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Article in *Water Science & Technology* · December 1999

DOI: 10.1016/S0273-1223(99)00203-6

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PII: S0273-1223(99)00203-6

# STATE OF THE ICHTHYOFAUNA IN ROPOTAMO RESERVE COMPLEX: ECOLOGICAL, CONSERVATION AND ECONOMIC ASPECTS

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## ABSTRACT

The aim of the investigations was to discover the actual state of the ichthyofauna in the water basins of Ropotamo Reserve Complex and to determine the ecological, conservation and economic aspects of its management. In total 55 fish species were found during this study. Five species belong to the category "threatened" in the Red Book of Bulgaria. Four species at different levels of endemism were also found. The highest species diversity characterizes the firth of Ropotamo River. In all marshes studied a comparatively low degree of species diversity was established, because of the extreme abiotic conditions, and especially because of the variable hydrological rate. The anthropogenic impact affects the studied basins to different degrees. In both Alepu and Stomopolu marshes, a more direct influence was noted. Some measures for decreasing the negative impact as well as for successful management of all water basins in the Ropotamo Reserve Complex are proposed. Realization of long-term monitoring of the water fauna, including the fish, is recommended. © 1999 Published by Elsevier Science Ltd on behalf of the IAWQ. All rights reserved

## KEYWORDS

Ichthyofauna; species diversity; impact; conservation; management.

## INTRODUCTION

The wetlands of the Ropotamo Reserve Complex include the firth (estuary) of the Ropotamo river, adjacent marsh Vodni lili Reserve and three coastal lagoons: Arcutino, Alepu and Stomopolu marshes (Dimitrov *et al.*, 1997). The firth of the river is characterized with an average depth of about 2.5 m (maximum 5.2 m), a variable salinity increasing toward the sea and a sluggish current. The bottom is covered mainly by silt (Karapetkova and Peshev, 1973). According to Rojdestvenski (1962) the slow rate of vertical water exchange causes an oxygen deficiency in the bottom water level with higher salinity. Only the intensive influx of the sea water can eliminate this deficiency. The small marsh Vodni lili has been formed in an old river bed. At present the three coastal marshes have no direct connection with the sea. The smallest marsh - Arcutino (surface about 0.03 km<sup>2</sup>) is a freshwater basin. In the largest one - Alepu (0.14 km<sup>2</sup>) the average salinity is about 3.5‰ and in Stomopolu marsh (0.06 km<sup>2</sup>) - it varies from 1.5 to 4‰. As the river firth as the marshes are eutrophic basins (Ivanov *et al.*, 1964).

All wetlands of the Ropotamo Reserve Complex are quite important objects from ecological and conservation points of view. The firth of the Ropotamo river (with the adjacent marsh Vodni lili) is a

Natural Reserve, the Alepu marsh is a Natural Landmark and Stomopolu marsh is a Protected Area according to Bulgarian legislation. Moreover, the Arcutino marsh is a wetland of international importance according to the Ramsar Convention; both Ropotamo Reserve and Alepu marsh are CORINE Subsites (Dimitrov *et al.*, 1997).

There is insufficient information in the literature concerning the ichthyofauna of the three studied coastal marshes. The known facts are that in Alepu different mullets have entered through the canal from the sea and that in both Stomopolu and Arcutino marshes the carp *Cyprinus carpio* has been introduced (Ivanov *et al.*, 1964). The ichthyofauna of the Ropotamo river is better studied. The fullest information is given in Karapetkova and Peshev (1973), but no investigations on the fish population have been carried out for the last 20 years.

The aim of this investigation is to discover the actual state of the ichthyofauna in the water basins of Ropotamo Reserve Complex and to determine the ecological, conservation and economic aspects of its management.

## MATERIAL AND METHODS

The investigations were carried out in the summer and autumn of 1996. The common ichthyological methods were used. The fish were caught by different nets at 2-4 points in each wetland. The species and the size of each fish as well as the food composition in the digestive tract were determined. Some information received from foresters and fishermen is also used. A comparison between the obtained results and the literature data is made. The factors affecting the fish populations in different basins are analyzed.

Table 1. Species composition of ichthyofauna in the investigated wetlands (T - threatened species; E - endemic species; N - new species for the region; ++ - the most numerous species)

Taxa	Ropotamo	Arcutino	Stomopolu	Alepu
Fam. Cyprinidae				
<i>Chalcalburnus chalcoides</i> T	++			
<i>Vimba vimba tenella</i>	++			
<i>Scardinius erythrophthalmus</i>	++			++
<i>Carassius auratus gibelio</i>	+			++
<i>Cyprinus carpio</i>	+		+	+
<i>Leuciscus cephalus</i>	+			
<i>Leuciscus boristhenicus</i>	+			
<i>Gobio gobio</i>	+			
<i>Rhodeus sericeus amarus</i>	+			
<i>Tinca tinca</i> N			++	
<i>Pseudorasbora parva</i> N			++	
fam. Gasterosteidae				
<i>Gasterosteus aculeatus</i> T	+	+		+
fam. Poeciliidae				
<i>Gambusia affinis holbrooki</i>	++	++	++	++
fam. Percidae				
<i>Perca fluviatilis</i>				+
<i>Stizostedion lucioperca</i>	+			
fam. Centrarchidae				
<i>Lepomis gibbosus</i> N			+	
fam. Mugilidae				
<i>Mugil cephalus</i>	+			
<i>Mugil (Liza) auratus</i>	++			
<i>Mugil (Liza) saliens</i>	++			
<i>Mugil (Liza) ramada</i>	+			
fam. Atherinidae				
<i>Atherina mochon pontica</i> T	++			
fam. Clupeidae				

Taxa	Ropotamo	Arcutino	Stomopolu	Alepu
<i>Alosa ponticai pontica</i>	+			
<i>Alosa caspia bulgarica</i> E T	+			
Fam. Engraulidae				
<i>Engraulis encrasicholus ponticus</i>	+			
fam. Pomatomidae				
<i>Pomatomus saltatrix</i>				
fam. Carangidae				
<i>Trachurus mediterraneus ponticus</i>	+			
fam. Serranidae				
<i>Morone labrax</i>	+			
fam. Sparidae				
<i>Diplodus annularis</i>	+			
fam. Sciaenidae				
<i>Sciaena umbra</i>	+			
fam. Maenidae				
<i>Spicara smaris</i>	+			
fam. Labridae				
<i>Symphodus ocellatus</i>	++			
<i>Symphodus cinereus</i>	++			
<i>Symphodus tinca</i>	++			
<i>Symphodus roissali</i>	+			
fam. Blenniidae				
<i>Blennius sanguinolentus</i>	+			
<i>Blennius pavo</i>	+			
fam. Gobiidae				
<i>Neogobius melanostomus</i> E	++			
<i>Mesogobius gymnotrachelus</i>	+			
<i>Proteorhinus marmoratus</i>	+			
<i>Gobius ophiocephalus</i>	+			
<i>Gobius niger</i>	+			
<i>Neogobius cephalarges</i>	+			
<i>Mesogobius batrachocephalus</i> E	+			
fam. Trachinidae				
<i>Trachinus draco</i>	+			
fam. Ophidiidae				
<i>Ophidion rochei</i>	+			
fam. Mullidae				
<i>Mullus barbatus ponticus</i>	+			
fam. Syngnathidae				
<i>Syngnathus nigrolineatus</i>	++			
<i>Syngnathus typhle argentatus</i>	+			
<i>Nerophis ophidion</i>	+			
fam. Gadidae				
<i>Gaidropsarus mediterraneus</i>	+			
fam. Anguillidae				
<i>Anguilla anguilla</i> T	+			
fam. Uranoscopidae				
<i>Uranoscopus scaber</i>	+			
fam. Scopthalmidae				
<i>Psetta maxima maeotica</i> E	+			
fam. Soleidae				
<i>Solea nasuta</i>	+			
fam. Pleuronectidae				
<i>Platichthys flesus luscus</i>	+			

## RESULTS AND DISCUSSION

Ropotamo river and Vodni lili marsh*Species diversity of the ichthyofauna*

In the firth of the Ropotamo river 50 fish species - residents and transitory inhabitants - were found (Table 1).

The comparison with the literature data (Karapetkova and Peshev, 1973) shows that there are no changes in the species composition of the residents. The freshwater fish predominate in this group. They are represented by 15 species. The most numerous ones are *Chalcalburnus chalcoides* and *Vimba vimba tenella*, found along the whole firth. In the upper zone of the firth high relative numbers of rudd *Scardinius erythrophthalmus* were registered too. Obviously the chub *Leuciscus cephalus* is no longer a "numerous species" as it was in the past (Karapetkova and Peshev, 1973). The rest of the freshwater species were found rarely during the study. Their number probably depends mainly on the water salinity. The most numerous species among the residents of marine origin is *Neogobius melanostomus*. The pipefish *Syngnathus nigrolineatus* was also numerous in the catches but only in the lower zone of the firth. The threespined stickleback was caught in the whole area studied but in low numbers.

The species composition, numbers and distribution of transitory inhabitants in the firth are quite variable, but according to the data obtained for this group no considerable changes have occurred during the last 20 years (in comparison with the data of Karapetkova and Peshev, 1973). Our results show that, as a whole, in the firth the families *Mugilidae* and *Atherinidae* have the most lasting and numerous presence. Some specimens of the family *Mugilidae* stay here during the mild winters. It must be noted that the black mullet *Mugil cephalus* has lost its leading role among mugilids (Karapetkova and Peshev, 1973) and *Liza saliens* has the highest numbers. This change evidently corresponds with the general tendencies occurring in the Black Sea during recent years. The rest of the fish species inhabit mainly the lowest zone of the firth near the sea, where the highest species diversity was found. The families *Gobiidae*, *Labridae*, *Bleniidae* and *Syngnathidae* are presented with highest numbers here. From April to September *Alosa pontica pontica*, *Alosa caspia bulgarica* and *Anguilla anguilla* come inside the firth but as in the past they remain rare species.

In the Vodni lili marsh three fish species were found. *Chalcalburnus chalcoides* predominates. This species spawns here but in late summer the marsh runs dry, so many larvae and juveniles die. The rudd is not numerous despite that in former studies it has been noted as a main species (Karapetkova and Peshev, 1973). The threespined stickleback is also rare species in this basin.

Among all species found in the area studied five (*Alosa caspia bulgarica*, *Chalcalburnus chalcoides*, *Atherina mochon pontica*, threespined stickleback and *Anguilla anguilla*) are registered in the Red Book of Bulgaria with "threatened" status (Karapetkova and Pomakov, 1985; Karapetkova and Zivkov, 1995). The other species do not have an official conservation status but it must be noted that a great part of them are classified as "rare species" or "species with restricted distribution in Bulgaria" (Karapetkova *et al.*, 1998). In the river four species of different levels of endemism were also found. For example, *Alosa caspia bulgarica* is a Southern Black Sea endemic species, *Psetta maxima maeotica* is a Black Sea endemic subspecies. Some gobies such as *Mesogobius batrachocephalus* and *Neogobius melanostomus* are Caspian relicts recently found only in the Black and Azov seas (Karapetkova and Zivkov, 1995).

*Ecological and conservation problems and threats to fish populations*

The data obtained show that the prohibition on fishing and the restriction of navigation have had a stabilising effect on the ichthyofauna during recent years. The food resources are not a limiting factor of its development because they obviously satisfy the needs of fish. On the other hand, the dam construction in the catchment area leads to a considerable disturbance of the natural water balance. This is one of the causes for the blocking up of the river's mouth, as well for the drying up of the adjacent small swamps and marshes. Another cause for the blocking up of the river's mouth is the change of the marine streams structure in the

bay in front of the estuary, due to the construction of moles and piers. The pollution of the Black Sea water and the intensive marine fishing also affect the populations of transitory fish species.

For the conservation of fish abundance it is necessary to: prolong the prohibition of fishing and the restriction of navigation; to assure the normal water regime of the river regulating the water balance in the catchment area; to start the restoration of the normal water exchange between the river and the sea for supporting the numbers of the transitory inhabitants.

### Coastal marshes

#### *Species diversity of fish*

Much lower species diversity in all three studied coastal marshes was registered. Due to the lack of a direct connection between these basins and the sea, the group of transitory inhabitants is absent here (Table 1). The ichthyofauna of Arcutino marsh is the poorest as a result of its drying up in 1995. Both the threespined stickleback and mosquito fish, *Gambusia affinis holbrooki* (Table 1), are characterized by high adaptability to unfavourable conditions.

Prerequisites for greater abundance of the ichthyofauna exist in the largest marsh Alepu. The fish population is composed mainly of freshwater species and the cyprinids predominate. The most numerous species from this family are *Scardinius erythrophthalmus* and the gold fish *Carassius auratus gibelio*. The carp introduced in the marsh is a rare species now. Some freshwater fish from other families are also caught (Table 1). One of the most numerous species, as it is in most parts of Bulgarian coastal lakes and marshes, is the mosquito fish (Fam. Poeciliidae). It has been introduced for control of the mosquitoes. Among the fishes of marine origin in Alepu marsh only the threespined stickleback was found (Table 1).

Stomopolu marsh is used for pisciculture. In 1991 it was stocked with about 40 thousand juveniles of carp and tench *Tinca tinca*. In total six fish species were found in the marsh (Table 1) during the investigation. It is obvious that the most numerous species in the ichthyofauna of this basin is of anthropogenous origin. It is of particular interest that the small-sized fishes predominate. This concerns not only the small-sized species but also the tench and the carp.

#### *Ecological and conservation problems and threats to fish populations*

The studied marshes are affected by anthropogenous influences to different degrees. In Arcutino marsh the lowest degree of direct impact is noted. The development of the ichthyofauna is limited mainly by the water balance, disturbed by the hydrotechnical construction in the catchment area. Alepu marsh is affected by the urbanisation of the region. The resort village "Djuni" has been built close to it. The roads make the marsh accessible by cars and the absence of fences gives a possibility for illegal fishing. Stomopolu marsh has been an object of anthropogenous influences for a long time because of the nearness of Primorsko town. At present the main impact is the fish culture. As stated above, the ichthyofauna is strongly affected by human intervention. Three of the introduced fish species (tench, pumpkinseed *Lepomis gibbosus* and pseudorasbore *Pseudorasbora parva*) are alien elements for the coastal basins in the whole area south of the Burgas lake. Both pumpkinseed and pseudorasbore, introduced accidentally, are quite undesirable in water basins where fish species of higher conservation or economic value are found. It is necessary to take measures against the water pollution and illegal fishing both in Alepu and Stomopolu marshes. The presence of some species - objects of sport fishing - gives possibilities to use these marshes as an additional tourist attraction. On the other hand it is possible to manipulate the ichthyofauna in Stomopolu marsh for the best utilisation of the existing food resources as well as for biological control of the water quality. However it is necessary to realise such kind of activities only after extensive research and under strict control.

For the water ecosystems of the Alepu and Stomopolu marshes an eventual intensive fertilisation of the catchment area is a potential threat. The influx of high quantities of nitrogen and phosphorus and the lack of water exchange between the marshes and the sea can provoke accelerated hypereutrophication. In the lakes Durankulac, Shabla, Ezerets and some other coastal basins similar changes have been noted (Kalchev and Botev, 1998).

## CONCLUSION AND RECOMMENDATIONS

In Ropotamo Reserve Complex as a whole a high species diversity of fish fauna is found. The populations of the resident species, including the "threatened" ones, are actually relatively stable due to the legal measures for protection of the wetlands in the region. The trophic resources in all studied basins answer the demands of the fish at different trophic levels. From the ichthyological point of view the firth of Ropotamo river and adjacent swamps are of the highest conservation importance. The coastal marshes are interesting mainly as specific water ecosystems.

In the whole area, a main cause for the problems of the ichthyofauna is the disturbance of the water balance by hydrotechnical construction in the catchment basins. Furthermore, a specific negative factor for the fish fauna in the firth of the Ropotamo river is the change of the marine streams in the bay in front of the river mouth. The pollution of Black Sea water and intensive marine fishing also affect the populations of transitory fish species. In both Alepu and Stomopolu marshes the urbanisation processes, water pollution, pisciculture activities and illegal fishing exert a direct influence on the ichthyofauna.

For the conservation of species richness, especially concerning the rare and endemic species in the Ropotamo river, it is necessary to prolong the restrictions of navigation and fishing as well as to start the restoration of the river mouth. In the whole region it is necessary to assure a normal water regime regulating the water balance in the catchment area. In both Alepu and Stomopolu marshes measures against pollution and illegal fishing must be taken. These marshes could be used as an additional attraction for tourist anglers. In Stomopolu marsh some manipulation of the species composition of the resident ichthyofauna is admissible. It would be advisable to restore the direct connection of these marshes with the sea as this can moderate the process of eutrophication and will assure prerequisites for reappearance of the transitory inhabitants here. It must be noted that these activities should be realised after extensive research and under strict control only. In all cases it is necessary to provide and carry out a long-term monitoring program.

For successful management of the wetlands in Ropotamo Reserve Complex, as well as for better utilisation of their natural resources, it is necessary to combine the interests of both the people (fishermen, hunters, foresters) and the organisations concerned (governmental, local administration, NGOs, tourist operators etc.) through corresponding information and education program.

## ACKNOWLEDGEMENTS

The investigations were carried out thanks to financial support from the Bulgarian-Swiss Biodiversity Conservation Program.

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