Bulgarian Journal of Agricultural Science, 21 (Supplement 1) 2015, 40–44
Agricultural Academy

IMPACT OF FISH RESOURCES MANAGEMENT ACTIVITIES ON THE FISH COMMUNITY STRUCTURE IN THE DOSPAT RESERVOIR (BULGARIA)

E. UZUNOVA*[1], T. HUBENOVA[2] and M. GEORGIEVA[3]
[1] *Sofia University, Biological Faculty, BG – 1164 Sofia, Bulgaria*
[2] *Institute of Fishery and Aquaculture, BG – 4000 Plovdiv, Bulgaria;*
[3] *National Agency of Fishery and Aquaculture, BG – 1000 Sofia, Bulgaria*

Abstract

UZUNOVA, E., T. HUBENOVA and M. GEORGIEVA, 2015. Impact of fish resources management activities on the fish community structure in the Dospat reservoir (Bulgaria). *Bulg. J. Agric. Sci.*, Supplement 1, 21: 40–44

The current study was initiated to gather baseline scientific information on the biological characteristics and general status of fish resources in the Dospat Dam Lake, with an emphasis on key harvested species. The main purpose of this dam is producing hydroelectric energy, but the reservoir also contains one of the biggest cage aquaculture facilities in Bulgaria. Stocking activities with different species (*Coregonus peled, Onchorhinchus mykiss* and *Cyprinus carpio*) have been conducted over the years. The fish composition observed in this investigation was compared with those from previous studies to outline the main changes in fish composition during the period from the dam's construction to nowadays. A total of 468 specimens were caught by gillnets and trap nets. Fish were collected from May 2009 to November 2011. Eleven fish species, belonging to five families (Cyprinidae, Cobitidae, Salmonidae, Percidae and Centrarhidae), were found. Three of them are exotic (*Pseudorasbora parva, Lepomis gibbosus* and *O. mykiss*). Three fish species are new in comparison to those reported previously (*P. parva, L. gibbosus,* and *Zander lucioperca*).A significant change was observed in the dominant fish species over the years. At present, *Rutilus rutilus* and *Perca fluviatilis* predominate in the catches. In the littoral zones, pumpkinseeds were the most abundant species. The dominant species *Barbus cyclolepis* in the past was not found. Biological data (size length frequencies and age distribution) are reported for the dominant fish species.

Key words: species composition, dominant fish, Dam Dospat, Bulgaria

Introduction

Development of fish communities in reservoirs is specific and depends on natural conditions and human activities in the post-damming period (*e.g.* Drenner and Hambright 1999*,* Gidoet al., 2000, Sharf, 2008, Říha et al., 2009).Kubecka (1993) divided the development of fish communities in reservoirs of Central Europe into five phases according to the change in dominant fish species during reservoir ageing. Indeed, it is observed that in final stages reservoir's fish communities were dominated by cyprinids (Vostradovsky et al., 1989; Kubecka, 1993).

Zivkov (1987) described the initial development of the fish community in the Dospat Reservoir during the first years after filling (1971–1985). Special attention was paid to the biology of the endemic species Maritza barbel *Barbus cyclolepis*, which inhabited the reservoir in the early years after its creation (Dikov and Zivkov, 1985).

The aim of this study was to outline the main changes in fish composition during the period from the dam's construction to nowadays. The aims were as follows: (i) to study the history of fish introduction and other activities (aquaculture) in the dam; (ii) to investigate current fish species diversity; and (iii) to determine the size and

**E-mail: e_uzunova@abv.bg*

age structure of the population of the dominant fish species.

This information will contribute to future plans to formulate management strategies for sustainable fisheries development.

Material and Methods

Site description

The Dospat Reservoir was built in 1967 by damming the River Dosspatska. The maximum area of the Dospat Reservoir is 2210 ha; dam volume is 570 $m^3 \times 10^3$; the maximum depth is 40 m with a mean depth of 20 m. The length ofthe reservoir is 19 km, and the maximum surface altitude is 1200 m asl. The reservoir is dimictic, with summer stratification usually lasting from April to October (Zivkov, 1987). The littoral zone is partially covered with submerged aquatic macrophytes, but there are zones with steep banks. The trophic status of the reservoir is mesotrophic to eutrophic, with phosphorus and chlorophyll-*a* concentrations decreasing towards the dam.

Fish collection and measurement

Fish were collected in 2009–2011 (May to November) at six sites situated between the dam wall and the inflow. Station 1 was situated 50 m from the dam wall (N 41°38′69″; E 24°09′13″);stations 2 (N 41°39′45″; E 24°09′06″),3 (N 41°39′80″; E 24°09′18″) and 4 (N 41º39`72″; E 24°8′89″) were located in zone with net cages; stations 5 (N 41°40′41″; E 24°07′46″) and 6 (N 41º42′45″; E 24°04′55″) were situated in pelagial zones.

The multi-mesh gill nets ranged in length from 50 to 200 m, their height was 4 m, and mesh size varied from 10 to 90 mm. Placement was carried out in the evening and the nets stayed in the water was about 10 hours. A littoral part of the dam was sampled by minnow traps to identify species composition and to estimate the relative abundance of small-bodied fish in the littoral zone. A total of 10 baited minnow traps were set per site. These were commercially available Gee minnow traps with an opening diameter of 6–7 cm and a mesh size of 0.8 cm. Traps were baited with a dry, trout feed and were set near the shoreline at depths ranging from 0.3 to 2.0 m. Traps were set for 1 hour during sunny days. Relative abundance estimates of minnow traps were derived from the mean catch per unit effort (CPUE).The collected fishes were counted and identified to species according to Kotel at and Freyhof (2007).

Size measurements included total (TL) and standard (SL) length. The fish were weighed (W) to the nearest 0.1 g. The age of the fish was determined from scales removed below the anterior part of the dorsal fin. Measurements were made on the oral radius. The ageing measurements were made using a microfilm reader at 17.5 x magnification. Two investigators independently determined the age of fish. Age was confirmed if the percentage of disagreement was below 10%; for the scales with higher discrepancies, additional measurements were made until agreement was reached.

Results and Discussion

Stages in the development of the fish community

The development of the fish community in the Dospat Reservoir can be divided into several separate phases. Species composition in the initial phase (1967–1970), covering the period immediately after the impoundment of the dam, is determined by reofilic species (common nase, chub, brown trout, gudgeon and barbel), which entered from the River Dospatska in the reservoir. Several factors contributed to the change of this phase: a significant portion of the sensitive riverine species of the original system have not been able to tolerate the lentic conditions and have disappeared (*e.g.*the lotic species *Barbus cyclolepis* and *Chondrostoma nasus*), and introduction of non-native species aiming to create new fisheries. Since 1969, fish stocking with common carp was carried out annually in Dospat Reservoir by the local authorities. In the next phase (1971–1980), the highly dynamic and unstable phase fish community was dominated by cyprinid fishes, *i.e.* common carp (*Cyprinus carpio*) and Prussian carp (*Carassius gibelio*). Stocking activities determined the composition and amount of industrial catches in individual years of this period. As well as common carp, the newly introduced peled (*Coregonus peled*) also significantly contributed to catches. The end of this period occurred as a result of over-catching of common carp and peled. Obviously, these two species failed to establish stable populations (Zivkov, 1987). This is probably a result of the combined effects of overfishing, significant fluctuations of the water level and the small number of fish reaching reproductive maturity. Fish species that had been dominant in the river before filling were replaced by introduced species, such as Prussian carp (*Carassius gibelio*), rouch (*Rutilus rutilus*) and perch (*Perca fluviatilis*).

In the third phase (1981–1984), fisheries activity in Dospat Reservoir was fully reoriented towards rearing salmonids. At the beginning of this period, the production of trout started in net cages. The lake was stocked with about half a million small trout per year, and most of the fish were released when loading cages or breaking the nets. Rainbow trout (*Oncorhynchus mykiss*) dominated in catches (40 tons of annual catches). Natural reproduction of rainbow trout

was not found, which is typical for other bodies in the territory of Bulgaria. Zivkov (1987) correctly predicted that the termination of intentional and unintentional introduction of this species in the water basin would lead to a rapid reduction of its stocks.

Currently, the ichthyofauna of the Dospat Reservoir consists of 11 fish species – three piscivourus, four zooplanktonivouros and four omnivorous (Table 1).

Fish assemblages were dominated by limnophilic and euritopic species.In pelagic waters, the most abundant were perch (*Perca fluviatilis*) and roach (*Rutilus rutilus*). Four fish species were found only in the littoral zone (pumpkinseed, pseudorasbora and beterling). Three fish species were exotic for Bulgaria and Europe (pumpkinseed, pseudorasbora and rainbow trout) (Uzunova and Zlatanova, 2007). *Lepomis gibbosus* was extremely numerous and, depending on the bottom substrate of the littoral zone, its abundance ranged from1 to 9.3 CPUE (number of fish per trap per hour). By strengthening the processes of eutrophication in the reservoir, the percentage of littoral areas with appropriate substrate, which is preferred by sunfish to lay eggs,will enhance and this will increase the number of sunfish. One other exotic fish species, stone moroko (*Pseudorasbora parva*), was found in the littoral areas. Both have probably fallen in the water basin with fish for restocking.

The littoral area was also inhabited by bitterling, *Rhodeus amarus*, which is among the species included in the list of species under Directive 92/43 / EEC on the conservation of natural habitats and of wild fauna and flora.

In the Dospat Reservoir, single specimens of species pike perch (*Zander lucioperca*), bleak (*Alburnus alburnus*) and common carp were also found.

Age and size structure of the dominant species

In pelagial zones of the Dospat Reservoir, the catches were dominated by perch. In terms of average body length, males differed significantly from females (Figure 1).Fish with a body length between 15 and 20 cm dominated. Only a single individual reached up to 40 cm (Figure 1).

Table 1

Fish species that were found in current investigation and during period 1971–1985

Fish species	1967–1971	1971–1985 (Zivkov, 1987)	2009–2011 (Our data)
Salmonidae			
Salmo trutta	+	+	–
Oncorhynchus mykiss		+	+
Coregonus peled	–	+	–
Cyprinidae			
Rutilusrutilus	–	+	+
Tincatinca	–	+	–
Squalius cephalus	+	+	–
Alburnus alburnus	–	+	+
Chondrostoma nassus	+	+	–
Gobiogobio	+	+	–
Carassius gibelio	–	+	+
Cyprinus carpio	–	+	+
Rhodeus amarus	–	+	+
Barbus cyclolepis	+	+	–
Pseudorasbora parva	–	–	+
Nemacheilidae			
Barbatula barbatula	–	+	+
Percidae			
Perca fluviatilis	–	+	+
Sander lucioperca	–	–	+
Centrarhidae			
Lepomis gibbosus	–	–	+

Two-year-old fish dominated,and one-summer-old fish were absent. The latter can be explained by the selectivity of the net-fishing gear used in the collection of ichthyological material (Figure 2).

The significant abundance of roach may be explained by the fact that cyprinid species are better adapted to utilise food resources under eutrophic conditions, since roach is able to feed on zooplankton as an adult and is also able to utilise algae. The total length (TL) of roach, *Rutilus rutilus,*varied from 16 to 19 cm (Figure 3). Three-year-old and four-year-old roach were the most numerous (Figure 4).

The dominant species in littoral fish communities, regardless of the season,was the pumpkinseed. The length frequency data for *Lepomis gibbosus* from the Dospat Reservoir revealed the prevalence of pumpkinseeds of 60 to 70 mm in length followed by those between 100 and 110 mm (Figure 5).

The smaller size of individuals from European populations of pumpkinseed can be explained by various factors. First is the lower average annual temperatures and the restrictions in the food base (Villeneuve et al., 2005). The age structure of the pumpkinseeds was determined on the basis of the study of 153 individuals. Among sunfish from three stations in the littoral areas of the Dospat Reservoir, 1- and 2-year-old fish dominated (Figure 6). The maximum established age was 4 years. Comparison with other European populations of the species shows that the established age structure is characteristic of populations with large numbers and high population density (Copp et al. 2004). The maximum age of the pumpkinseeds in their natural habitat is 10 years (Carlander, 1977), while that of the European population is 8 years (Brabrand and Saltveit, 1989). Based on the data on the size and age structure of the pumpkinseed catches in the littoral zone, we can conclude that this is a place of habitation not only

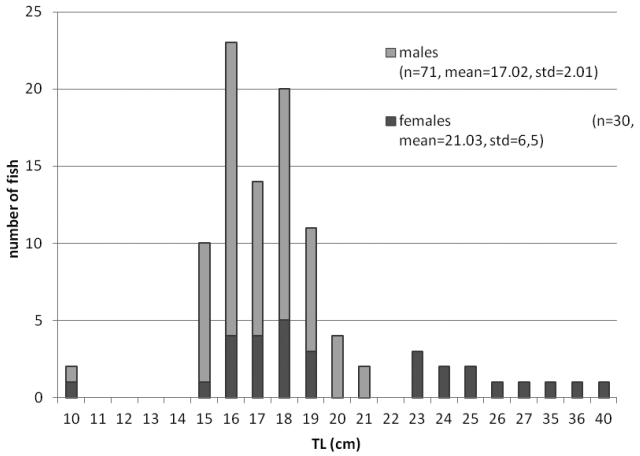

Fig. 1. Length (TL, cm) frequency distribution of perch (*Perca fluviatilis*) collected from the Dospat Dam , 2009-2011

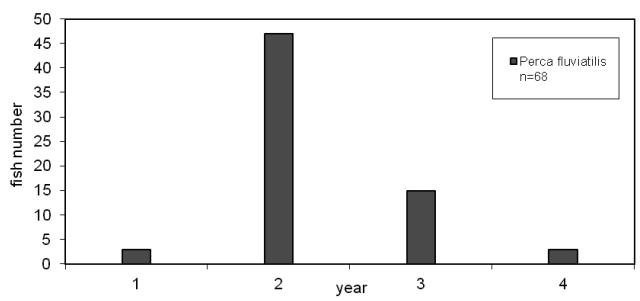

Fig. 2. Age structure of perch *Perca fluviatilis* from Dospat Dam, 2009–2011

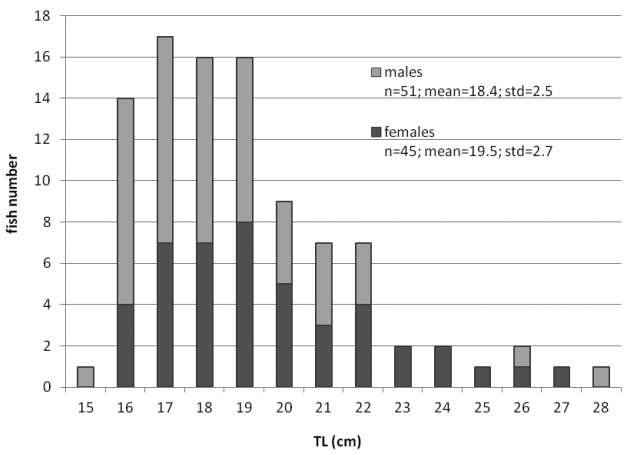

Fig. 3. Length frequency distribution of *Rutilius rutilus* collected from the Dospat Dam during 2009-2011

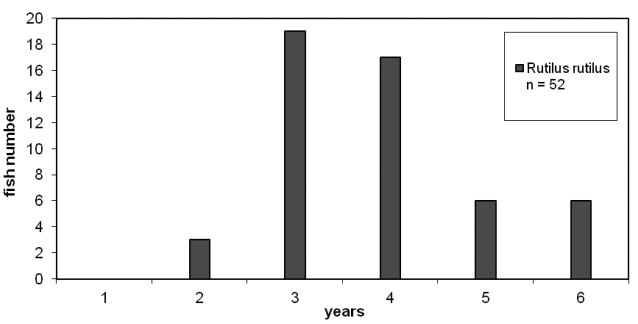

Fig. 4. Age structure of *Rutilus rutilus* from Dospat Dam during 2009–2011

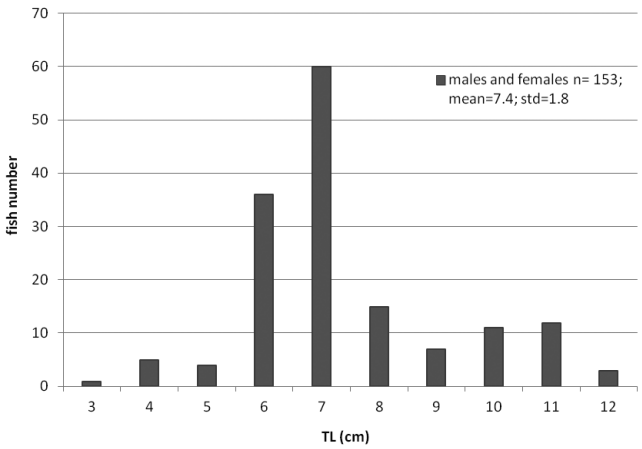

Fig. 5. Length frequency distribution of pumpkin seed (*Lepomis gibbosus*) collected from the Dospat Dam during 2009-2011

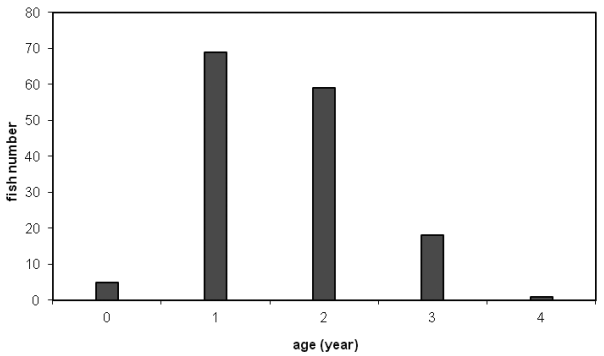

Fig. 6. Age structure of pumpkin seed (*Lepomis gibbosus*) from the Dospat Dam during 2009–2011

for the reproductive part of the population, but also for juvenile fish.

Conclusions

Based on the present results, the following conclusions can be drawn:

At present, the species composition of ichthyofauna in Dospat is dominated by lake species that were not present in the river fauna in the early stages of creating the reservoir.

The main factor that determined the development of the fish community in the Dospat Reservoir in the initial phase was the changes in hydrologic characteristics of the ecosystem from lotic to lentic.

Typical riverine species (*e.g.* Maritza barbel, common nase) do not adapt, and thus disappear due to changes in hydraulic parameters and loss of suitable habitats for reproduction and wintering.

Stocking the Dospat Reservoir with different fish species, such as common carp, peled and rainbow trout, did not result in formation of a sustainable population, probably due to insufficient stocking rate or lack of suitable conditions for reproduction (water fluctuation).

High abundance of the non-native and invasive fish species pumpkinseed (*Lepomis gibbosus*) in the littoral area is an indicator of the increasing level of eutrophication of the reservoir.

Dominant fish species have a simple age structure, probably due to the strong fishing pressure.

References

Dikov, Tz. and M. Zivkov, 1985. A copmerative analysis of the growth of the barbel (*Barbus tauricus cyclolepis*) in the Dzerman River and the Dospat Dam. *Hydrobiology*, **26**: 81–90 (Bg).

Drenner, R. W. and K. D. **Hambright,** 1999. Biomanipulation of fish assemblages as a lake restoration technique. *Archiv fur Hydrobiologie,* **146**: 129–165.

Gido, K. B., Matthews W. J. and W. C. Wolfinbarger, 2000. Long-term changes in a reservoir fish assemblage: Stability in an unpredictable environment. *Ecological Applications*, **10**: 1517–1529.

Kubečka, J., 1993. Succession of fish communities in reservoirs of Central and Eastern Europe. In: M. Straškraba, J. G. Tundisi & A. Duncan (eds.) Comparative Reservoir Limnology and Water Quality Management. Amsterdam: Kluwer Academic Publishers Group, pp. 153–168.

Vostradovsky, J., J. Krizek, O. Albertova, L. Ruzicka and M. Vostradovska, 1989. The changes of fish communities and biomanipulation in water supply reservoirs. *Arch. Hydrobiol. Beih. Ergeb. Limnol.* **33:** 587–594.

Sharf, W., 2008. Development of the fish stock and its manageability in the deep, stratifying Wupper Reservoir. *Limnologica*, **38**: 248–257.

Zivkov, M., 1987. Icthyofauna and fish resource exploitation of the Dospat Dam. *Hydrobiology*, **30**: 15–22.

Uzunova, E. and S. Zlatanova, 2007. A review of the fish introductions in Bulgarian fresh waters. *Acta Ichthyologica et Piscatoria*, **37**(1): 55–6.