according to the results we can say that the fishing pressure had no effect on the abundance of brown trout in fishing size. Abundance of brown trout in salmonid fisheries Moravice 7 and Moravice 8 is probably affected by drought and occurrence of piscivorous predators.

Keywords: salmonid waters, electrofishing investigation, fish stocking, angling

INTRODUCTION

The salmonid fisheries belong to the most valuable structures of water courses in the Czech Republic. The fishery management of these fisheries is difficult and becomes more and more actual topic. The key stone of such management is a stocking by salmonids, e.g. brown trout (Salmo trutta m. fario). The origins of brown trouts artifical spawning come from the mid 19th (Frič 1875) and thanks to this the first transports of brown trout were realized. E.g. in 1862 the import of brown trout eggs from Salzburg (Austria) to Nedolín (Bohemia), as well as in 1946 from Denmark (Kálal 1989). In 1904 there were 45 salmonids hatcheries in Bohemia, 9 in Moravia and 7 in Silesia. Only the yolk sack fry was stocked into the salmonid fishing grounds in this time. Such state in brown trout rearing in the Bohemia had been stable till the fifties of last century. The United Fishing Union was found after 1950 and the fisheries were joined into larger units. These arrangements influenced the gradual increase of anglers and demanded more professional management of fisheries, including the more intensive stocking. The salmonid fisheries were stocked by 1–2 years old brown trouts. The fish were reared in the rearing stream (natural small tributaries within salmonid
fisheries with the supply of natural food). Despite the increasing fishing pressure (with the same area of fisheries) the stocking with this age category of brown trout headed to the significant increase of brown trout catches. The production of hatcheries and fish farms rapidly grew. The stocking and transportation of fish eggs, yearlings and broodfish was realized throughout the Czech Republic and Slovakia. In 1950, there were 65,500 brown trout caught by anglers in Czech Republic, the fishing union had currently 65,867 members. In 1986, there were 335,000 brown trout caught, the fishing union had currently 265,509 members. The increasing fishing pressure in salmonid fisheries had to be compensated by higher numbers of stocked brown trouts. Due to the negative anthropogenic factors (including the inadequate protection of piscivorous predators), the stagnation of brown trout catches occurred after 1980. Such state was caused by the lack of high quality broodfish available for artificial spawning. These broodfish have been collected by electrofishing directly from the salmonid fisheries till nowadays (Lusk 1989, Adámek et al. 1997, Libosvárník et al. 1971). Since 1990, the catches of brown trout have degressively decreased. Numbers of brown trout catches exceeded 100,000 pcs in 2004 and it was for the last time in salmonid fisheries of Czech Republic. In 2012, registered anglers caught only 71,765 pcs of brown trout within fishing unions (ČESKÝ RYBÁRSKÝ SVAZ. © 2014; MORAVSKÝ RYBÁRSKÝ SVAZ © 2014) which had currently approximately 330,000 members (Spurný et al. 2009). Rapidly decreasing number of catches evokes the necessity of management changes in salmonid fisheries.

**MATERIALS AND METHODS**

**Moravice River and angling**

The fisheries in Czech Republic are divided into salmonid and non-salmonid waters. The law No. 99/2004 LC. impose a duty on authorized users to manage properly particular fisheries, mainly by the equal stocking. The greatest authorized user of fisheries in Czech Republic is the Czech fishing union, r. a. (registered association) which manages also the monitored section of Moravice River. This section is divided into two salmonid fisheries, Moravice 7 (reg.no. 473 056, length 13 km, area 12 ha, locality 1 – 3, see Fig. 1) and Moravice 8 (reg.no. 473 057, length 18 km, area 10 ha, localities 4 – 6, see Fig. 1). These two salmonid fisheries are managed by local organisation of Czech fishing union Rýmařov. The anglers are here allowed to catch the brown trouts only from April, 16th to August, 31st using the spin or fly fishing. Anglers can keep the catch of 3 pieces of brown trouts in size of 25 cm in minimum. Salmonids can be angled only three days in week. Data on catches (in pcs) and the level of stocking (in pcs) were provided by Czech Fishing Union for the period between 1976 to 2013 (data on catches and restocking levels were recalculated per 1 ha of water surface).

**Ichthyological investigations**

The ichthyological investigation was carried out from 18th to 19th September 2013. This ichthyological investigation builds on the ichthyological investigations realized from 2004 a 2012. The first ichthyological investigation was carried out by Spurný et al. (2006) from 26th to 27th July 2004. The second ichthyological survey was carried out by manager of local organization Rýmařov 16th September 2012 (unpublished data). Our ichthyological survey 2013 was carried out in the same way and in the same localities as the ichthyological survey 2004 and 2012. The all ichthyological surveys were carried out in the section from opening of Slezská Harta dam reservoir to Karlov pod Fradědem village (6 identical localities in total between 69.8 and 91.6 river km, see Fig. 1).

Spurný et al. (2006) described single localities as follows:

- **Locality 1** (WGS–84: N 4955.356 E 1700.000, N 4955.321 E 1727.097) – This is an untreated river section with gravel-rocky bottom substrate with large stones in the flow. The location is shadowed by the forests along both banks.
- **Locality 2** (WGS–84: N 4955.115 E 1724.157, N 4955.141 E 1724.07) – Flow features unaltered shorelines and natural riverbed with gravelly or stony bottom. Location is shadowed by the surrounding forests.
- **Locality 3** (WGS–84: N 4954.745 E 1722.217, N 4954.745 E 1722.217) – The substrate consists of gravel and small stones. The flow is straightened. This is located in the village of Břidlčíná. It is a protected fish area - with ban on fishing.
- **Locality 5** (WGS–84: N 4959.508 E 1719.114, N 4959.537 E 1719.067) – Riverbed and shorelines are naturally highly indented. The flow is overshadowed by the surrounding forests.
- **Locality 6** (WGS–84: N 5001.013 E 1718.660, N 5001.033 E 1718.608) – It is a swift creek flow with greater drop of the riverbed. The bottom and the banks are untreated, in their natural state. The section is well shadowed by bank vegetation of broadleaved trees and shrubs.

The primary data from ichthyological investigations 2004 and 2012 were also used for this study. The results of ichthyological investigation 2004 were already published by Spurný et al. (2006). Spurný et al. (2006) have provided for authors of this article the primary data for other processing (for processing Fig. 2, 3, 4 and 5 and for statistical analysis). The results of ichthyological investigation 2012 were never published; on the contrary, they
were hand over to the authors for drawing up of this article.

Electrofishing gear (Honda EX 1000, 230 V, 0.75 – 0.90 kW) was used for the investigations. Quantitative method (Zippin 1958), i.e. repeated passing through the electrode in the whole width of the stream was used. The measured sequences were from 64 to 194 m long due to the morphology of particular localities. The total length (TL) was measured in caught brown trouts. Also the abundance of brown trout on each locality was established based on the electrofishing. Growth abilities of particular age categories of brown trout in upper stream of Moravice river were established by Hochman (1957) during the ichthyological investigations in years 1953–1954. During these surveys brown trouts were sorted into following size categories in terms of total length: TL < 15 cm; 15–20 cm; 20–25 cm; > 25 cm. The Czech Hydrometeorological Institute provided hydrological data from hydrometric station Velká Štáhle. This station is situated on the 85.20 river km with the coordinates 17.2113 East longitude and 49.5513 North latitude (see Fig. 1). Hydrologic data contained information about average yeartime flow rate (m³.s⁻¹) and number of days, when the drought was measured (the water column level < 32 cm) for years 2000–2013. Furthermore, in 2013 also average daytime flow rate (m³ . s⁻¹) of monitored river section were obtained from Czech Hydrometeorological Institute.

Statistical data analysis

The following question was stated before statistical data analysing: Has the size structure in brown trouts population changed during the years 2004, 2012 and 2013. Question was tested by factorial analysis TWO-WAY ANOVA. Factorial test ANOVA was applied on the comparison of the different TL of brown trouts (variable: log length) in particular localities (factor: locality) in years 2004, 2012 and 2013 (factor: year). The normality was secured by logarithmic transformation of brown trouts TL. The significance was accepted for the value P < 0,05.

RESULTS AND DISCUSSION

According to the executive director of the Czech Fishing Union the management of salmonid fisheries Moravice 7 and Moravice 8 was implemented until 2004 as follows: local organizations Rýmařov fished broodfish brown trout from these fisheries, such fish were artificially spawned and fish eggs then reared in their own hatchery. Then brown trout (aged 3 months) were stocked into rearing streams in river basin of salmonid fisheries Moravice 7 and Moravice 8 (natural flows with occurrence of natural food) where brown trout were reared up to the age of 2 years. Brown trout were then caught by electrofishing and stocked into salmonid fisheries Moravice 7 and Moravice 8 (unpublished data). Brown trout were stocked in size corresponding to the results by Hochman (1957) who found out that in the river basin of Moravice, brown trout grow in average 14.9 cm to 2 years of age, at the age of 3 years,
an average is 20.3 cm. Such growth rate in rearing streams is also confirmed by Libosvárský et al. (1971).

In 2004, Spurný et al. (2006) conducted an ichthyological investigation of salmonid fisheries Moravice 7 and Moravice 8. The ichthyological investigation discovered the abundance of brown trouts in salmonid fishery Moravice 7 amounted to 413 pcs/ha and 1,342 pcs/ha in fishery Moravice 8 (Spurný et al., 2006). These authors found out a below-average abundance of brown trouts during the ichthyological investigation in 2004 comparing to investigations of Moravice river in years 1953–1954 (Hochman 1957) and to other fisheries in Czech Republic. Hochman (1957) states that the brown trout abundance in fishery Moravice 7 was in the range of 1,525 pcs/ha (surveyed in July) and 2,123 pcs/ha (surveyed in September). Baruš et al. (1995) summarized that the abundance of brown trout in salmonid fisheries of the Czech Republic varies in the range of 1,000–6,000 pcs/ha, 2,218 pcs/ha in average. Spurný et al. (2006) have also recorded the unbalanced size (age) structure of brown trout's population in Moravice river (Fig. 2) comparing the results of Hochman (1957). Quoted author states that the brown trout's abundance in salmonid fishery of Moravice 7 reached in July 1953 and 1954 397 pcs/ha in size category < 15 cm, 519 pcs/ha in size category 15–20 cm, 472 pcs/ha in size category 20–25 cm and 137 pcs/ha in size category > 25 cm. In September, the author found out the following values: size category < 15 cm 297.5 pcs./ha, 15–20 cm 1,105 pcs/ha, and > 25 cm 0 pcs/ha.

Spurný et al. (2006) confirmed the opinion of an executive director of Czech Fishing Union in Rýmařov that in these fisheries there is insufficient amount of broodfish which would continue to be used for artificial spawning. This decline is also shown in Fig. 6 and 7 (decrease of catches of brown trout in size over 25 cm). Significant loss of brown trout is recorded in all salmonid fisheries of the Czech Republic (ČESKÝ RYBÁRSKÝ SVAZ. © 2014; MORAVSKÝ RYBÁRSKÝ SVAZ © 2014).

Based on the reached results, a new way of salmonid fisheries management was suggested and accepted by the manager of local organization Rýmařov as well:

1. The ban of brown trout fishing from the catchment area of Moravice upstream stretch used for artificial spawning (unpublished information)
2. Stocking in catchment area of Moravice upstream stretch will be realized by brown trouts in age of 2–3 years reared in rearing brooks from fish eggs supplied by one source – local hatchery in Jeseník city. This hatchery uses for artificial spawning and subsequent stocking only the local population of brown trouts originating from the Bělá Jesenická river (unpublished information). The intensity of stocking before 2004 and after 2004 is shown in Fig. 6 and 7.

Another ichthyological investigation was conducted in 2012 by local organization Rýmařov (unpublished data). This ichthyological investigation discovered the abundance of brown trout in salmonid fishery Moravice 7 amounted to 1,773 pcs/ha and 3,831 pcs/ha in fishery Moravice 8. The ichthyological investigation in 2012 discovered the increase of brown trout abundance compared to 2004 about 77 % in Moravice 7 and 65 % in Moravice 8 fisheries. The highest increase was noticed in abundance of brown trout yearling (the size category up to 15 cm) in Moravice 7 (from 15 to 841 pcs/ha) as well as in Moravice 8 (from 719 pcs/ha to 2,234 pcs/ha) fisheries.

The ichthyological investigation in 2013 discovered the abundance of brown trout in salmonid fishery Moravice 7 amounted to 1,621 pcs/ha and 668 pcs/ha in fishery Moravice 8. This ichthyological investigation discovered another increasing of brown trout abundance in the size category up to 15 cm about 19 % in Moravice 7 (from 841 pcs/ha to 1,039 pcs/ha). But the total
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abundance of brown trout in 2013 has decreased about 9% (from 1,773 pcs/ha to 1,621 pcs/ha) in Moravice 7 and about 83% (from 3,831 pcs/ha to 668 pcs/ha) in Moravice 8 comparing to situation in 2012. Increased abundance of brown trout in size category up to 15 cm can be significantly affected by stocking with fish at the age of 2 years (see above). Fig. 2 shows the development of abundance of individual size categories of brown trout recorded during three ichthyologic surveys. Figs. 3 and 4 show the change in size structure of brown trout population in these fisheries during ten years.

During the ichthyological investigation in the salmonid fishery Moravice 7 there was 54 pcs/ha of brown trouts with TL > 25 cm caught in 2004 (Spurný et al. 2006), 41 pcs/ha in 2012 (unpublished data) and 56 pcs/ha in 2013. Despite the stagnation of number of brown trouts in size above 25 cm during all three ichthyological investigations, their catches by anglers decreased (13 pcs/ha in 2004, 5 pcs/ha in 2012, 3 pcs/ha in 2013). In Moravice 8 fishery, the increase in numbers of brown trouts in TL above 25 cm has occurred in 2012 (82 pcs/ha – unpublished data) comparing to 2004 (46 pcs/ha – Spurný et al. 2006). In 2013 the ichthyological investigation discovered only 6 pcs/ha of brown trouts in TL above 25 cm. Number of angler's catches decreased as well from 9 pcs/ha in 2004 to 1 pc/ha in 2013. Cox et Walters (2002), Lewin et al. (2006) state, that the population of brown trout in fishing size (category 25 cm or more) could be affected by recreational fishing, especially in terms of excessive fishing pressure. In the Czech Republic there is recorded long-term decline in catches of brown trout and this is despite increasing stocking and decreasing level of fishing pressure (Chalupa 2012). The level of fishing pressure reached in the fishery Moravice 7 in 2012 25 attendances/ha and in 2013 and 29 attendances/ha; for salmonid fishery Moravice 8 in 2012 it was 8 attendances/ha, in 2013 3 attendances/ha. The level of fishing pressure on salmonid fisheries of Moravice river was rather below average because, as mentioned by Chalupa et al. (2013), the level of fishing pressure on selected salmonid fisheries of the Czech Republic was approximately 160 attendances/ha in years 2000–2010. As emerged from the above, fishing pressure on salmonid fisheries Moravice 7 and
Moravice 8 has no significant effect on quantity of individuals in fishing size in populations of brown trout. This fact is also demonstrated by the abundance of brown trout in fishing size which was found at various locations during three ichthyologic surveys, see Fig. 2. At location 3 where there is a ban on fishing, the abundance of brown trout in fishing size is not significantly different from other locations which are subject to fishing pressure.

Results of ichthyologic investigations in different years could be significantly affected by hydrological regime (Tab. I). Hydrological data were measured in hydrometric station Velká Štáhle (the average annual water height is 46 cm and the average annual flow of 2.62 m$^3$/s). The greatest drought on Moravice river was recorded in 2003, 2004 and 2013 when flow rates were lower than 0.600 m$^3$/s. Such flow rate is already below the minimum flow $Q_{330d}$ which allows the survival of the fish community (Spurný et al. 2008). $Q_{330d}$ is in hydrometric station Velká Štáhle determined to be 0.758 m$^3$/s. Speed of water flow and height of water level are critical environmental factors that at their minimum values cause the decay of populations of brown trout (Libosvárský et al. 1971), reduction in the abundance of this species (Gaboury et Patalas 1984, Vlach et al. 2005) and have also different effects on different age categories of fish (Spurný et al. 2008). Drought could therefore affect also the results of ichthyologic surveys, mainly the results of ichthyologic survey from 2013 at fishery Moravice 8. In this fishery a serious decline in population of brown trout was recorded-in July and August 2013 an average daily flow rate was only 0.275 m$^3$/s. These data do not provide accurate information about the state of hydrological conditions in the upper section of Moravice 8 fishery (the station is located in Moravice 7 fishery below the confluence with Podolský Brook – see Fig. 1), but the actual values of hydrological parameters in this section are even lower because Podolský Brook represents a major tributary of the Moravice river. This fact is supported by data from the years 1926 - 1940 when the average annual flow of the Moravice river above Podolský Brook was 1.45 m$^3$/s and below the confluence with Podolský Brook 2.69 m$^3$/s (Hochman 1957).

Based on available data, it is obvious that the results can be influenced by the deadline of individual ichthyologic investigations. It is also known that ichthyologic investigations generally underestimate the size of the population (Bohlin et Sundström 1977, Riley et Fausch 1992) and that ichthyologic surveys conducted in summer underestimate primarily the individuals of brown trout population at age 0+ (Libosvárský 1968;
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Baruš et al. (1995). For this reason, the ichthyologic investigations were conducted by the double fishing method because repeated fishing reduces the risk of underestimating the size of the population (Libosvárský 1968, Humpl et Lusk 2006). Results of ichthyologic investigations could also be affected by fish migration (Lusk et al. 2014), primarily by spawning migration of trouts (during ichthyologic surveys in September). The migration of brown trout to the upstream of the Moravice river is confined only to particular sections of salmonid fisheries Moravice 7 and Moravice 8 and its tributaries. The cause is the occurrence of 9 weirs without fish passages (see Fig. 1). Migration from Slezská Harta dam reservoir to salmonid fishery in Moravice 7 is prevented by the weir in river, on 75th km (see Fig. 1 – point a). The river weir (see Fig. 1 – point f) is located on the border of Moravice 7 and Moravice 8 fisheries and does not allow fish migration between these fisheries. Therefore brown trouts must adapt spawning migration to available length of the river stretch (Závorka et al., 2013; Slavík et al., 2012).

Abundance, size composition of the population of brown trout and development of catches in salmonid fisheries of the Moravice river were probably also influenced by long-term presence of piscivorous predators. A substantial part of salmonid fisheries Moravice 7 and Moravice 8 is a part of the NATURA 2000 territory (see Fig. 1) where the subject of protection under European special protection area CZ0813456 is Eurasian otter (Lutra lutra) but from fish also bullhead (Cottus gobio) and brook lamprey (Lampetra planeri). Eurasian otter was to salmonid fisheries Moravice 7 and Moravice 8 deliberately reintroduced in 1997–2003 (12 individuals were reintroduced in total; Poledníková et al. 2007). Occurrence of otter was confirmed by follow-up studies: in 2006 and in 2011 (Poledníková et al. 2007; Polednik et al. 2012). Poledníková et al. (2007) confirmed that Eurasian otter in the area consumes fish of all sizes while the proportion of brown trout in food was growing upstream (1–38 %). The authors also note that otters consume catches depending on the food offer. Poledníková et al. (2007) also stated that brown trout were consumed by otter usually in sizes 15–25 cm, while it was estimated that otters consume in a given flow approximately 980 kg of brown trout per year, most of them in size of 20–25 cm (total of 427 kg/year), then the size of 15–20 cm (total of 364 kg/year). Based on findings of the above-cited authors we can conclude that the results of ichthyologic surveys (2004, 2012, 2013) were also significantly affected by otter predation, especially for brown trout of size category: 15–20 cm and 20–25 cm.

**CONCLUSION**

In salmonid fisheries Moravice 7 and Moravice 8 there was recorded low abundance of brown trout useful for artificial spawning. For this reason salmonid fisheries began to be subject of stocking by brown trout from other catchment area but reared in the basin of Moravice river. Results of ichthyologic investigations from 2004 (Spurný et al. 2006), 2012 (unpublished data) and 2013 show that the abundance of brown trout in concerned fisheries is affected, among other things, also by climatic conditions (drought). In years 2006–2011 there was no single day recorded with the incidence of drought which could affect the abundance of brown trout in salmonid fishery Moravice 8 in 2012 (3831 pcs/ha; unpublished data). In 2013 when there were 39 days of drought, abundance of brown trout...

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### Table: The average annual flow rates and the number of days when it was declared a drought (water level below 32 cm) in hydrometric station Velká Štáhle in years 2000–2014 (the Czech Hydrometeorological Institute)

<table>
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<th>Water height &lt; 32 cm (number of day)</th>
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<td>2.53</td>
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trout in salmonid fishery declined to 668 pcs/ha. Abundance of brown trout is also influenced by otter predation, as stated by Poledníková et al. 2007, and especially in salmonid fishery Moravice 8 where brown trout make up 39% of the food of otter (usually in size 15–25 cm). Results of ichthyologic surveys 2004 (Spurný et al. 2006), 2012 (unpublished data) and 2013 in comparison to the economic records of fisheries proved that the reported level of fishing pressure does not have significant effect on abundance of brown trout in surveyed fisheries of Moravice. The authors are aware of genetic variability of brown trout in single river basins and all the consequences that may arise from stocking by genetically distinct brown trout (e.g. Youngson et al. 2003, Van Poorten et al. 2010). However in terms of long-term evolution of the population and catches of brown trout in salmonid fisheries Moravice 7 and Moravice 8 we can say that fish population is significantly affected primarily by biotic (e.g. Eurasian otter) and abiotic (e.g. migration obstacles in rivers) factors.

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REFERENCES


FRIČ, A. 1875. Artificial breeding of fish in Bohemia. Report on results of salmon and trout breeding during the years 1871–1874 and a brief guide to artificial breeding of fish. Praha.


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hydrobiologický, Střední rybářská škola Vodňany, 115–119.

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