STOCK ASSESSMENT OF *PAMPUS ARGENTEUS* (EUPHRASEN, 1788) IN THE NORTHWEST OF THE PERSIAN GULF

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KEYWORDS: *Pampus argenteus*, ELEFAN, growth parameters, Persian Gulf, fisheries management.

ABSTRACT

Monthly data of length composition for silver pomfret, *Pampus argenteus*, were landed from the between the Northwest of Persian Gulf (Khuzestan province), from March 2004 to February 2005. ELEFAN in the software package FiSAT was used to analyse of their length frequency data. Maximum fork length and weight were 132 cm and 18.4 kg respectively. The parameter values of the von Bertalanffy growth function were: L_∞ = 339 mm; k = 0.55 and t_0 = - 0.16 years. The estimated value of the instantaneous rates of total mortalities, Z based on length converted catch curve was 2.07 $year^{-1}$. The instantaneous rates of natural mortality, M based on growth parameters and mean environmental temperature was 0.58 $year^{-1}$. The annual instantaneous fishing mortality rate, F was estimated to be 1.49. Exploitation rate, E (0.72 $year^{-1}$) and the results derived from yield-per-recruit analysis indicated that the resource was heavily over-exploited, and that management of this species should have been implemented rapidly to remain sustainable.

REZUMAT: Evaluarea stocurilor de *Pampus argenteus* (Euphrasen, 1788) in nord-vestul Golfului Persic.

Date lunare privind lungimea exemplarelor de *Pampus argenteus* au fost colectate in zona de NV a Golfului Persic (provincia Khuzestan) din martie 2004 până în februarie 2005. Pentru analiza datelor de frecvență a lungimilor s-a utilizat programul ELEFAN din pachetul de programe FiSAT. Intervalele maxime de lungime şi greutate au fost 132 cm şi respectiv 18,4 kg. Valorile parametrilor funcției de creştere von Bertalanffy au fost: L_∞ = 339 mm; k = 0,55 şi t_0 = - 0,16 ani. Valoarea estimată a ratelor instantanee de mortalitate totală, Z bazate pe curba capturilor convertite în lungimi a fost de 2,07 an^{-1}. Valoarea estimată a ratelor instantanee de mortalitate naturală, M bazate pe parametrii de creştere şi pe media de temperatură din mediu a fost de 0,58 an^{-1}. Rata anuală de mortalitate instantanee la pescuit, F a fost estimată la 1,49. Rata de exploatare, E (0,72 an^{-1}) şi rezlutatele derivate din analiza randament-per-exemplar capturat a arătat că resursa a fost intens supraexploatată şi că gestiunea acestei specii ar trebui implementată rapid pentru ca resursa să rămână sustenabilă.

RÉSUMÉ: L'évaluation des stocks de *Pampus argenteus* (Euphrasen, 1788) dans le nord-ouest du Golfe Persique.

Des données mensuelles sur la longueur des exemplaires de *Pampus argenteus* ont été collectées dans la région de nord-ouest du Golfe Persique (la province de Khuzestân), de Mars 2004 à Février 2005. L'analyse des données de fréquence des longueurs a été faite en utilisant le programme ELEFAN du paquet de programmes FiSAT. L'intervalle des valeurs maximales de longueur et de poids a été de 132 cm respectivement 18,4 kg. Les valeurs des paramètres de la fonction de croissance von Bertalanffy ont été: L_∞ = 339 mm; k = 0,55 et t_0 = - 0,16 ans. La valeur estimée des taux instantanés de mortalités totales, Z basés sur la courbe des captures converties en longueurs a été de 2,07 année^{-1}. Les taux instantanés de mortalité naturelle, M basés sur les paramètres de croissance et la température du milieu a été de 0,58 année^{-1}. Le taux instantané annuel de mortalité due à la pêche, F a été estimé à 1,49. Le taux d'exploitation, E (0,72 année^{-1}) et les résultats qui en dérivent ont indiqué le fait que la ressource est fortement surexploitée et que la gestion de cette espèce devrait être implémentée rapidement pour rester soutenable.

INTRODUCTION

The silver pomfret, *Pampus argenteus*, locally known as 'zobaidy' is a member of the Stromateidae family and is widely distributed throughout Indo-West Pacific: Persian Gulf to Indonesia, Japan, West and Southwest of Korea and Eastern parts of China (Haedrich, 1984). Silver pomfret is one of the most commercially important fish in the Northern Persian Gulf that its stock is shared by Iran, Iraq and Kuwait (Al-Hussaini, 2003). Due to the high market demand and economic value, commercial fisheries in Persian Gulf usually target them.

Information on growth, mortality and population biology of this species are available from Korea (Lee and Kim, 1992 and Lee et al., 1992), Kuwait (Morgan, 1985; Al-Hussaini, 2003; Al-Abdul-Elah et al., 2002), China (Liming and Yongsong, 2005; Lin et al., 2006), bay of Bengal (Mustafa, 1993 and 1999). Reports on the silver pomfret stock of the northern Persian Gulf is limited to the works by Ali, (2001) and Mohamed et al., (2008) from the Iraqi waters and Salari, (1996) and Parsamanesh et al., (2003) from Iranian waters.

The catch statistics show that, in spite of increasing fishing effort, the total catches and catch rates of Iran and Kuwait decreased in recent years (Al-Hussaini, 2003) which subsequently lead to economic loss of the fishing sector in the area. It might be the result of high fishing pressure upon spawning biomass and the young fishes smaller than first maturity length. Many fish populations in the Persian Gulf have been heavily exploited and fishing effort may be above optimum levels for some species (Samuel et al., 1987 and Siddeek et al., 1999). The expansion of the fishing fleet of many Gulf countries and lack of appropriate data on most stocks (FAO, 1994) underscore the need to assess the region's fisheries resources.

In this context an attempt was made to understand the present status of the stock and the impact of fishing on the same. The specific objectives include estimation of the growth parameters, mortality coefficients and length at first capture (Lc_{50}) and the evaluation of the yield and biomass-per-recruit to provide a preliminary assessment of the stock status of *Pampus argenteus* in the Northwest of Persian Gulf.

Knowledge of growth parameters determinations, minimum legal size and other estimation that done in this study is important in fishery assessment and management of the *P. argenteus* population because they form the basis information required in determining whether an area is heavily fished or under-exploited to allow possible management measure to be taken.

MATERIALS AND METHODS

Fish samples were collected during April 2004 to March 2005 from commercial catches of Hendijan ($49^{O}33'$E - $30^{O}04'$ N) and Abadan ($48^{O}35'$ E - $30^{O}10'$ N), two major landing centres in the Khuzestan Province (Fig. 1).

Figure 1: Location of study and landing areas for *Pampus argenteus* in Northwest of Persian Gulf (2004 - 2005).

In total 6789 fish (both sexes combined) were collected and studied throughout the period of study. Fork length (FL) of individual was measured to the nearest 1 mm by using a measurement board. The length frequency data were pooled into groups with 10 mm length intervals.

Growth was investigated by fitting the von Bertalanffy growth function (VBGF) to length frequency data (von Bertalanffy, 1938). The von Bertalanffy growth model as given by Sparre and Venema (1998) is defined as

$$L_t = L_\infty(1 - e^{-k(t-t0)})$$

where, L_t is the length at time t, L_∞ is the asymptotic length, k is the growth coefficient, and t_0 is the hypothetical age when the size of fish is zero.

Length-frequency data were analyzed with the most recent version of FiSAT II (FAO ICLARM STOCK ASSESSMENT TOOLS) version 1 software package (Gayanilo et al., 2003). The value for L_∞ was obtained by Powell-Wetherall method (Sparre and Venema, 1992).

The method used to estimate k was electronic length frequency analysis (ELEFAN I) (Pauly et al., 1984). Using the value of L_∞ preliminary, values of k were scanned and the value of k that gave the highest Rn value (goodness of fit index value) was obtained (Gayanilo et al., 2003).

In order to compare the growth of *P. argenteus* from the study area with those from other studies, the growth performance index was calculated (Pauly and Munro, 1984).

$$\phi' = \log k + 2\log L_\infty$$

The estimate of theoretical age at length zero (t_0) was obtained ssing Pauly's empirical equation (Pauly, 1980a)

$$\log(-t_0) = -0.3922 - 0.275 \log L_\infty - 1.038\, k$$

The annual instantaneous rate of total mortality (Z) was estimated using the length converted catch curve method (Pauly, 1983). Length frequency samples were converted into relative age frequency distribiution using parameters of the von Bertalanffy growth function.

The annual instantaneous rate of natural mortality (M) was estimated using Pauly's empirical formula (1980b):

$$\ln M = -0.0152 - 0.279 \ln L_\infty + 0.6543 \ln k + 0.463 \ln T$$

where L_∞ is the asymptotic length, k is the growth coefficient and T is the mean annual water temperature of the area (in °C), which is assumed to reflect the water surface temperature.

The annual instantaneous rate of fishing mortality (F) was obtained by subtracting the natural mortality rate (M) from the total mortality rate (Z) according to the Beverton and Holt (1956). The exploitation rate (E) was calculated by the Beverton and Holt formula (1957), as the proportion of the fishing mortality relative to total mortality.

$$E = F/Z$$

The probability of capture was estimated by backwards extrapolation of the descending limb of the length converted catch curve. A selectivity curve was generated using linear regression fitted to the ascending data points from a plot of the probability of capture against length, which was used to derive values of the lengths at capture at probabilities of 0.25 (L_{250}), 0.5 (L_{50}), 0.75 (L_{75}) and 1 (L_{100}).

The relative yield-per-recruit (Y'/R) and relative biomass-per-recruit (B'/R) were estimated using the knife-edge method of Beverton and Holt model (1957):

$$Y'/R = EU^{M/k}\,[1 - (3U/1 + m) + (3U^2/1+2\,m) + (U^3/1 + 3\,m)]$$

where:

$$m = (1 - E)/(M/k) = k/Z$$

$$U = 1 - (Lc/L_\infty)$$

$$E = F/Z \text{ (exploitation rate)}$$

$$B'/R = (Y'/R)/F$$

RESULTS

A total of 6789 specimens were collected during the study period in a ranging size between 95 mm to 312 mm (FL).

3.1. Growth

The von Bertalanffy growth parameters for *Pampus argenteus* population were L_∞ = 339 mm (FL), k = 0.55 year^{-1} (the value of k-scan (Rn) was 0.24) and t_0 = - 0.16 year. The L_∞ value was estimated using the regression equation fitted to Powell-Wetherall plot (y = - 0.223x + 75.59, r^2 = 0.99) (Fig. 2).

We use this value in all the future analysis involved in this study.

The von Bertalanffy equation for growth in length for this species could thus be written as:

$$L_t = 339\,(1 - e^{-0.55\,(t + 0.16)})$$

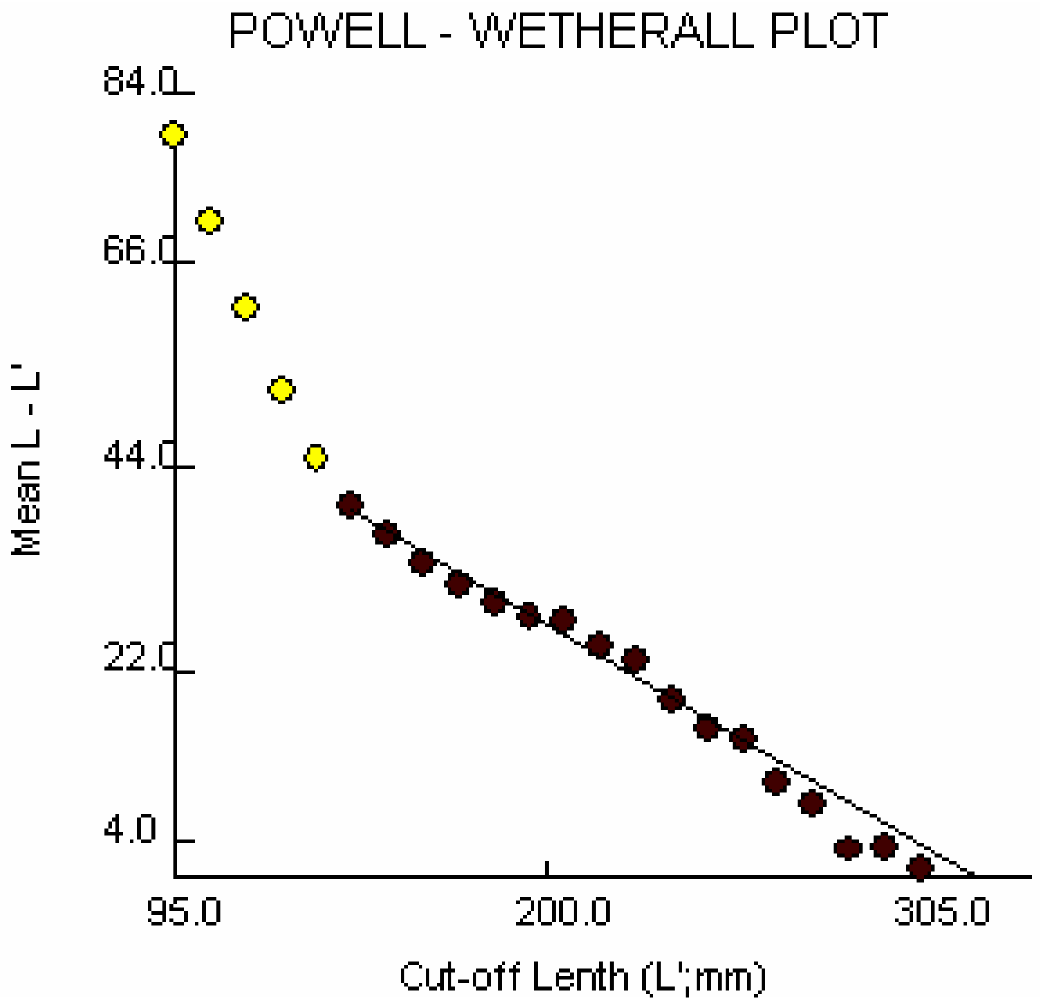


Figure 2: the Powell-Wetherall plot of *Pampus argenteus* in Northwest of Persian Gulf (2004 - 2005).

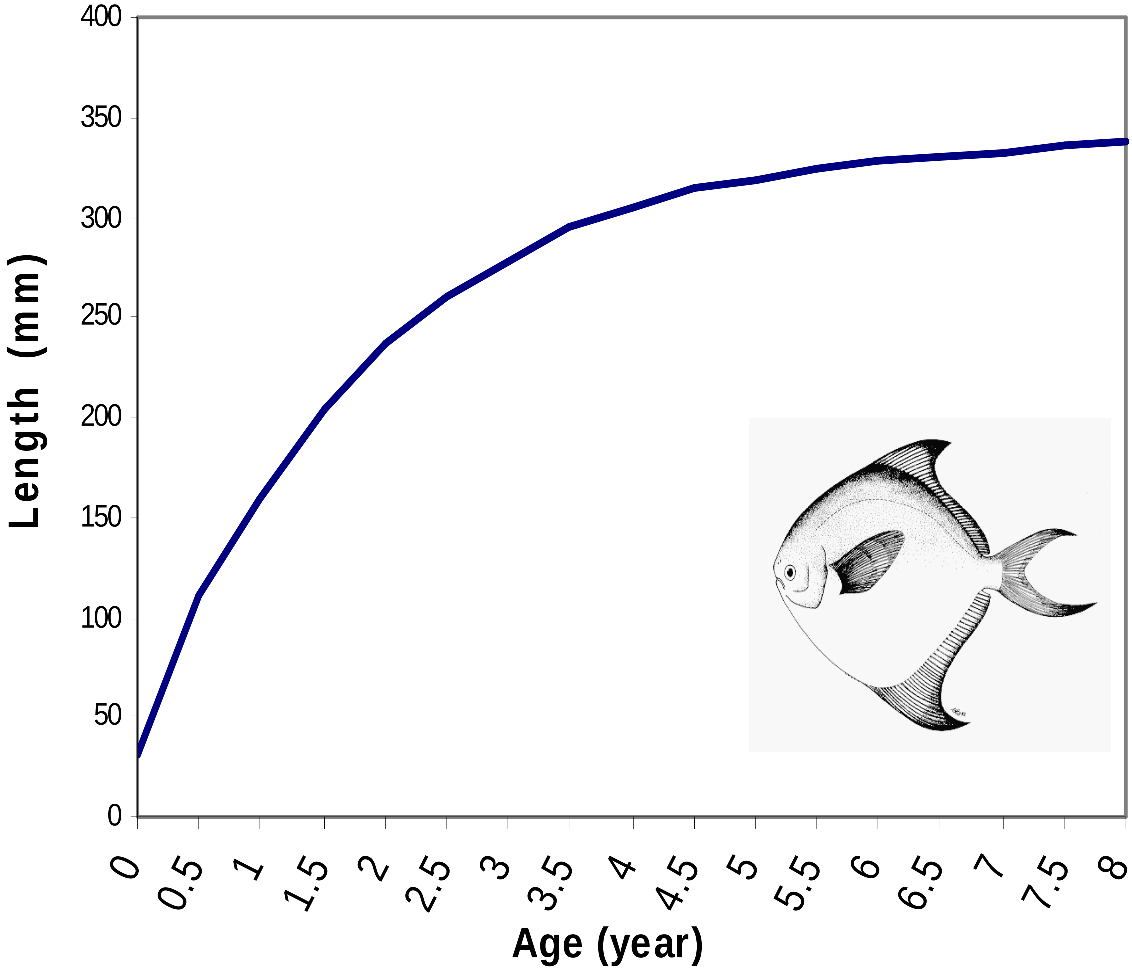
The yearly growth curve of this particular fish species using the von Bertalanffy growth parameter indicate that it attained 159.33 mm, 237.3 mm, 277.98 mm, 305.1 mm, 318.66 mm and 328.83 mm, respectively from one year to six years (Fig. 3).

The obtained raw data were restructured with the ELEFAN I, plotting the curves from the growth parameters.

The catch curves showed the fact that fisheries operate upon five cohorts of the population.

The value of growth performance index was estimated from the growth parameters as:

ϕ'= 2.8 (Tab. 1).



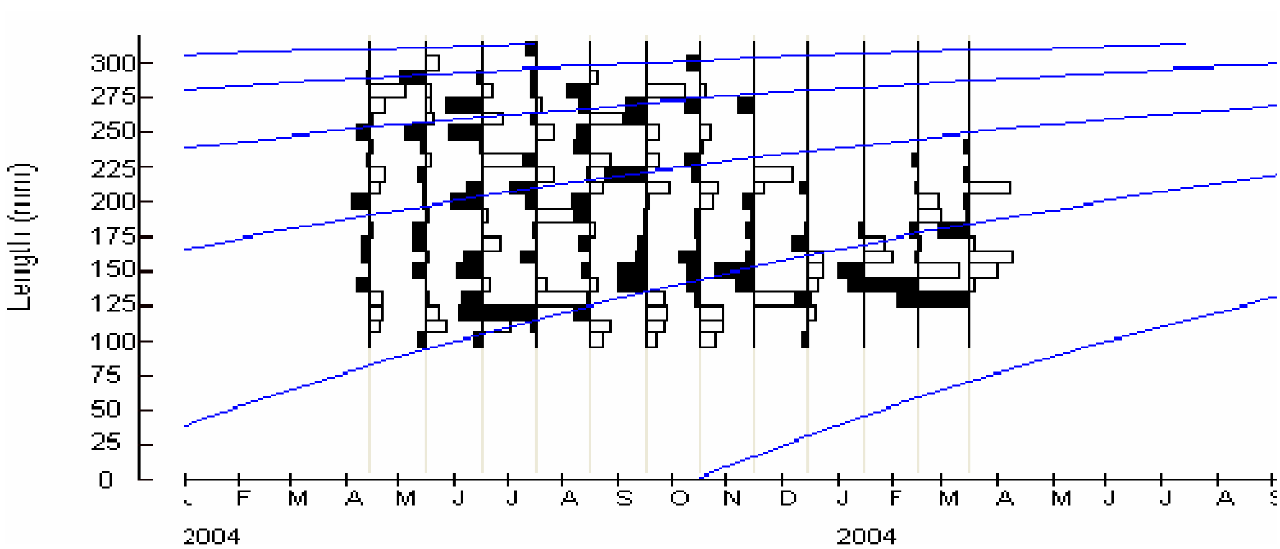


Figure 3: Growth curve of *Pampus argenteus* (L_∞ = 339 mm, k = 0.55, t_0 = - 0.16) in Northwest Persian Gulf (2004 - 2005).

3.2. Mortality

The annual instantaneous rate of total mortality (Z) derived from length-frequency catch curve was 2.07 $year^{-1}$, The solid line show the regression equation fitted to data for length converted catch curve (y = - 2.07x + 11.5, r^2 = 0.97).

The annual instantaneous rate of natural mortality (M) derived from the Pauly equation (1983) was estimated as 0.58 $year^{-1}$. The 12 months water temperature average that use in this study was 25°C. Annual instantaneous rate of fishing mortality (F) was 1.49 $year^{-1}$. The exploitation rate (E) was estimated as 0.72 $year^{-1}$.

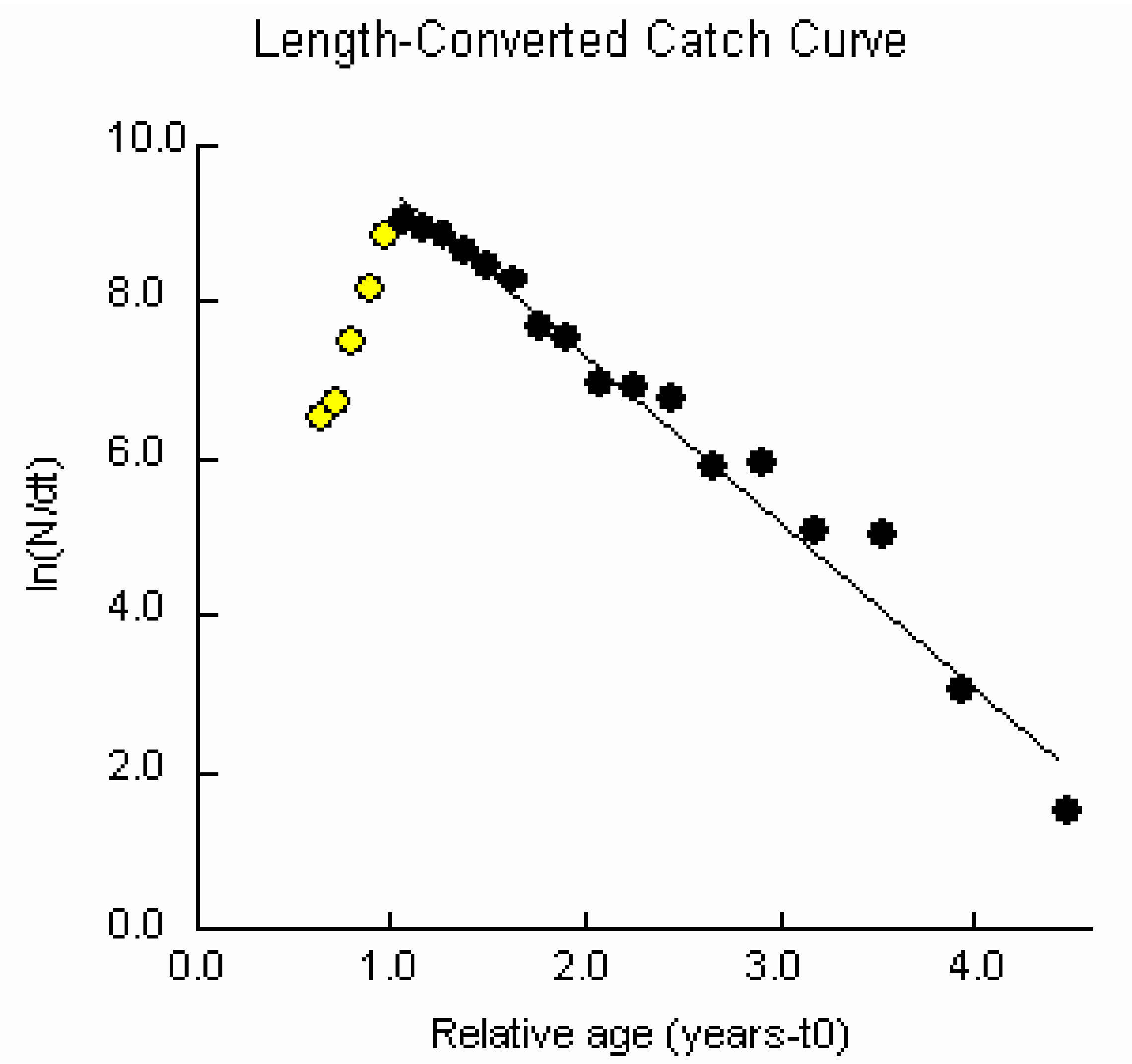


Figure 4: The length-converted catch curve for *Pampus argenteus* in Northwest of Persian Gulf (2004 - 2005).

The mean lengths at first capture, Lc or L_{50}, was 101 mm (FL) and the lengths at capture at probabilities of 0.25 (L_{250}) and 0.75 (L_{75}) were 90 and 110 mm (FL), respectively. Fish were fully recruited to the fishery at a 150 mm (FL).

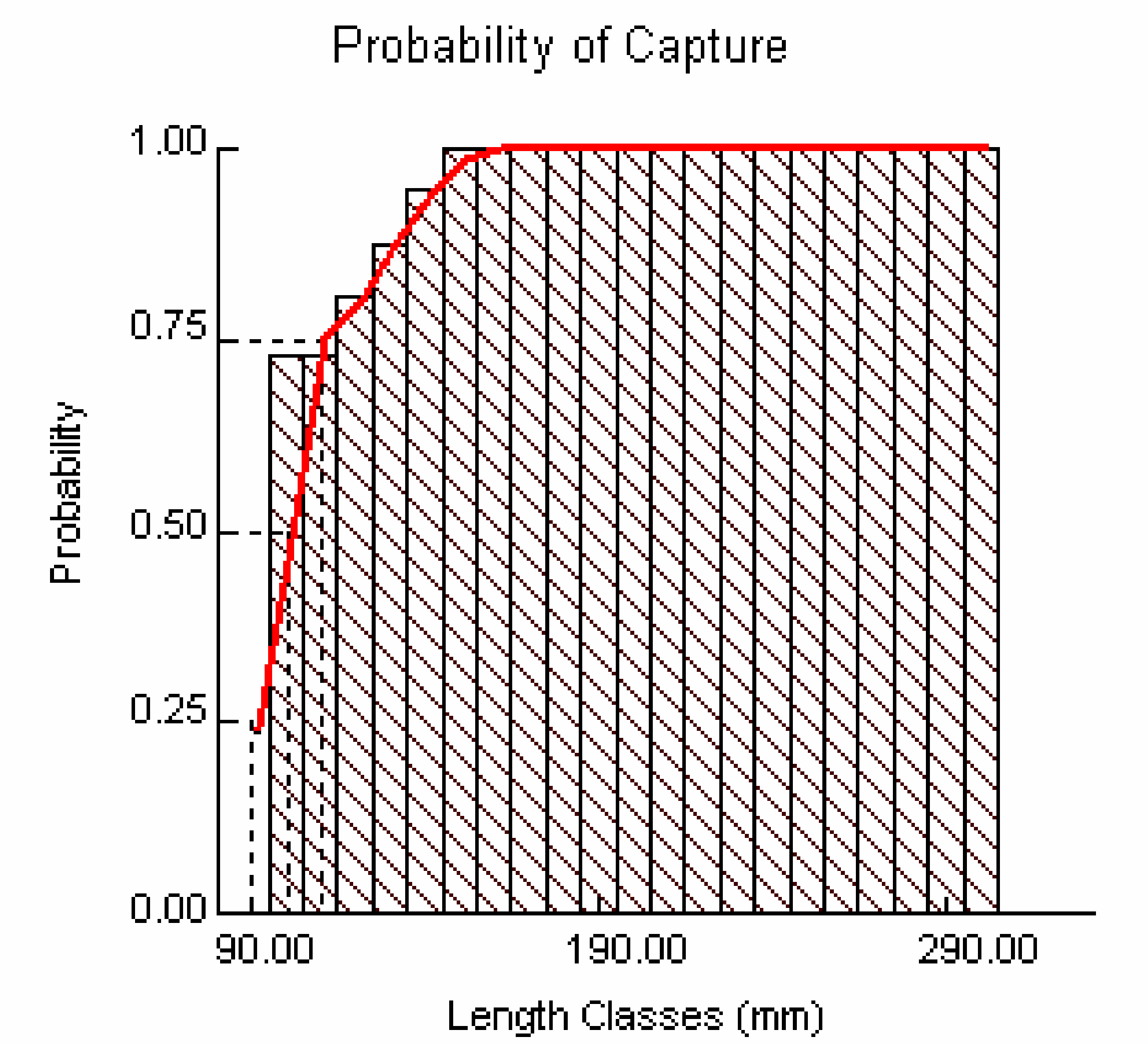


Figure 6: The probability of capture plot for *Pampus argenteus* in Northwest of Persian Gulf (2004 - 2005).

The relative yield-per-recruit (Y'/R) and biomass-per-recruit (B'/R)were determined as a function of Lc/L_∞ and M/K. The exploitation rate of population obtained in this study exceeded the maximum allowable limit based on yield-per-recruit calculation (E_{max}) which was 0.52 year^{-1}. E_{max} was level of exploitation that lead to muximun sustainable yield (MSY).

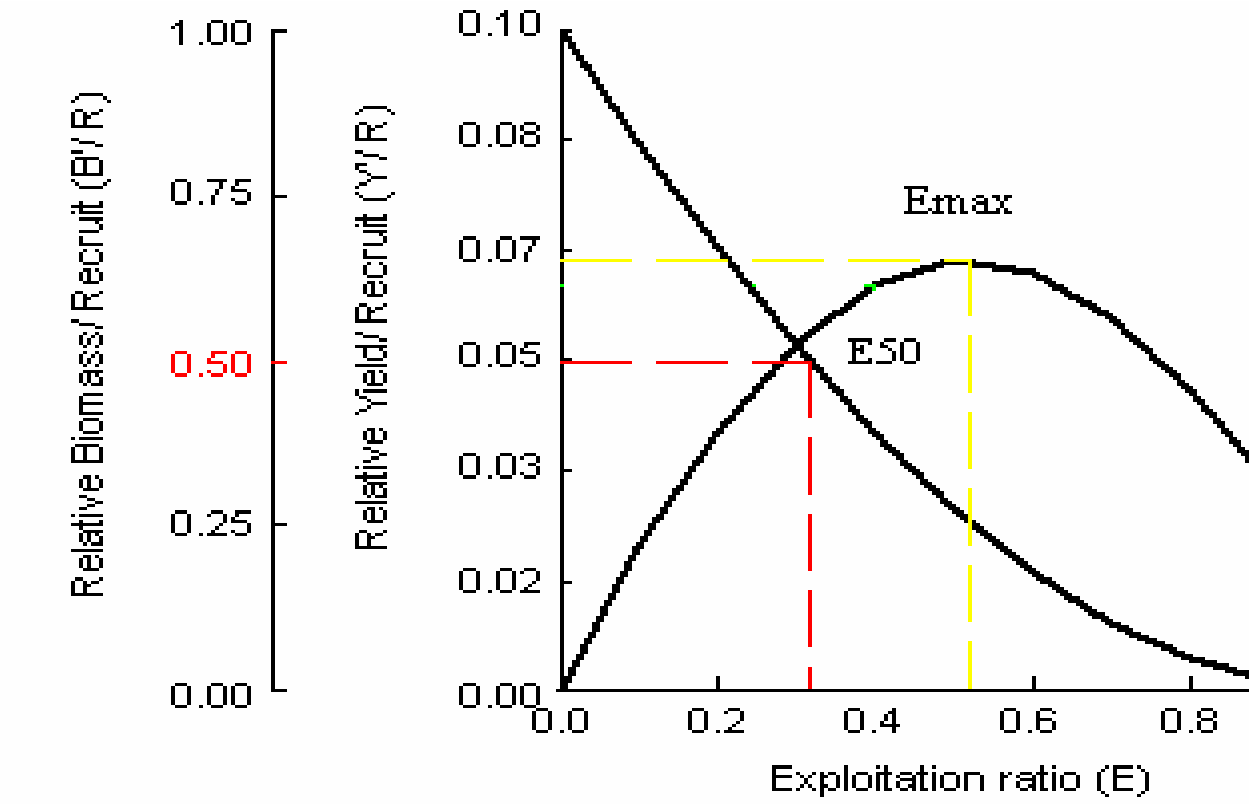


Figure 7: The relative yield and biomass per recruit plot of *Pampus argenteus* in Northwest of Persian Gulf (2004 - 2005), yellow line: E_{max}, red line: E_{50}.

DISCUSSION

Stock identification is important because continuous fishing on a particular population has a indirect effect on the other stocks population. Beverton and Holt (1957) pointed out that the two parameters of growth; asymptotic length (L_∞) and growth coefficient (K) are inversely proportional to each other. It implies that fishes with high L_∞ should have lower k values and vice versa.

The calculated values of growth parameters, L_∞ and k for *Pampus argenteus* population during the study period were as 339 mm and 0.55 (year^{-1}), respectively.

For comparison the published results of estimated growth parameters of the von Bertalanffy growth function derived from length frequency studies, are summarized in the table 1.

Table 1: Comparison of the estimates of growth parameters for *Pampus argenteus* from different areas.

L_∞ (mm)	ϕ'	k ($year^{-1}$)	Source	Area
325	2.72	0.55	Morgan (1985)	Persian Gulf (Kuwait)
315	2.97	0.95	Dwiponggo et al. (1986)	Java sea
336	2.47	0.26	Lee et al. (1992)	Korean waters
280	2.69	0.63	Mustafa (1993)	Bay of Bengal
298	2.67	0.53	Mustafa (1999)	Bay of Bengal
410	3.19	0.92	Parsamanesh et al., (2003)	Persian Gulf (Iran)
375	3.13	0.99	Salary (1996)	Musa estuary (Iran)
424	2.98	0.53	Mohamed (2008)	Persian Gulf (Iraq water)
339	2.8	0.55	Present study	Persian Gulf (Iran)

The estimates of L_∞ obtained from the studies in the Persian Gulf and others areas have a very wide range, with L_∞ between 280 and 339 mm (FL), the lowest estimated asymptotic length was calculated for Bay of Bengal (Mustafa, 1993) and the highest one was 424 for Persian Gulf (Mohamed et al., 2008). The estimated k was between 0.26 and 0.99. The L_∞ and k values obtained in this study are more similar to to the results given by Morgan (1985) in Kuwait water.

Our estimates of k and L_∞ was lower han earlier estimates of k and L_∞ reported from the same area (salary, 1996 and Parsamanesh et al., 2003).

The reasons for the variation of this values in the different regions are said to be due to the difference in Ecological differences, physiological conditions of the fish and nutritive conditions in the environment of fish or samling (Biswas, 1993). But the decline in the asymptotic length (L_∞) in our study area in the recent years seem to be the result of the increasing of fishing activities pressure on this fish population and may hence be related to excessive exploitation.

Age at zero length (t_0) was calculated as - 0.55. With negative t_0 values, juveniles grew more quickly than the predicted growth curve for adults, and with positive t_0 values, juveniles grew more slowly (King, 1995).

The growth performance index value (ϕ') is the result of the relation between L_∞ and k and should present close values for species phylogenetically related (Gayanillo et al., 1997). Thus, its values constitute a reference to validate the growth parameters estimate. The value ϕ' for the Kuwait study was 2.72, and was similar to the finding in the present study (2.8) suggesting that our estimates of the von Bertalanfty growth parameters are reliable (Tab. 1).

Many factors in the marine environment act to reduce the survivability of individuals in a population (King, 1984). These include adverse conditions, food lack, competition and, perhaps most important of all, predation. The mortality coefficients varies from year to year, because of environmental factors and especially relative abundance of predators in an area.

The instantaneous total mortality coefficient (Z) estimated using the length converted catch curve method (Pauly, 1983) during the present study was 2.07 year^{-1}. In this method length frequency data are used and a length-requency distribution can be converted to an age frequency distribution by means of this method. In length-catch curve analysis for estimation of total mortality, the initial ascending data points are not included in the regression (Fig. 5). These points represent younger age groups, which are subjected to a lower fishing mortality because they are either not fully recruited or not fully vulnerable to the fishing gear used (King, 1984). Perhaps only a proportion of each of the younger age classes can reach the fishing grounds, but is small enough to escape through the meshes of the gear used.

Our estimate of the total mortality coefficient (2.07 year^{-1}) compared well to that derived by Mohamed et al., (2008) for *Pampus argenteus* population in Iraq waters of Persian Gulf, 2.15 year^{-1}. Our estimate was considerably lower than the estimates of Parsamanesh et al., (2003) from the same area which ranged from 2.6 to 10.2 year^{-1}. The estimated value during this study was comparatively low when compared to the Z value estimated from Kuwait waters, which was 2.4 year^{-1} (Al-Hussaini, 1994). The levels of total mortality, 1.62 year^{-1} from Kuwait waters (Morgan, 1985) and Korean waters, 1.5 year^{-1}, (Lee et al., 1990) were both much higher than present study.

On the basis of 175 stocks independent data sets Pauly (1980b) has made a regression analysis of the natural mortality coefficient, M, (year^{-1}) on K (year^{-1}), L_∞ and T (average annual temperatures) which directly related to the growth coefficient (k) and inversely related to the asymptotic length (L_∞) and the lifespan (Beverton and Holt, 1956).

According to Pauly (1980b), natural mortality is the result of three components: physiological mortality, caused by disease, old age, or both (in theabsence of predators); selective mortality, caused by diminished performance of individuals, because of disease, old age, or both, making them accessible to predators; and risk mortality, unrelated to any physiological mechanism, and proportional only to the probability of encountering potential predators.

The instantaneous natural mortality coefficient (M) estimated using Pauly equation (1983) during the present study was 0.58 year^{-1}. The obtained value was less than the estimated values, 1.4-1.6 year^{-1} reported by Parsamanesh et al., (2003). Our result did not show much difference when compare to the instantaneous natural mortality coefficient estimated for the same species off the Korean waters, which was 0.5 year^{-1} (Lee et al., 1990). The derived value from Iraq waters of Persian Gulf 1.25 year^{-1} by Mohamed et al. (2008) was comparatively high when compared to the our estimation.

The value of the instantaneous fishing mortality coefficient (F) in the present study 1.49 year^{-1} was higher than the results of Mohamed et al., (2008) study which was 0.9 year^{-1}. Our estimate was considerably lower than the estimates of Parsamanesh et al., (2003) from the same area.

The exploitation ratio for population (E = 0.72 year^{-1}) in the present study is high. Gulland (1969) suggested that in an optimally exploited stock, fishing mortality should be equal to natural mortality, resulting in an exploitation rate of 0.50 year^{-1}. This shows that the population of silver pomfret in Northwest of Persian Gulf is being exploited at a higher than optimal level. Therefore, could be claimed that population was under the over fishing and there was fishing pressure on the *Pampus argenteus* population in the Northwest Persian Gulf. It can be asserted that the opulation in this area has not been managed properly.

The relative yield-per-recruit (Y'/R) and relative biomass-per-recruit (B'/R) values were obtained for estimated value of Lc and M/K, indicated that the present level of exploitation rate (E = 0.72 $year^{-1}$) exceeded the maximum allowable limit based on yield-per-recruit calculation (E_{max}) which was 0.52 $year^{-1}$. There was a reduction in the yield-per-recruit and thereby hampered the muximun sustainable yield (MSY). This suggests that exploitation of this stock has exceeded the maximum fishing level and thereby the fishing mortality seems to be a great concern for this stock.

A critical limitation of the yield-per-recruit model is the assumption that there is no relationship between the size of the spawning stock biomass and recruitment (Buxton, 1992). Even if the size at first capture is less than the size at first sexual maturity, the stock size may approach zero at high levels of fishing mortality in spite of predictions of high levels of yield-per-recruit. It is, therefore, important to consider the size of the spawning stock biomass across the range of fishing mortality rates when interpreting results (King, 1995).

For resource management purposes, it is suggested that the exploitation rate should be reduced to the optimum exploitation rate level witch obtained from the Beverton and Holt (1957) relative yield and biomass per recruit analysis. It is necessary to immediately impose fishing regulation on the stock and this can be done by gradually increasing the mesh size of the gears or by restricting fishing for spawning seasons or in spawning areas

Amrollahi et al., 2007 reported that the length at first maturity of this species from the region was 192 mm (FL) for the combined sexes.

In order to maintain the population in equilibrium it is of great importance to give each fish the chance of reproducing at least once in its lifetime to recruit the stock, and therefore the length at first capture, Lc, should be bigger than Lm (192 mm FL) while the actual fishery figure was less than it (71 % of total specimens was less than length at first maturity and there were specimens with 95 mm (FL)). As a result, the current Lc (101 mm FL) for *Pampus argenteus* population in Northwest of Persian Gulf was lower than Its Lm, this problem may cause a greater reduction of this fish catch in future due to the continuous removal of pre-spawning fishes.

Therefore a management work should be started to design a net of an appropriate mesh size to collect optimum lengths and increase the size at first capture to bigger than the size at first maturity. In same investigations that did in China sea: Liming and Yongsong (2005) suggested that Lc should be increased to 150 mm (Lm) from 120 mm, Lin et al., (2006) suggested that Lc should be reached 170 mm to have sustainable fishery. Morgan (1985) reported that the size at first maturity in Kuwait waters was 200 mm and for having sustainable fishery the Lc must reach Lm.

It was also understood that females belong to the larger length groups and contribute more to the commercial catches than males (Amrollahi et al., 2007). Hence high fishing pressure on this population and over-exploitation of females may lead to the collapse of this stock. Fisheries management options such as size-limit regulation, time-limit regulation for *Pampus argenteus* population in the northwest of Persian Gulf is essential.

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POLLUTING FACTORS AND THEIR EFFECTS ON THE ICHTHYOFAUNA OF THE LĂPUŞ VALLEY (MARAMUREŞ, ROMANIA)

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KEYWORDS: pollution, mining of non-ferrous metals, organic pollution, autopurification, resistent fish species.

ABSTRACT

Over the period 2003-2005 we made ichthiologic research in the basin of the Lapus River. During the sampling we noticed that in some area the water was polluted. In those areas fish were totally or partially missing.

The main pollution sources are those related to the non-ferrous metal extraction and processing, but there is also the pollution from organic substances resulted from the communal residual waters, as well as the "tuica" (alcoholic drink) distilleries.

Then, I confronted the spotting of the pollution sources with the results of the ichtiologic research. I noticed a significant correspondence between the qualitative and quantitative component of the ichtiofauna and the presence of these sources.

I could therefore notice the effectiveness of the process of self-purification of the water, as well as the existence of some species of fish showing a great degree of tolerance towards pollution.

REZUMAT: Factori poluanți şi efectele lor asupra ihtiofaunei în bazinul Lăpuşului.

În anii 2003 şi 2005 am efectuat cercetări ihtiologice în bazinul râului Lăpuş. Cu această ocazie am constatat că în anumite porțiuni apa era poluată iar peştii au lipsit total sau parțial.

Cele mai importante surse de poluare sunt legate de extracția minereurilor neferoase, dar este importantă şi poluarea cu substanțe organice reprezentată de reziduurile comunale şi borhotul rămas în urma distilării alcoolului.

Comparând localizarea surselor de poluare cu rezultatele pescuitului am constatat o corespondență significantă între acestea şi compoziția cantitativă şi calitativă a ihtiofaunei.

Am putut vedea şi rezultatele procesului de autoepurare şi am găsit şi specii de peşti rezistenți la poluare.

ZUSAMMENFASSUNG: Umweltverschmutzende Faktoren und ihre Auswirkungen auf die Ichthyofauna des Lapustals (Maramureş, Rumänien).

Während der Jahre 2003 und 2005 untersuchten wir den Lapus auf seine Ichthyofauna. Dabei stellten wir fest, dass in einigen Abschnitten das Wasser verschmutzt ist. Hier fehlten die Fische teilweise oder gänzlich.

Die Hauptverschmutzungsquellen ergeben sich aus der Nicht-eisen-metallgewinnung und verarbeitung. Hinzu kommt die Verschmutzung organischer Substanzen aus kommunalem Abwasser wie auch von Pflaumenschnaps-Destillerien.

Daraufhin wurden die Schadstoffeintragspunkte mit den Ergebnissen der ichthyologischen Untersuchung verglichen und ein deutlicher Zusammenhang zwischen dem quantitativen und qualitativen Vorkommen der Ichthyofauna und den Eintragspunkten festgestellt.

Ausserdem wurde die Wirksamkeit des Selbstreinigungsprozesses des Gewässers wie die Existenz einiger Fischarten mit hohem Toleranzgrad gegenüber Verschmutzung bemerkt.

INTRODUCTION

In 2000 the whole world was shocked by the tragical event when cyanides poured in the Lapus River destroyed a part of the ichthyological fauna of the Somes and Tisa rivers and reached even the Danube River.

However, this ecological catastrophe is only the tip of the iceberg, the valley of the Lapus River being continuously affected by pollution. The most important source of pollution here is represented by the mining of non-ferrous metals. The water with acidic reaction is flowing not only from the present active mines, but also from the passive ones and from the wells of the search bores. A similar effect is given by the flowings from mine dumps and mainly from the basins of decanting flotations.

Quarries and bentonite mines areas also contribute to the pollution of the rivers of the Lapus Valley.

The sources of organic pollution are represented by non or partially purified sewages, communal residues and the residues remaining after the distillation of alcohol, a characteristic activity here.

During our research in 2003 we could observe in some places changes in the colour of the water accompanied by the total or partial lack of fish individuals. In other cases we did not see organoleptic modification of the water, however fish individuals were also absent. Since we were not prepared and did not have time to carry out researches regarding the quality of the water, we have published only data regarding the composition of the ichthyofauna.

In 2005 we have extended our investigations to the tributaries Libotin (Rotunda), Cupseni, Dobrica, Rohia and Firiza in order to get a more clear insight into the ichthyofauna of the Lapus River.

Later we have identified the location of the main polluting sources and combined them with the results of the ichthyological studies.

MATERIALS AND METHODS

Our studies have been performed in September 2003 and July 2005 in the points formerly established on the map, respectively, using an electrical fishing apparatus, type IUP-12.

During the study we have noted some observations regarding the quality of the water, including the colour of the water, sediments in the river bed, excessive spreading of algae, the smell of the water, etc. Between the source and the mouth of the Lapus River we have sampled 12 points. Only the Cheile Lapusului zone was left out because of sailing difficulties.

From the left side tributaries we have studied the Tocila, Botiza (in 2 points), Roaia, Suciu (in 5 points), Tibles, Brad (in 4 points) and Rohia (in 4 points).

From the right side tributaries the Strambu-Baiut has been sampled in 2 points, the Rotunda in 3 points, the Stoiceni and Dobrica in 1 point each, the Bloaja and the Cavnic in 4 points each, the Sasar in 2 points, and we have also studied the Firiza and one of its tributaries (Fig. 1).

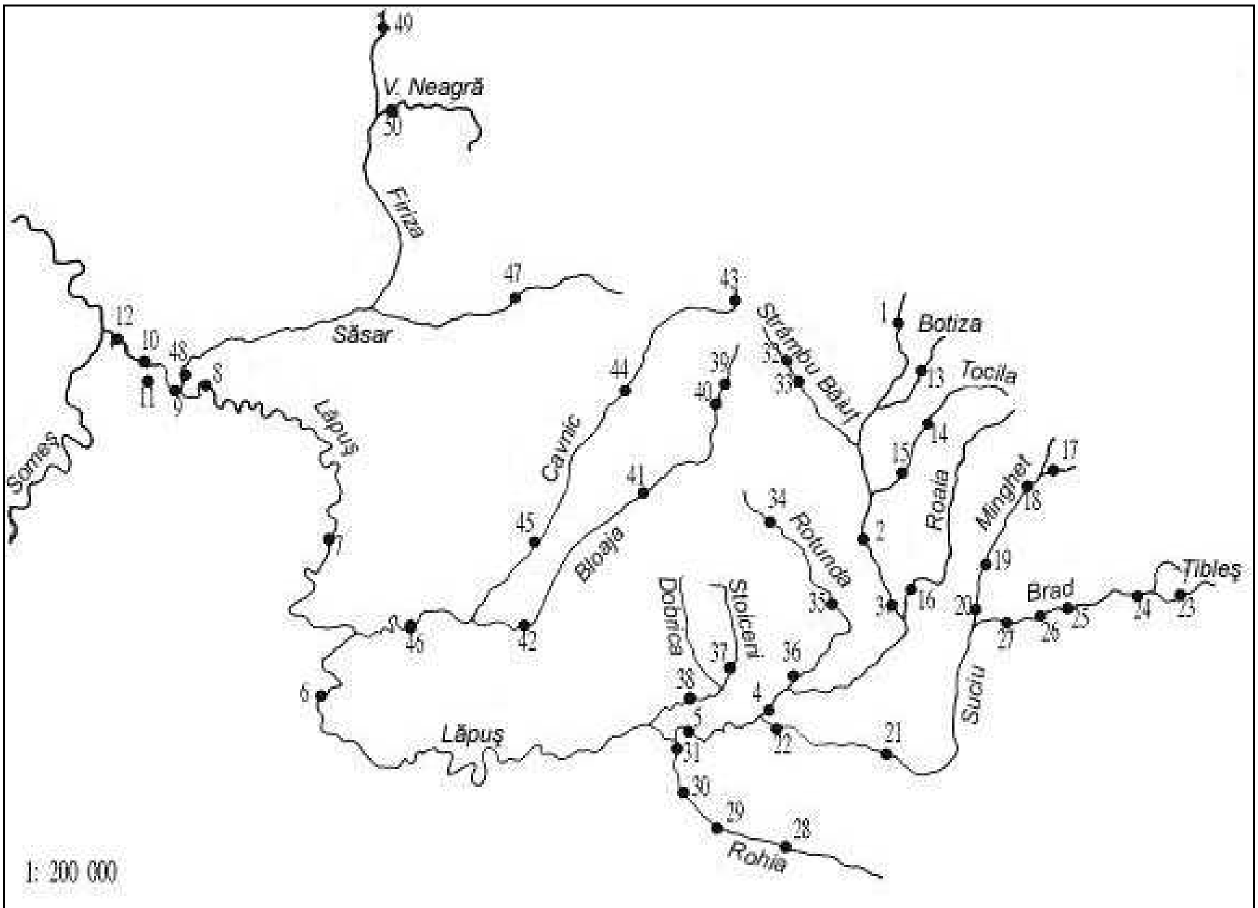

Figure 1: The gathering points
in the Lăpuş Valley.

The zones mostly affected by the mining and processing of non-ferrous minerals are the following: on the Lapus in the region of Baiut village there are several mines and a flotation (I); at Strambu-Baiut there is a mine dump close to the river (II); in the upper region of the Suciu brook (here referred to as Minghet) there flows acidic water from the geological research wells (III); at Razoare next to Targu-Lapus there is in operation a betonite mine (IV); the Cavnic brook is afected by the mines and flotation from Cavnic (V), and also by the deposit at Rachitele (VI); next to the source of the Sasar brook there is the Suior mine (VII); around Baia-Sprie there are several active and abandoned mines (VIII); around Tautii-de-Sus there are several mine dumps (IX); the Firiza brook is polluted by the mines from Herja and the dust emitted by the factories of Baia Mare (X); in Baia Mare there worked the ROMPLUMB and PHOENIX factories and the flotation of the AURUL company. The decanting lake of this latter one is at Bozanta-Mare (XI). All these affect the water of the Sasar (Fig. 2).

Besides heavy metals, the waters of the mines, mine dumps and decanting lakes contain a large quantity of sulphuric chemicals, cadmium and arsenic, all having poisonous effects.

Sources of organic pollution such as the residual waters of Baia Mare, Cavnic and Târgu-Lăpuş and the spirit destillaries of every village in the region are not marked on the map.

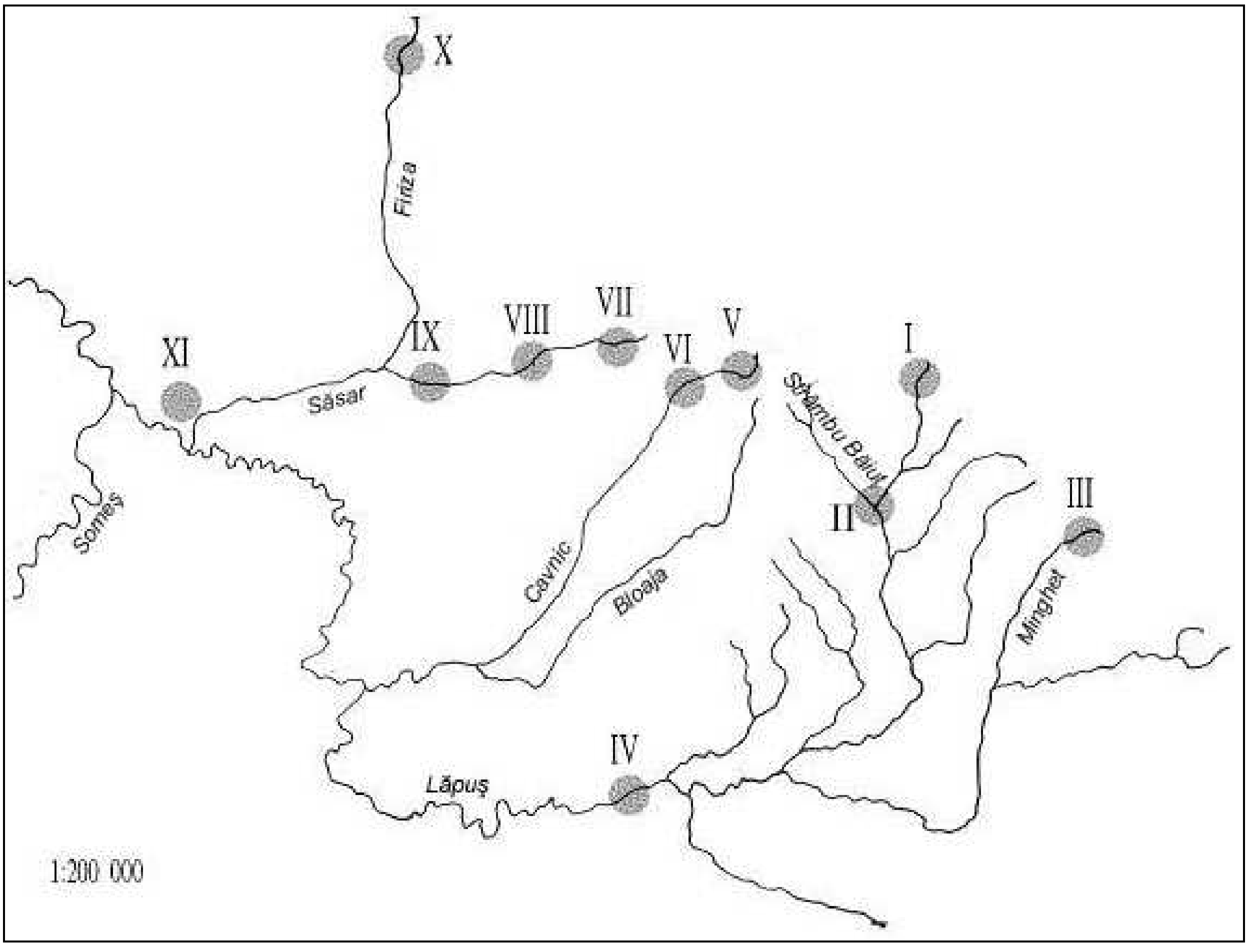

Figure 2: Polluting sources in the Lăpuş Valley.

RESULTS

In the upper flow of the Lapus the effects of the residual waters are evident. These are coming from the mines of Baiut and the mine dump of Strambu-Baiut and are changing the colour of the water into yellow which is evidently free of fish. Under the confluence with the Bozanta brook the polluting substances start to get diluted resulting in the appearance in the yellow water of a large number of *Leuciscus cephalus* individuals of considerable sizes, suggesting the resistance of this species towards damaging factors. Pollution can be observed up to the region of Lapus village. Downstream of this zone the effects of autopurification given by the high speed of the water flow and the diluting effect of the waters of the tributaries are coming out. Therefore around the confluence with the Suciu brook the ichthyofauna is rich.

We could not study the effects of betonite extraction at Razoare because we could not take samples at Cheile Lapusului and at the exit from the strait one could already observe the phenomenon of autopurification.

At the mouth of the Sasar there became apparent the effects of mineral substances and of the organic residues carried by them, and also the influence of the spirit destillaries. As a result we could catch only a few juvenile specimen of 3 non-pretentious species.

The variety of the river bed and the high speed of the water make the autocleaning process effective. Therefore at the level of Bozanta-Mare village both the river and the lake fed by it have a rich fish fauna. However, around the flow into the Somes, where the bed is uniform resembling a channel, the fish fauna becomes poor again (Tab. 1).

Table 1: The fish species of Lapus River.

No. crt.	Fish species	Lăpuş River sampling stations											
		1	2	3	4	5	6	7	8	9	10	11	12
1.	*Leuciscus leuciscus*						1						
2.	*Leuciscus cephalus*		25	9	1	23	18	9	28	2	38	14	15
3.	*Alburnus alburnus*							8	1		40	25	2
4.	*Alburnoides bipunctatus*			2	7	4		4	1				1
5.	*Vimba vimba*								5				
6.	*Chondrostoma nasus*							1					
7.	*Barbus barbus*								30		6		
8.	*Barbus petenyi*			2	100	28	16	13	2		2		
9.	*Gobio gobio*				1		20	3	4		3	27	2
10.	*Gobio uranoscopus*				4	3							
11.	*Gobio kessleri*						7	10					1
12.	*Pseudorasbora parva*										3	10	
13.	*Rhodeus sericeus*							3	23	1	3	17	
14.	*Carassius auratus*						1					11	3
15.	*Barbatula barbatula*				2	3							
16.	*Cobitis elongatoides*						1					1	
17.	*Sabanejewia aurata*				16			8	5				
18.	*Lepomis gibbosus*		1							1		1	

Among the left side tributaries of the Lăpuş River, the Tocila, Botiza and Poaia rivers are not polluted and their ichthyofauna corresponds to their size.

The source region of the Suciu (Minghet) brook is affected by the geological borings, the water is opalescent, white greenish and the fish are missing.

The brooks downstream bring clean water that dilutes the pollutants, therefore the fish appear, firstly the bullhead (*Cottus gobio*), then the minnow (*Phoxinus phoxinus*), schneider (*Alburnoides bipunctatus*), stone loach (*Barbatula barbatula*) and in a surprizingly high number the mediterranean barbel (*Barbus petenyi*). The Țibleş, Brad and Rohia are not polluted and have a rich ichthyofauna (Tab. 2).

The Liboteni, Stoiceni and Dobrica brooks are free of mining and has an ichthyofauna corresponding to their size.

Table 2a: The fish species of the left tributaries.

No. Crt.	Fish species	Tocila	Botiza	Roaia		Suciu					
		13	14	15	16	17	18	19	20	21	22
1	*Leuciscus leuciscus*			2						1	
2	*Leuciscus cephalus*			8	15					26	13
3	*Phoxinus phoxinus*	19	23	19				6	30		
4	*Alburnus alburnus*							1		12	1
5	*Alburnoides bipunctatus*							1		12	1
6	*Barbus barbus*										
7	*Barbus petenyi*		5	3	45			3	8	60	40
8	*Gobio gobio*										2
9	*Gobio uranoscopus*										
10	*Rhodeus sericeus*									1	2
11	*Barbatula barbatula*	9	8		16				4	9	
12	*Cobitis elongatoides*				4						2
13	*Sabanejewia aurata*										11
14	*Thymallus thymallus*							5			
15	*Salmo fario*										
16	*Cottus gobio*						16	5	10		

Table 2b: The fish species of the left tributaries.

No. Crt.	Fish species	Ţibleş	Brad				Rohia			
		23	24	25	26	27	28	29	30	31
1	*Leuciscus leuciscus*								2	
2	*Leuciscus cephalus*					8		4	63	10
3	*Phoxinus phoxinus*			13	16	4	5	14	32	4
4	*Alburnus alburnus*								13	
5	*Alburnoides bipunctatus*					20		2		3
6	*Barbus barbus*							6		
7	*Barbus petenyi*		2	5	3	10		6	37	10
8	*Gobio gobio*					2				
9	*Gobio uranoscopus*									2
10	*Rhodeus sericeus*									
11	*Barbatula barbatula*				4	2	4	27	16	27
12	*Cobitis elongatoides*									
13	*Sabanejewia aurata*								7	
14	*Thymallus thymallus*	1	13		5	1				
15	*Salmo fario*	5								
16	*Cottus gobio*	52	4	9	5	1	60	25		

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THE EFFECT OF PROBIOTIC (*BACILLUS* SPP.) ON GROWTH, SURVIVAL AND GUT MICROBIAL LOAD OF THE *ONCORHYNCHUS MYKISS* (WALBAUM, 1792)

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KEYWORDS: Bacillus, micro flora, nutrition.

ABSTRACT

A commercial *Bacillus* spp. probiotic was tested on rainbow trout fry, during the two months of first feeding. Probiotic was introduced in diets at five different levels, (T_1: 4.8 × 10^8, T_2: 1.2 × 10^9, T_3: 2.01 × 10^9, T_4: 3.8 × 10^9, T_5: 6.1 × 10^9 CFU g-1) and their effects compared with those of control diet, containing no probiotic. Survival in treatments were significantly (*P<0.05*) higher than control and a slight increasing mortality rate was observed during the first week of experiment. The counts of bacteria associated with trout intestine in all treatments were significantly (*P<0.05*) higher than controls and *Bacillus* spp. was not detected in controls. Total bacteria counts were significantly different among treatments and controls; it may suggest that the colonization rate of digestive tracts of rainbow trout fry with bacteria was affected by dietary bacteria level. Specific growth rate, condition factor, protein efficiency ratio were slightly, but significantly (*P<0.05*) higher and feed conversion ratio was lower in groups received probiotic via diets than controls. It may show that probiotic stimulates digestive development and enzymatic activity in fish. Growth performance in treatment received 3.8×10^9 CFU g-1 showed the best results. Therefore, it does not appear that higher levels of probiotics improved results and suitable dose of probiotic should be assessed before application in large scale to prevent any undesired effects. The supplementation of trout starter diet with *Bacillus* spp. is probably effective for improving rearing conditions.

REZUMAT: Efectele probioticelor (*Bacillus* spp) asupra creşterii, supravieţuirii şi încărcăturii microbiene intestinale la păstrăvul curcubeu.

Un probiotic comercial *Bacillus* spp. a fost testat pe alevini de păstrăv curcubeu în timpul primelor două luni de alimentaţie exogenă. Probioticele a fost introdus în alimentaţie în cinci concentraţii diferite, (T_1: 4.8 × 10^8, T_2: 1.2 × 10^9, T_3: 2.01 × 10^9, T_4: 3.8 × 10^9, T_5: 6.1 × 10^9 UFC g-1) şi s-au comparat efectele lor cu cele ale alimentaţiei controlate ce nu a conţinut probiotice. Supravieţuirea în cazul aplicării tratamentelor a fost semnificativ mai mare (*P<0.05*) decât cea a grupului martor dar s-a observat şi o rată de mortalitate uşor crescută în timpul primei săptămâni de tratament. În toate tratamentele numărul de bacterii asociate intestinului de păstrăv a fost semnificativ (*P<0.05*) mai mare decât cel din grupa martor, pentru care nu s-au detectat *Bacillus* spp. Numărul total de bacterii obţinut în cazul tratamentelor a fost semnificativ diferit de cel obţinut la grupa martor; acest lucru poate sugera că rata de colonizare cu bacterii a tractului digestiv la alevinii de păstrăv curcubeu a fost afectată de cantitatea de bacterii prezentă în alimentaţie. Rata de creştere specifică, coeficientul de condiţie Fulton, raportul de eficacitate proteică au fost cu puţin dar statistic semnificativ(*P<0.05*) mai mari iar indicele de conversie a hranei a fost mai mică la grupele care au primit probiotice în alimentaţie, comparativ cu grupele martor. se poate deduce că probioticele stimulează dezvoltarea digestivă şi activitatea enzimatică la peşti. Performanţa de creştere a avut cele mai bune valori în tratamentul cu 3.8 × 10^9 UFC g-1. Din acest motiv, considerăm că concentraţiile mai mari de probiotice nu pot fi asociate cu rezultate mai bune iar doza de probiotice cea mai potrivită trebuie evaluată înainte de aplicarea la scară largă pentru a preveni eventuale efecte nedorite. Suplimentarea alimentaţiei puietului de păstrăv cu *Bacillus* spp. este probabil eficientă în ameliorarea condiţiilor de creştere.

RÉSUMÉ: Les effets des probiotiques (*Bacillus* spp.) sur la croissance, la survie et la charge microbienne intestinale chez la truite arc-en-ciel.

Un probiotique commercial *Bacillus* spp. a été testé sur des alevins de truite arc-en-ciel pendant les deux premiers mois d'alimentation exogène. Des probiotiques ont été introduites dans l'alimentation à cinq concentrations différentes (T_1: 4.8 × 10^8, T_2: 1.2 × 10^9, T_3: 2.01 × 10^9, T_4: 3.8 × 10^9, T_5: 6.1 × 10^9 UFC g-1) et les effets ont été comparés à ceux de la groupe témoin ayant reçu une alimentation contrôlée sans probiotiques ajoutés. La survie des groupes ayant reçu les traitements a été significativement plus grande que celle de la groupe témoin mais une légère augmentation de la mortalité a été observée pendant la première semaine de traitement. La quantité des bactéries associée à l'intestin de la truite pendant tous les traitements a été de manière significative *(P<0.05)* plus grande que celle des groupes témoins et *Bacillus* spp. n'a pas été détecté dans le groupe témoin. La quantité totale de bactéries a varié significativement entre les groupes de traitement et les groupes témoin; ceci peut signifier que le degré de colonisation du système digestif des alevins de truite arc-en-ciel par les bactéries a été influencé par les concentrations de bactéries distribuées dans l'alimentation. Le taux spécifique de croissance, le coéfficient de condition, le taux d'efficacité protéique ont été légèrement, mais statistiquement significatif *(P<0.05),* plus élevés et l'indice de conversion alimentaire a été plus bas dans les groupes ayant reçu des probiotiques dans leur alimentations que dans les groupes témoin. Ceci peut démontrer que les probiotiques stimulent le développement digestif et l'activité enzymatique chez les poissons. Le traitement à 3.8 × 10^9 UFC g-1 a donné les meilleurs résultats concernant la performance de croissance. Pour cela, il n'est pas clair que des concentrations plus élevés de probiotiques ont donné des meilleurs résultats mais la dose de probiotique la plus adaptée doit être établie avant l'application à grande échelle afin de prévenir des effets indésirables. La supplémentation de l'alimentation du fretin de truite avec *Bacillus* spp. est probablement efficace dans l'amélioration des conditions d'élevage.

INTRODUCTION

Rainbow trout culture is economically important in Iran and bacterial infectious disease in trout farming seems to be the major reason for decreasing the production level in some farms. Success and failure of fish culture programs are determined by the early life stage conditions (Ghosh et al., 2002). On the other hand, the occurrence of sub-clinical infections under farming conditions probably lead into reduced growth and increased mortality (Kapetanovic et al., 2005). In order to make cessation or reduction such of undesired results in fry rearing, many feed additives have been used for improving health conditions and the feed utilization efficiency (Ahilan et al., 2004). Antibiotics, one of the feed additives, were commonly used in the early 1950's (Ahilan et al., 2004). Due to the abuse of antibiotics in animal growth promoters, antibiotic resistance has become a common characteristic in microorganisms (Austin et al., 1994; Robred et al., 2000), thus caused in serious problems in microbial infectious treatments (Saarela et al., 2000). The probiotics use, beneficial microorganisms or their products with the benefit effects to the hosts, have been used in aquaculture to to control disease, as supplements for growth and as a mean of replacing antimicrobial compounds (Irianto and Austin, 2002).

Many researches on probiotic for aquaculture has been done (Moriarty, 1998; 1999; Ghosh et al., 2002; Paniggraahi et al., 2004; Ahilan et al., 2004; Salinas et al., 2005). Some of the probable mode of action for probiotics include competitive exclusion, i. e. the probiotics inhibit the colonization of potential pathogens in the digestive tract by production of inhibitory compounds or through competition for nutrients and/or space, modification of microbial metabolism, and/or by the stimulation of host immunity responses. What's more, probiotics may produce vitamins and detoxify the compounds in the diets or break down the indigestible compounds which may lead into the nutritional improvement and stimulate appetite (Irianto and Austin, 2002).

Some works have been done to evaluate competitive exclusion of potential probiotics on rainbow trout (Nikoskelinen, 2002; Ji-Woong, 2003; Irianto and Austin, 2003; Ibrahim et al., 2004). Stimulation of immune system in rainbow trout with several candidate probiotics has been also evaluated by some researchers (Irianto and Austin, 2002; Nikoskelainen, 2002; Paniggraahi et al., 2004; Ji-Woong, 2003; Kim and Austin, 2006).

Since the *Bacillus* genus has not been reported as pathogens of the aquatic organisms (Moriary, 1998), its application has been promoted and more widely accepted within the aquaculture industry (Gullian et al., 2004). *Bacillus* species are able to produce antibiotics, amino acids and enzymes (Sanders et al., 2003). Consequently, *Bacillus* probiotics may have positive nutritional effects on fishes.

Here, we investigated the effect of *Bacillus* probiotic by administering via diets on digestibility of food, growth and survival of rainbow trout fry, with attention to fry intestinal micro-biota exposed to probiotic, compared to not receiving probiotic.

MATERIALS AND METHODS

2.1. Rearing conditions and experimental design

Rainbow trout, *Oncorhynchus mykiss* (Walbaun) (average weight = 120 mg), were obtained from a well known hatchery in Iran, and maintained in 18 Californian flow-through with continuous fresh water supplied from spring (temperature = 13.98 ± 0.06, mean ± standard error), for a period of 63 days. Five treatments were conducted to evaluate the effect of probiotics administered to the rainbow trout fry, each treatments, in triplicate, was stocked with 500 fishes. The fish were fed at five different levels, (T_1: 4.8×10^8, T_2: 1.2×10^9, T_3: 2.01×10^9, T_4: 3.8×10^9, T_5: 6.1×10^9 CFU g-1) and control diet groups served as well. The sampling for nutritional effects was carried out once in a week.

2.2. Feeding and probiotic supplement preparation

Commercial rainbow trout starter food (SFT0, Chine Co., Tehran) was taken as a basal diet for the supplementation of probiotic. The commercial probiotic used in this experiment (Bio plus 2B, Razak Co., Iran) contained spores of two species of *Bacillus* (i. e., *B. subtilis* and *B. licheniformis*). Probiotics prepared as its original manual. The proper amounts of probiotic suspension were sprayed into the feed slowly, mixing part by part in a mixer. Then, the feed was air dried under sterile conditions for 12 h and stored at 20°C. The commercial feed sprayed with sterilized diluents alone served as the control diet.

2.3. Fish dissection and microbiology

Six fish were collected from each feed trial, after 20 h of starvation at the end of the experiment (Wache et al., 2006). After killing them, intestines were dissected out in sterile conditions, and then three intestine samples from each treatment were used for microbiological examination and kept in ice until transferring to microbiology laboratory. Here, each intestine sample was homogenized and serially diluted with sterilized normal saline solution, and then samples were placed onto tryptic soy agar plates for isolation and total counts of bacteria. The plates were incubated for 27 h at 37°C. For obtaining pure culture, from each sample 20-25 colonies per plate were picked randomly and re streaked onto nutrient agar plates three times according to the methods of Spangaard et al. (2000) and Kapetanovic et al. (2005). Observation and identification of all the purified isolated was done according to the cell morphology, motility, gram staining, oxidize and catalas activities followed by Barrow and Feltman (1993) key identification.

2.4. Determination of nutritional effects and survival

Weekly, for 10 samples from each treatment was determined wet weight and total length. The numbers of survivors were recorded. At the end of the experiment, carcass of 3 fish, which intestines were dissected out, transferred for biochemical analysis. Feed conversion ratio (FCR), specific growth rate (SGR), protein efficiency ratio (PER) were expressed as following:

$$FCR = \frac{\text{Dry weight of ingested food}}{\text{Wet weight of produced trout}}$$

$$PER = \frac{\text{Wet weight of produced trout} \times 100}{\text{Dry weight of ingested protein}}$$

$$SGR = \frac{(\text{Ln Wt - Ln Wo}) \times 100}{T}$$

Where t is the period of culture in days, ln W0 is the natural logarithm of the weight of the fry at the beginning of the experiment, and ln Wt is the natural logarithm of the weight of the fry at day t. (W0 and Wt are in gram).

2.5. Statistical analysis

One way analysis of variance (ANOVA; SPSS, 10.0) was used to determine whether significant variation between the treatments existed or not. Difference between means were determined and compared by LSD test. All tests used a significance level of $P<0.05$. Data are reported as means ± standard errors.

RESULTS

3.1. Survival and growth

Under five levels of probiotic supplement, among the experimental fish normal behavior exhibited and no cannibalism were observed. Probiotic feed acceptance in all treatments was as good as control group. Although mortality was low in both controls and treatments, administering probiotic showed significantly higher survival in all treatments, except T_1 (Fig. 1).

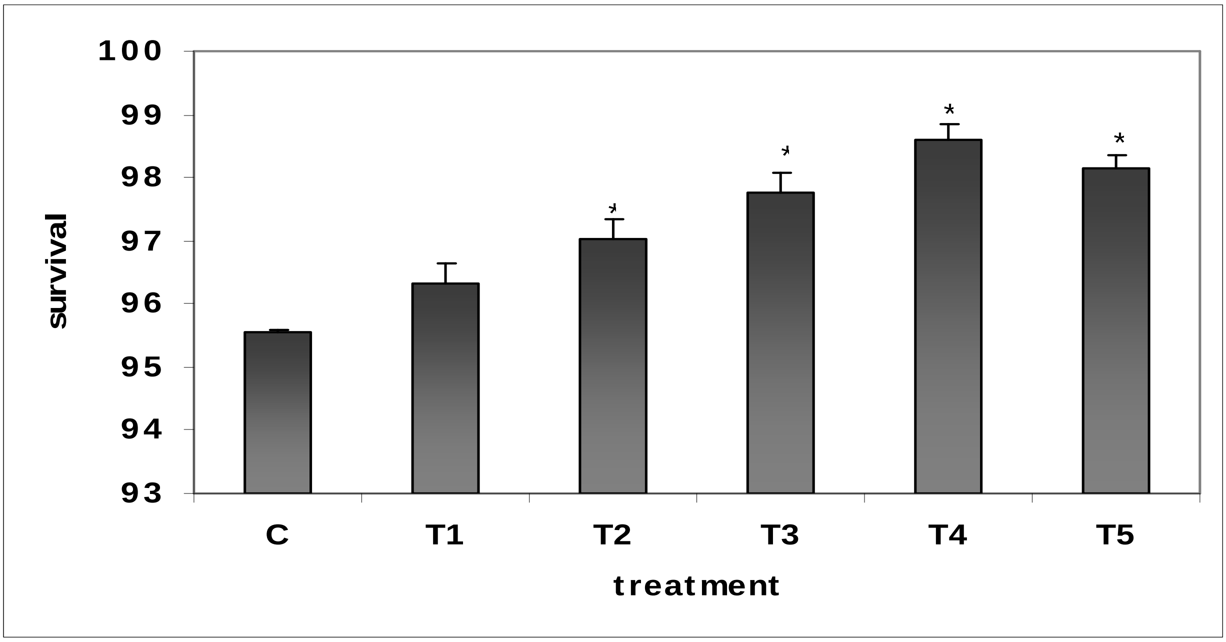

Figure 1A: Survival percent of rainbow trout fry in treatments;
C - control, T1 to T5 - treatments 1 to 5. * Significantly (P< 0.05) different.

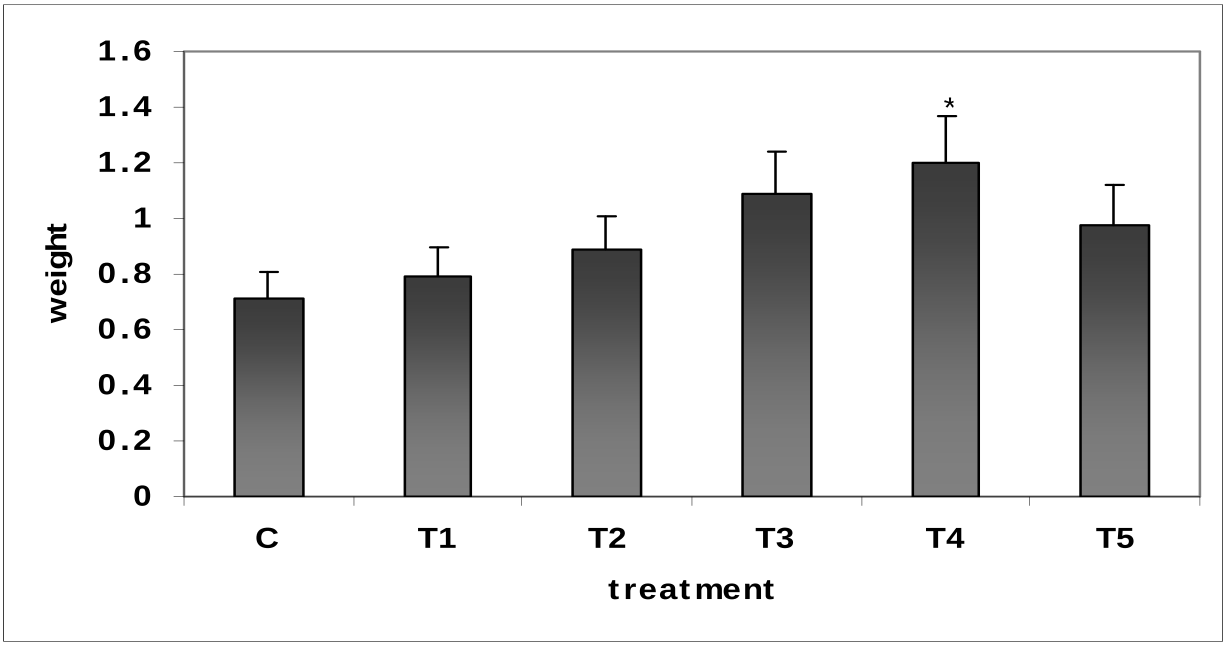

Figure 1B: Mean weight (B) of rainbow trout fry in treatments;
C - control, T1 to T5 - treatments 1 to 5. * Significantly (P< 0.05) different.

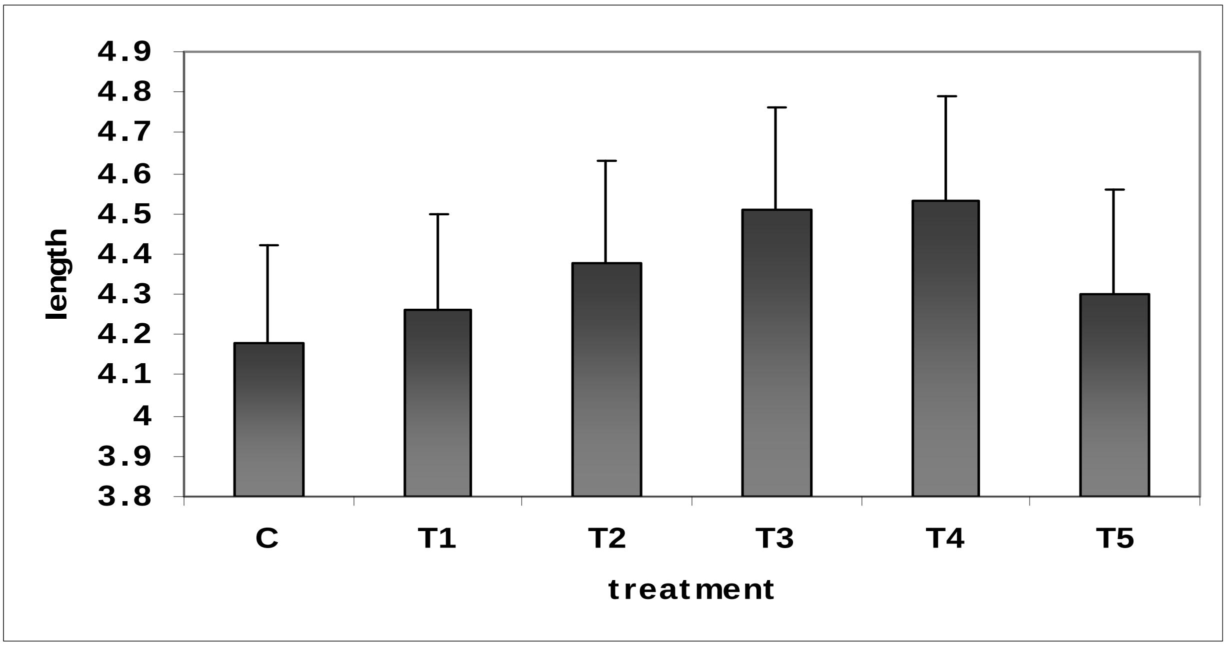

Figure 1C: Total length (C) of rainbow trout fry in treatments;
C - control, T1 to T5 - treatments 1 to 5. * Significantly (P< 0.05) different.

Higher mean weight and total length were recorded in fishes fed with probiotic supplement. Although mean weight just in T_4 was significantly higher than control, total length was not significantly affected by the administered probiotic (Fig. 1). In all probiotic treatments, except T_1, food conversion ratio (FCR) and protein efficiency ratio (PER) were significantly higher than in controls (Fig. 2). Specific growth ratio (SGR) of the treated fishes was also determined and showed significantly higher rate just in T_4 and T_5 (Fig. 2).

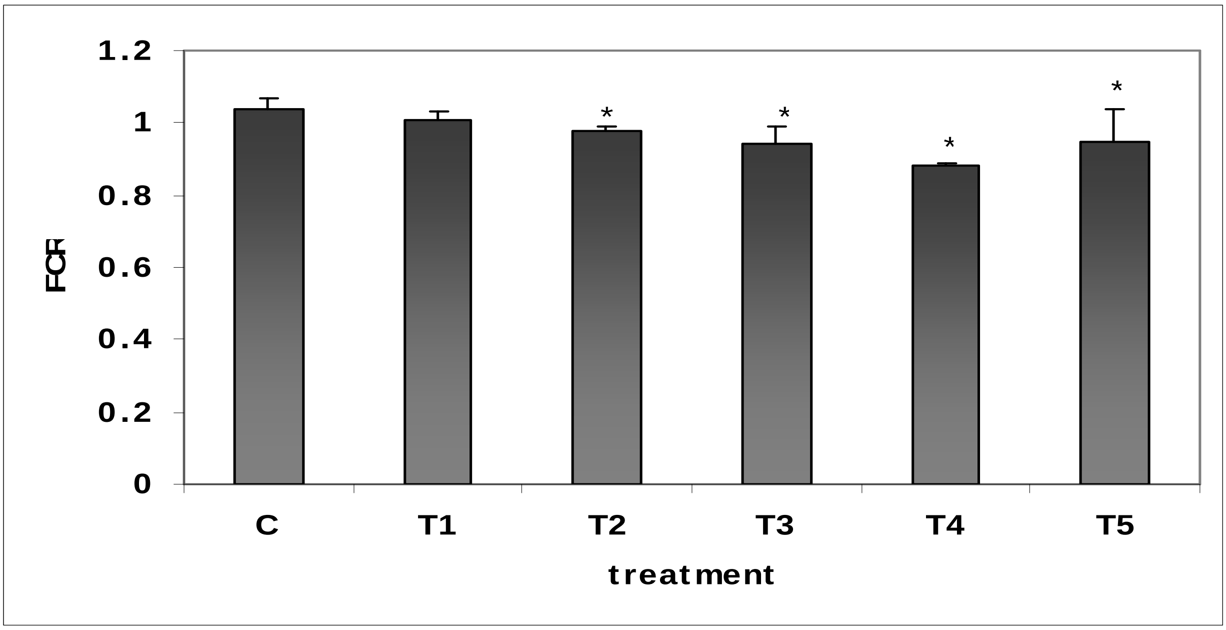

Figure 2A: Food convertion ratio; C - control, T1 to T5 - treatment 1 to 5.
* Significantly (P< 0.05) different.

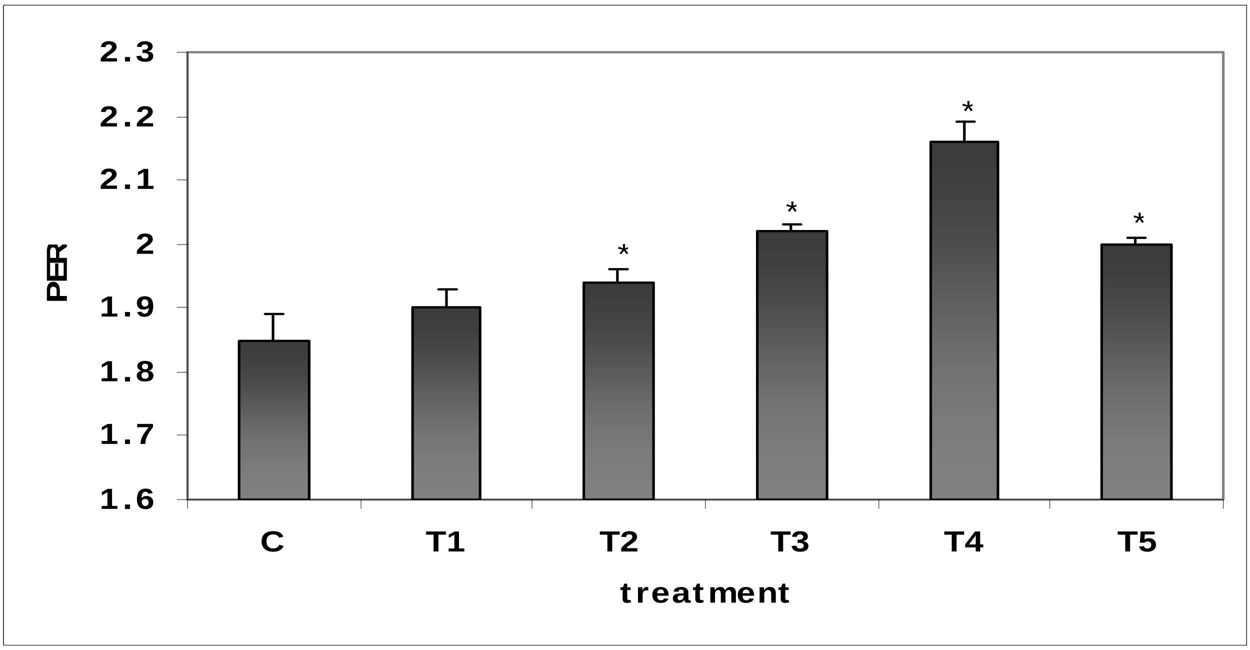

Figure 2B: Protein efficiency ratio;
C - control, T1 to T5 - treatment 1 to 5. * Significantly (P< 0.05) different.

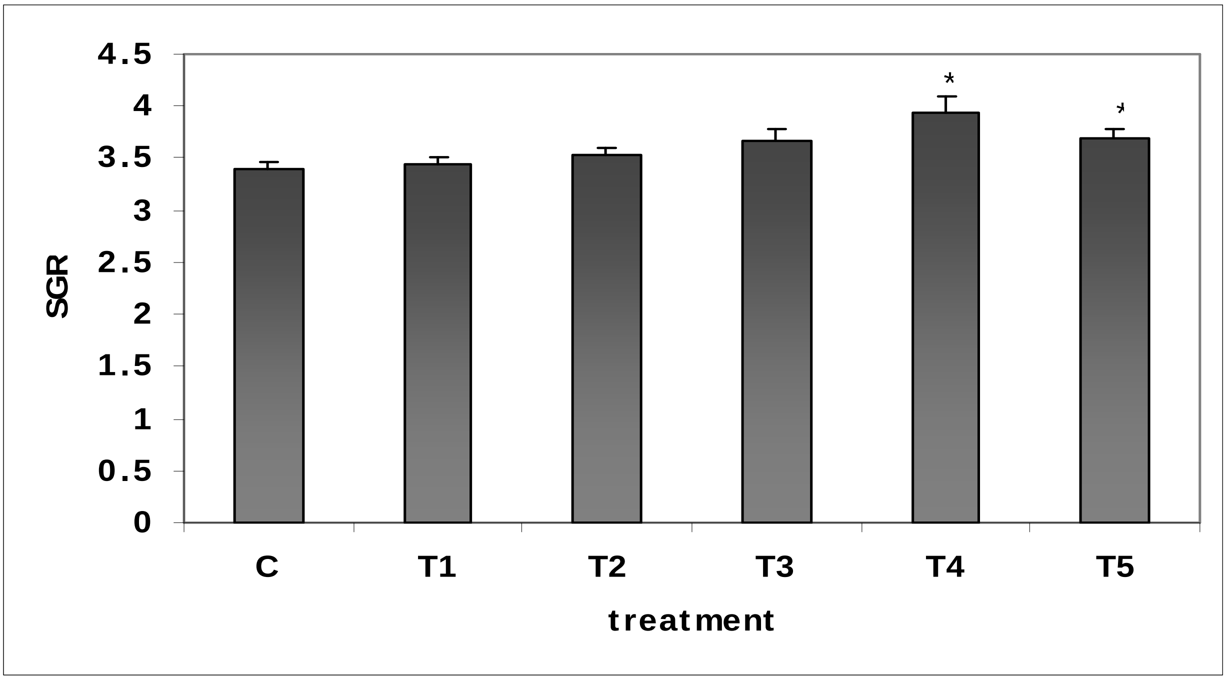

Figure 2C: Specific growth rate (C);
C - control, T1 to T5 - treatment 1 to 5. * Significantly (P< 0.05) different.

At the end of the study the best results were retrieved from T_4. In order to determine the nutritional effects of administered probiotic on rainbow trout fry, the biochemical composition of carcass was analyzed. The results are represented in the table 1. Protein values of carcass in all treatments, except T_1, were significantly higher than controls. The best result obtained from T4. Significantly different fat values of carcass in probiotic groups, compared to the controls, were indicated. Moisture values of T_3, T_4 and T_5 indicated a significant difference as well (Tab. 1).

Table 1: chemical composition of carcass after feeding with probiotic; Mean ± S. E. (N = 3). C - control, T_1 to T_5 - treatment 1 to 5. * Significantly (P < 0.05) different.

Treatment	Moisture	Fat	Protein
C	74.7 ± 1.4	10.1 ± 0.2*	10.3 ± 0.1
T1	71.9 ± 0.5	9.0 ± 0.1*	10.8 ± 0.2
T2	73.4 ± 0.4	8.9 ± 0.1*	11.9 ± 0.1*
T3	69.9 ± 0.1*	7.8 ± 0.1*	13.7 ± 0.3*
T4	67.8 ± 0.7*	6.5 ± 0.1*	15.0 ± 0.3*
T5	69.98 ± 0.5*	5.9 ± 0.0*	12.1 ± 0.3*

3.2. Intestinal microbiota

Bacillus was dominant bacteria in probiotic treatments. In contrast, no *Bacillus* strains were detected in control groups (Tab. 2). Total bacterial counts in trout intestine, which received probiotic, were not significantly different.

No clear effects on intestine bacteria associated with different levels of probiotic in treatments and control groups was detected (Fig. 3). Vibrionaceae was dominant bacterium in all treatment as well as control groups

Table 2: Total bacterial counts and Bacillus in the intestine of rainbow trout fry after feeding for 63 days; Mean ± S. E. (N = 3). C - control, T_1 to T_5 - treatment 1 to 5.

Treatment	Mean number of cells g-1 (CFU) in intestine 63 days after feeding		
	Probiotic cells	Total microflora	Ratio (%) probiotic/total
C	-	$12.5 \pm 1.08 \times 10^4$	-
T1	$29.4 \pm 2.17 \times 10^6$	$45.2 \pm 4.07 \times 10^6$	65.0 ± 2.3
T2	$11.9 \pm 1.28 \times 10^6$	$1.40 \pm 0.79 \times 10^6$	85.1 ± 2.0
T3	$2.52 \pm 2.1 \times 10^6$	$2.71 \pm 2.90 \times 10^6$	92.9 ± 4.6
T4	$1.79 \pm 1.51 \times 10^7$	$1.82 \pm 1.32 \times 10^7$	98.3 ± 4.0
T5	$3.37 \pm 2.05 \times 10^7$	$3.39 \pm 2.06 \times 10^7$	99.4 ± 3.8

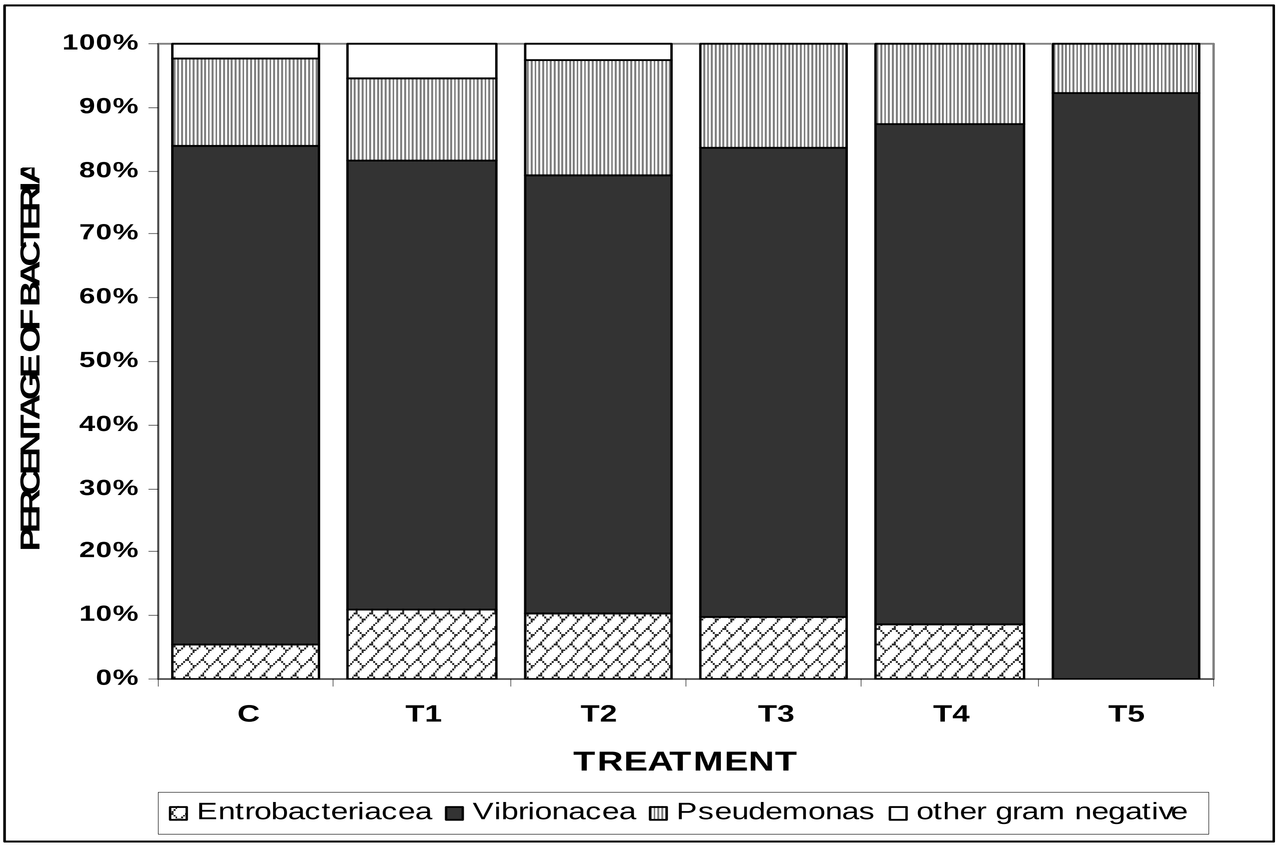

Figure 3: Proportion of dominant group of bacteria characterized in rainbow trout fry.

DISCUSSIONS

The relative proportion of *Bacillus* spp. in the intestinal flora of rainbow trout fry fed diets containing probiotic, increased with greater density of probiotic in treatments. High proportion (Ringo et al., 1995) is probably related to an increase in suitable attachment sites as a result of histological and functional development of fry and improved internal environmental conditions for bacterial growth (Vine et al., 2006). In contrast to constant habitat of terrestrial animals and resident flora in their tract, in aquatic animals most microbes are transient (Panigrahi et al., 2004) and affected by conditions of surrounding water (Gomez-Gill et al., 2000). Since fishes are poikilotherms, one of the primary factors influencing the microbiota of fish perhaps is temperature changes (Panigrahi et al., 2004). High proportion of *Bacillus* spp. in the intestinal of experimental fishes may shows that intestinal environment is suitable for the given probiotic to settle and grow and also lead into harbor a great number of microbial cells of host intestine. Survival increasing associated with *Bacillus* probiotic proportion in the gut flora is may be due to competitive exclusion of other bacteria, especially with potentiall pathogenic bacteria. The identified bacteria of fry intestine were recognized as fish pathogenic species (Kapetanovic et al., 2005). Enterobacteriaceae population, one of the identified bacteria, in T_5 disappeared and the population of the other bacteria in probiotic treatments declined. It can strongly confirm the idea of out-competing the other bacteria by colonization of probiotic in intestine. On the other hand, survival in T_4 was higher, so we can not definitely conclude that the exclusion of other bacteria by the probiont result in improved survival. However, this effect should not be ignored.

Because growth rate throughout the experiment was improved in T_4, not in T_5, it can be certainly suggested that the more probiotic cells in diets and host intestine necessarily does not result in the more improved growth and survival. Better growth, as observed in T4, may establish better health conditions in rainbow trout fry and so, decrease mortality. *Bacillus* spp. produces few peptide antibiotics, including subtilin and bacitracin produced by *B. subtilis* and *B. leicheniformis*, respectively, which was present in the used probiotic. There are other substances with biocontrol activities isolated from species of *Bacillus* (Rosvitz et al., 1998). Iturins, cyclic lipoproteins isolated from *B. subtilis*, are toxic to a wide range of fungi and yeast (Maget-Dana and Peypoux, 1994). Therefore, administered *Bacillus* made the fry resistance to pathogens and enhanced survival by producing inhibitory substances to other microorganisms. The *Bacillus* species produce proteases (for example, subtilin) which helps in digestion (Sanders et al., 2003). They are also said to produce vitamin K and B_{12} (Rosvitz et al., 1998). Gram-positive bacteria, including members of the genus *Bacillus*, secret a wide range of exoenzymes (Moriarty, 1998) which might have supplied digestive enzymes and certain essential nutrients to promote better growth. *Bacillus_subtilis* and *B. leicheniformis* can break down proteins and carbohydrates (Rosvitz et al., 1998; Farzanfar, 2006). So it can be suggested that *Bacillus* bacteria administration to trout fry result in enhanced digestion of food and improved growth, including low food conversion ratio (FCR), and high specific growth rate (SGR). High protein efficiency ratio (PER) also as higher protein values of carcass in probiotic treatments may be due to proteins secreted by genus *Bacillus* members (Rosvitz et al., 1998).

We found that supplementation of trout starter diet with the proper density of commercial *Bacillus* probiotic could be beneficial for rainbow trout fry growth and survival, especially in fast growing conditions, where it would be essential to stimulate the precocious maturation of digestive system (Wache et al., 2006). No clear effect of probiotic on diversity of rainbow trout fry intestine flora detected, but high rate of probiotic bacteria colonization was observed. Since the results might be affected by the rearing conditions (Spanggaard et al., 2000), so we propose the effects of *Bacillus* probiotic be tested in other locations.

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MIDDLE OLT RIVER (TRANSYLVANIA, ROMANIA) - SPECIAL AREA FOR CONSERVATION (NATURA 2000 SITE) PROPOSAL FOR *BARBUS MERIDIONALIS* RISSO, 1827 AND ASSOCIATED FISH SPECIES

Doru BĂNĂDUC [1]

KEYWORDS: Danube Basin, Romania, Transylvania, Olt River, Cibin River, Hârtibaciu River, Natura 2000, *Barbus meridionalis* Risso, 1827, ichtiocenosis, specific criteria.

ABSTRACT

This paper brings arguments in favor of Natura 2000 site proposing - Middle Olt River, for *Barbus meridionalis* Risso, 1827 and associated fish species conservation.

These arguments depend on the author's original data obtained in the 2000 - 2007 period, about the Mediterranean barbell local populations and its fish community - specific criteria (well preserved fish populations; permanent fish populations; healthy fish populations; typical natural habitats; declining human impact; favorable geographical position).

REZUMAT: Oltul mijlociu (Transilvania, România) - propunere ca arie specială pentru conservare (sit Natura 2000) pentru specia *Barbus meridionalis* Risso 1827 şi speciile de peşti asociate.

Această lucrare aduce argumente în vederea propunerii unui sit Natura 2000 - Oltul mijlociu, pentru conservarea lui *Barbus meridionalis* Risso, 1827 şi a speciilor de peşti asociate.

Aceste argumente se bazează pe datele originale ale autorului obținute în perioada 2000 - 2007, referitoare la populațiile locale de mreană de munte şi a comunității de peşti din care aceasta face parte - criterii specifice (populații de peşti bine conservate; populații de peşti permanente; populații de peşti sănătoase; habitate naturale tipice; impact antropic în scădere; poziție geografică favorabilă).

RESUMEN: En la porción media del Río Olt (Transilvania, Rumanía) - area especial para su conservación (sitio Natura 2000) propuesta para *Barbus meridionalis* Risso, 1827 y especies de peces asociados.

Este artículo ofrece argumentos en favor de el sitio Natura 2000, que propone al media del Río Olt, para la conservación de *Barbus meridionalis* Risso, 1827 y especies de peces asociados.

Estos argumentos dependen de los datos originales obtenidos en el periodo 2000 - 2007, acerca de las poblaciones locales del barbel Mediterráneo y los criterios específicos de sus comunidades de peces (poblaciones de peces bien preservadas; poblaciones de peces permanentes, poblaciones de peces saludables, hábitats naturales típicos; declive del impacto humano, posición geográfica favorale).

INTRODUCTION

The main objectives of the European Community in the nature field of interest are the conservation, the protection and the improvement of the environment quality, in the condition of the reasonable use of the natural resources. The natural biodiversity conservation constituted a very important objective of the European Union at least in the last quarter of (the 20th) century.

To frame its environmental policies the European Community structures take account of the scientific and also the technical disposable information, the environmental conditions characteristic to different areas of the Community and the very important need for a balanced development of all its component regions, the result benefits and the necessary involved financial costs.

The action frame at the European Community level, the biodiversity preservation, was established especially based on the Habitats Directive (92/43/EEC) and also on the Birds Directive 79/409/EEC).

Both these European Directives aim at the protection and maintaining of the biodiversity in the European Union through the creation of an extended protected areas network (Natura 2000 net), in which the habitats and species characteristic for the European biogeographic regions are specifically preserved.

In the present, the Romanian territory contributes to the European natural heritage, from the Natura 2000 continental initiative perspective, with over: 47 % of the territory covered by natural and also semi-natural ecosystems; 780 types of habitats; 3700 superior plant species; 33085 invertebrate species and 717 vertebrate species (Bănăduc, 2001).

The Romanian territory has the highest biogeographic (regions) diversity of all the present European Union countries; this country which will join the European Union in 2007, have five biogeographic regions: continental, alpine, pannonic, pontic and steppic.

There are few approaches through which the Natura 2000 initiative can improve significantly its nature protection in our country and not only: extension of the natural area surface; the creation and implementation of correct management plans for these protected areas; institutional capacity building; raising awareness; European control and support on the governmental structures!

One major element of the implementation of these two European Directives is the establishment of a Natura 2000 site network in Romania, too (Bănăduc, 2006).

The author have done already some works regarding different fish species of European conservative interest and their associated fish species populations for the potential Natura 2000 sites frame designation proposal and/or management (Bănăduc 2001, 2006, 2007a, b, c, 2008, 2009).

This paper data objective is to sustain arguments for the proposal for a Natura 2000 site based on *Barbus meridionalis* Risso, 1827 fish species, the discussions regarding this fish species necessary sites related aspects not being finished, till the present.

The paper is based on the author's original data and meets the scientific as well as the European Union criteria for Natura 2000 site selection; will be presented at the Biogeographic Seminars for Bulgaria and Romania.

MATERIALS AND METHODS

Several kinds of samplings methods were used for the interest fish capture: angling, nets and electric fishing devices.

According to the European Natura 2000 initiative the following main site selection criteria were used in this paper respect: well preserved fish (of European Community interest - oCi) populations; stable fish (oCi) populations; healthy fish (oCi) populations; typical natural habitats (oCi); lowest (as possible) human impact presence; favorable geographical position (possibility of species spreading in more than one hydrographic watersheds); best option for species/habitat (oCi) in relation with the needed future Natura 2000 areas management.

This paper is based on the author's original scientific data, no older than six years. It has to be stated the fact that no complete data are available to definitely and comprehensively statute and border the local populations. Further populational field studies are needed.

This paper focused mainly on the *Barbus meridionalis*, Annex II fish species.

This species can be an ‘umbrella species’ in the studied area.

Secondary, the other fish species of the local ichthiocenosis are considered.

The sampled fish were released immediately after their identification in the same place where they were captured due to conservative reasons.

RESULTS AND DISCUSSIONS

Species fact sheet

Scientific name: *Barbus meridionalis* Risso, 1826 / *Barbus petenyi* Heckel, 1852. Order: Cypriniformes / Family: Cyprinidae. Vernacular names: Mediterranean barbell (English) / moiță, moioagă, cârcuşe, jumugă, jamlă, jamnă, mreană pătată, mreană vânătă, mreană de munte, mreană de vale (Romanian) / Balkanska mriana (Bulgarian) / Semling (German) / Petenyi-márna (Hungarian) / Barbeau méridional (French). Terra typica: Mureş River in Romania. (Bănărescu, 1964).

It is a benthopelagic, freshwater fish. A short-lived species which is found in mountainous and hilly rivers, with springs in this area. Prefer the clear and fast flowing water sectors and the hard substrata. No migrations were registered for this species. The reproduction is happened in the spring, sometimes is prolonged till the summer. Its food consist mainly of benthic aquatic invertebrates (tendipedes, ephemeropterans, trichopterans, gamarids, oligochetes and rarely also plants fragments).

Its meat economic value it is strictly local, being apreciated in some areas of Romania.

In Romania had a wide range; its range evolution is in progress. Its position is considered as being with low vulnerability. *Barbus meridionalis* species is protected by Law 13 of 1993 (through which Romania became a part to the Bern Convention), Annex II of the European Directive 92/43/EEC, through the Law no. 462/2001 (and the last amendments) regarding the protected natural areas and the habitats and wild flora and fauna conservation.

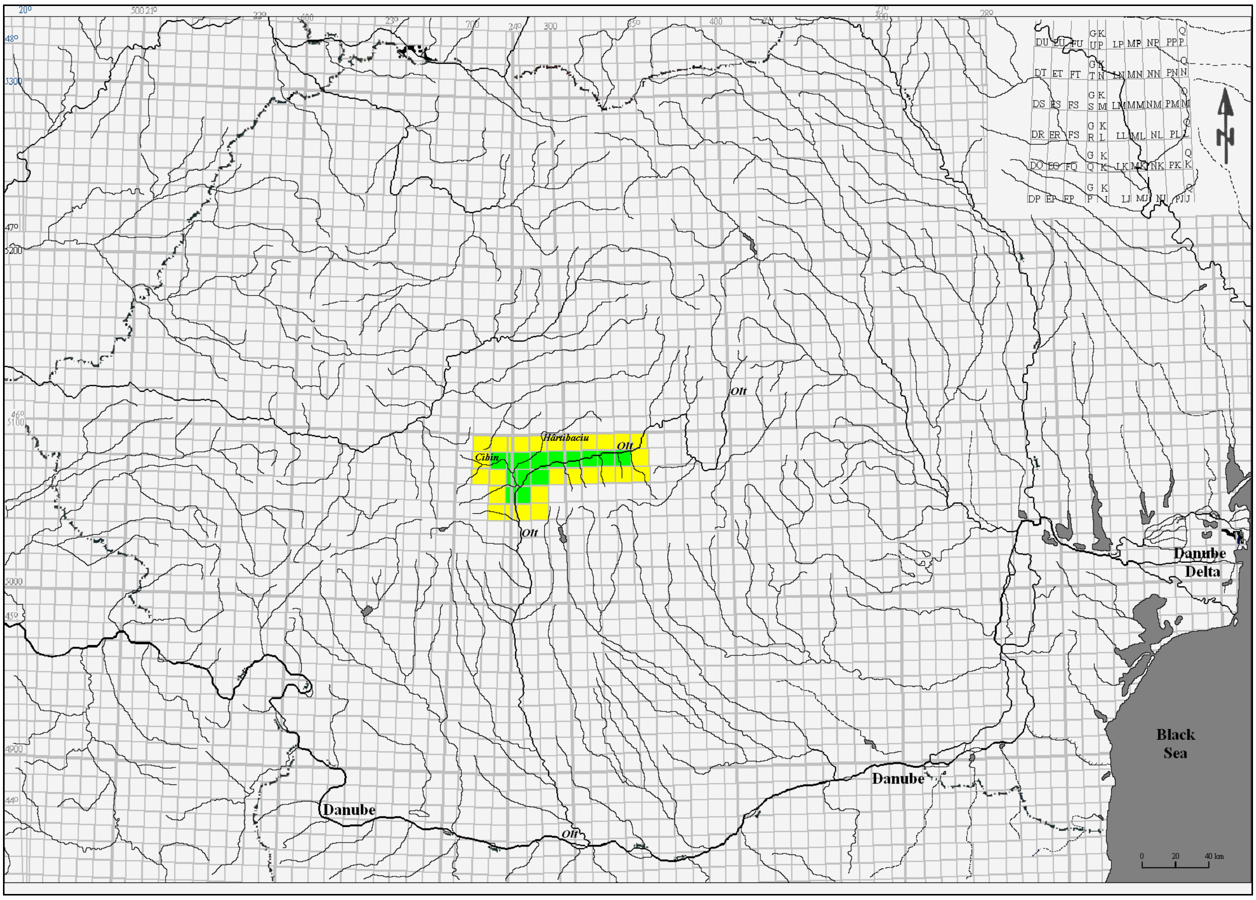

Figure 1: Natura 2000 (SCI) proposed site (■), with buffer zone (■), for *Barbus meridionalis* on the middle Olt River (Lehrer and Lehrer, 1990 - modified by the author).

For an optimum conservative effect, through this paper we propose that the middle Olt River site to lay at least from the Şercaia River tributary to the entrance of the Olt River in the Meridional Carpathians, including the lower courses of both the Cibin and Hârtibaciu rivers. The major arguments for the proposal of this site (including the Olt River tributaries at least in their confluence areas - minimum 1 km; with the exception of the Cibin and Hârtibaciu rivers which should be protected at least for 5 to 10 km in their lower parts) are the following: high number of *Barbus meridionalis* individuals; historic records continuity of this species there in the last 100 years; healthy *Barbus meridionalis* individuals; good habitats under quantitative and qualitative aspects - enough space and diverse microhabitats in mosaic (longitudinal and transversal) shape; the anthropogenic impact presence is in the limits of this fish species tolerance; river sector with a favorable geographical position with possibility for this species spreading upstream and also downstream in the Olt Basin and its tributaries and with a direct connection to the Danube main stream and as a consequence in its whole basin.

Barbus meridionalis can act here as an umbrella species for the high local ichtyofauna diversity of over 20 species (Bănăduc, 2006). From the conservative interest can be enumerated: *Esox lucius* Linnaeus, 1758; *Tinca tinca* (Linnaeus, 1758); *Aspius aspius* (Linnaeus) 1758; *Alburnus alburnus* (Linnaeus, 1758); *Alburnoides bipunctatus* (Bloch) 1782; *Vimba vimba* (Linnaeus, 1758); *Pelecus cultratus* (Linnaeus, 1758); *Rhodeus sericeus amarus* (Bloch, 1782); *Gobio uranoscopus* (Agassiz, 1828); *Gobio kessleri* Dybowsky, 1862; *Rutilus rutilus* (Linnaeus, 1758); *Barbatula barbatula* Linnaeus 1758; *Cobittis taenia* Linnaeus, 1759; *Sabanejewia aurata* (Filippi) 1865; *Perca fluviatilis* Linnaeus, 1758; *Zingel streber* (Siebold, 1863); *Zingel zingel* (Linnaeus, 1766).

CONCLUSIONS

These data are based on the author original scientific data.

These data are no older than six years, and can be easily checked on the field by appropriate specialists.

The proposed lower middle Olt River proposed site of Community interest in relation with at least *Barbus meridionalis* and its local ichtiocenosis prove the need for this valuable site inclusion in the European Natura 2000 net.

This material was sustained by the author through the Natura 2000 standard data form fulfillment and also will be on the Biogeographical Seminars for Bulgaria and Romania.

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HABITATS DIRECTIVE (92/43/EEC) FISH SPECIES (OSTEICHTHYES) ON THE ROMANIAN TERRITORY

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KEYWORDS: Natura 2000, Romania, fish species, Osteichthyes, taxonomy, distribution, ecology, protection status, economic value.

ABSTRACT

For the Natura 2000 net realisation in Romania, the implementation of specific management plans should cover one by one, all the designated sites with all the species and habitats of conservative interest.

For this purpose this paper want to bring concentrated data (scientific and vernacular names, terra typica, description, image, ecology, biology, distribution, conservation, threats, etc.) regarding the fish species (Osteichthyes) included in the Habitats Directive (92/43/EEC) and being present on the Romanian territorry: *Alosa pontica*, *A. tanaica*, *Aspius aspius*; *Barbus meridionalis*, *Cobitis elongata*, *C. taenia*, *Cottus gobio*, *Gobio albipinnatus*, *G. kessler*, *G. uranoscopus*, *Gymnocephalus schraetzer*, *G. baloni*, *Hucho hucho*, *Leuciscus souffia*, *Misgurnus fossilis*, *Pelecus cultratus*, *Proterorhinus marmoratus*, *Rhodeus sericeus amarus*, *Romanichthys valsanicola*, *Rutilus pigus*, *Sabanejewia aurata*, *Umbra krameri*, *Zingel streber* and *Z. zingel*.

REZUMAT: Specii de peşti (Osteichthyes) din Directiva Habitate (92/43/EEC) de pe teritoriul României.

Pentru realizarea rețelei Natura 2000 în România, planuri specifice de management trebuie să acopere una câte una, toate siturile desemnate cu toate speciile şi habitatele de interes conservativ.

Pentru acest scop, această lucrare doreşte să aducă date concentrate (denumiri ştiințifice şi populare, terra typica, descriere, imagine, ecologie, biologie, distribuție, conservare, amenințări, etc.) referitoare la specii de peşti (Osteichthyes) incluse în Directiva Habitate (92/43/EEC) şi care sunt prezente pe teritoriul romăesc: *Alosa pontica*, *A. tanaica*, *Aspius aspius*; *Barbus meridionalis*, *Cobitis elongata*, *C. taenia*, *Cottus gobio*, *Gobio albipinnatus*, *G. kessler*, *G. uranoscopus*, *Gymnocephalus schraetzer*, *G. baloni*, *Hucho hucho*, *Leuciscus souffia*, *Misgurnus fossilis*, *Pelecus cultratus*, *Proterorhinus marmoratus*, *Rhodeus sericeus amarus*, *Romanichthys valsanicola*, *Rutilus pigus*, *Sabanejewia aurata*, *Umbra krameri*, *Zingel streber* and *Z. zingel*.

ZUSAMMENFASSUNG: In der Habitatrichtlinie (92/43/EEC) aufgelistete Fischarten (Osteichthyes) auf dem Gebiet Rumäniens.

Für die Einrichtung des Natura 2000 Netzwerks in Rumänien müssen die auszuarbeitenden Managementpläne mit nach und nach alle ausgewiesenen FFH-Gebiete, ihre schutzwürdigen Arten und Habitate berücksichtigen und erfassen. Zu diesem Zweck will die vorliegende Arbeit umfassende, genaue Daten (wissenschaftliche und volkstümliche Namen, typische Standorte, Beschreibung, Abbildungen, Ökologie, Biologie, Verbreitung, Erhaltungszustand, Bedrohungen, usw.) betreffend die Fischarten der Osteichthyes liefern, die in der Habitatrichtlinie (92/43.EEC) aufgelistet sind und auf dem Gebiet Rumäniens vorkommen. Dabei geht es um folgende Arten: *Alosa pontica*, *A. tanaica*, *Aspius aspius*; *Barbus meridionalis*, *Cobitis elongata*, *C. taenia*, *Cottus gobio*, *Gobio albipinnatus*, *G. kessler*, *G. uranoscopus*, *Gymnocephalus schraetzer*, *G. baloni*, *Hucho hucho*, *Leuciscus souffia*, *Misgurnus fossilis*, *Pelecus cultratus*, *Proterorhinus marmoratus*, *Rhodeus sericeus amarus*, *Romanichthys valsanicola*, *Rutilus pigus*, *Sabanejewia aurata*, *Umbra krameri*, *Zingel streber* and *Z. zingel*.

INTRODUCTION

The objectives of the European Community in the environment field are the conservation, the protection and the improvement of the environment quality, in the condition of the rationale use of the natural resources. The biodiversity conservation constituted an important objective of the European Union, more accentuated in the last 25 years.

To elaborate its environmental policies the European Community structures take in consideration the scientific and technical available information, the environmental conditions characteristic to different regions of the Community and the need for a balanced development of all its component regions, the result benefits and the involved costs.

The action frame at the European Community level, the biodiversity preservation, was established basing on the Habitats Directive (92/43/EEC) and Birds Directive 79/409/EEC).

Both European Directives aim at the protection and maintaining of the biodiversity in the European Union through the creation of a protected area network (Natura 2000 net), in which the habitats and species characteristic for the European biogeographic regions are preserved.

At this moment, Romania contributes to the European Natural heritage with around: 47 % of the territory covered by natural and semi-natural ecosystems; 780 types of habitats; 3700 superior plant species; 33085 invertebrate species and 717 vertebrate species (Bănăduc, 2001).

Romania has the highest biogeographic diversity of all the present European Union countries and the country which will join the European Union in 2007, with five biogeographic regions: continental, alpine, pannonic, pontic and steppic.

There are few ways through which the Natura 2000 initiative can improve its nature protection in our country: extension of the natural area surface; the creation and implementation of correct management plans for these protected areas; institutional capacity building; raising awareness.

One important element of the implementation of these two Directives is the establishment of a Natura 2000 site network on the Romanian territory too (Bănăduc, 2006).

Before this main task which should follow based on the all Romanian specialists in this field of reserach, this paper data goal was to present the fish species present in the Annex II of the Habitats Directive (92/43/EEC) on the Romanian territory and represent a logic continuation and development of the publication Important Areas for Fish in Romania - Preinventory for a draft list of Natura 2000 sites (SCIs) for five fish species, which represented the final report for the pilot project The implementation of the EU Nature Conservation Legislation in Romania PPA03/RM/7/5 Ameco Environmental Services, Utrecht and Bureau Waardenburg, Culemborg, for the Romanian Ministry of Environment and Waters Management counterpart.

For all the Romanian Natura 2000 fish species (Osteichthyes) were offered here different categories of bibliographical and personal data regarding these fish species elements regarding the: Natura 2000 codes, taxonomy, denominations, terra typica, description, identification sketches, ecology, economy, geographical distribution, conservation, protection, etc.

Due to this paper main goal, the fish species names were used in accordance with the Natura 2000 initiative official documents.

In the context in which Natura 2000 objectives for all the Europe, including our country, is so important but also time, personal, technical and money resource consuming in such a relatively short time, it is almost sure that the Romanian Ministry of Environment and Waters Management should involve directly not only all the Romanian and other foreign ichtiologists in this field of interest activities but a lot of other volunteer personal with no keen ichtiological scientific skills, knowledge and bibliographic support, for all these persons this paper was create and intend to be a minimal guidance and support!

2491 *Alosa pontica* (Eichwald) 1838/ *A. immaculata* Bennet, 1835 (Fig. 1).

Ord. Clupeiformes, Fam. Clupeidae.

RO-Scrumbie de Dunăre, GB-Pontic shad, Black Sea shad; Kerch Black Sea shad, Kerch shad; DE-Donauhering, Schwarzmeer-Hering, FR-Alose de la Mer Noire, ES-Sábalo del Mar Negro; BG-Dunavska skumriya, Karagyoz; RU-Chernomorskaia sel'd, HU-nagy dunai hering, UA-Chernomorskaia seld.

Odessa is **Terra typica** of this species.

Description elements. Elongated and lateral compressed body. The body dorsal profile smoothly and almost regularly advance from the snout to over the pectoral fin, after which go almost orizontaly. Gill rakers rather thin, usually equal to or a little shorter than the gill filaments. The mouth is big and terminal, a little oblique upward. The jaw is very big, broadened and rounded at its posteriour edge. The mandible tooth are egregious. The teeth are well developed in both jaws. The well developed eyelids, often cover the bigest part of the eye. The interorbitaryspace is plane or a little stuck out. Lofty and lateraly obtuse compressed snout. Rounded back. Lateraly compressed abdomen. The dorsal fin is situated aproximatively at the middle of the body, its insertion is situated closer to the snout than the caudal fin base or at equal distace. The dorsal fin is short and low, its edge is plain or slightly concave. The pectoral and ventral fins are short and edgy. The ventral fins are a little in the back of the dorsal fin. The anal fin is much back of the dorsal fin, long and low, its edge is almost plain. The caudal fin is deeply intrusive. Its back is intense green-bluish, its flanks silvery with an accentuated gloss. The head is sometimes hoary, or darkened. The fins are colourless.

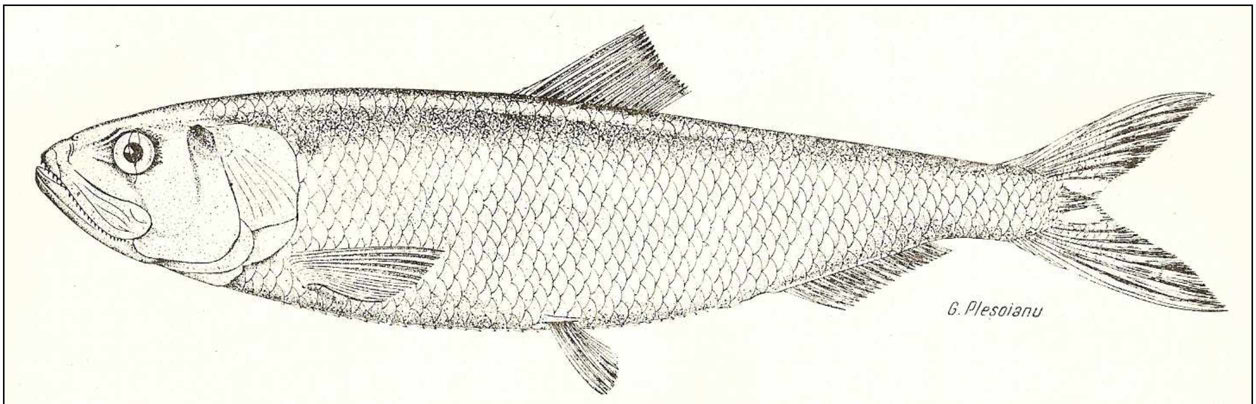

Figure 1: *Alosa pontica*; (original image - Bănărescu, 1964).

Ecologic elements. marine pelagic-neritic, anadromous migratory, freshwater, brackish species, at a depth range of 3 to 90 m, spend the winter in the sea and is reproducing in large rivers. Some individuals became sexual mature at two years but mostly at three years. The spring migration start in March, at 6°C temperature, when the fish appear near the shores. The most intense migration is in April and in May. Imediately after the reproduction they came down in the sea. The alevines go downstream imediately after the reproduction and stay for a while in or near deltas or estuaries until the winter. The reproduction places on Danube are between Călăraşi and Brăila, but also upstrem Călăraşi till the Iron Gates area. This species individuals can reach 15 to 21 cm at two years, 23 to 34 cm at three years, 27 to 37 cm at four years and 40 to 50 cm at five years. This species food consist mainly (70 – 75 %) of fish, in the sea *Engraulis*, *Clupeonella*, *Sprattus* and in freshwaters cyprinidaes. Secondary they eat crustaceans (*Crangon*, *Upogebia*, *Idothea*, gammarids).

Economic elements. Excepting the sturgeons, the Pontic shad is the most tasty lowland freswaters fish (18.8 - 21.8 % fats). It is sel conservated and fresh. The colected quantities decreased due to overexploitation and to the Danube water quality decreasing.

Distribution elements. Live in Black and Azov seas and in Danube, Nistru, Don.

Conservation elements. Protected by Habitats Directive (Annexes 2 and 5), Bern Convention (Annex 3), IUCN Red List (VU-vulnerable), 462 Law (Annexes 2 and 4A), OUG 57/2007, OMMDD 1964/2007, l13/1993.

Threatening elements.

Pollution, damming and the overfishing in its spring-summer migratory period.

4120 *Alosa tanaica* (Grimm, 1901) (Fig. 2)

Ord. Clupeiformes, Fam. Clupeidae.

RO-Rizeafcă, GB-Azov shad, RU-Azovskii puzanok, Palaeostomskii puzanok; HU- kis dunai hering.

This species **terra typica** are the Danube River mouths.

Description elements. The body is higher than at the other two species of the genus. The teeth from the mandible are very small, in general them can not be feel at fingering. The gills spines although long and numerous (67-91), in general exceed once/once and a halph the gills foils.

From the other taxonomic characteristics point of views differ not very much by the previous approached species *A. immaculata*.

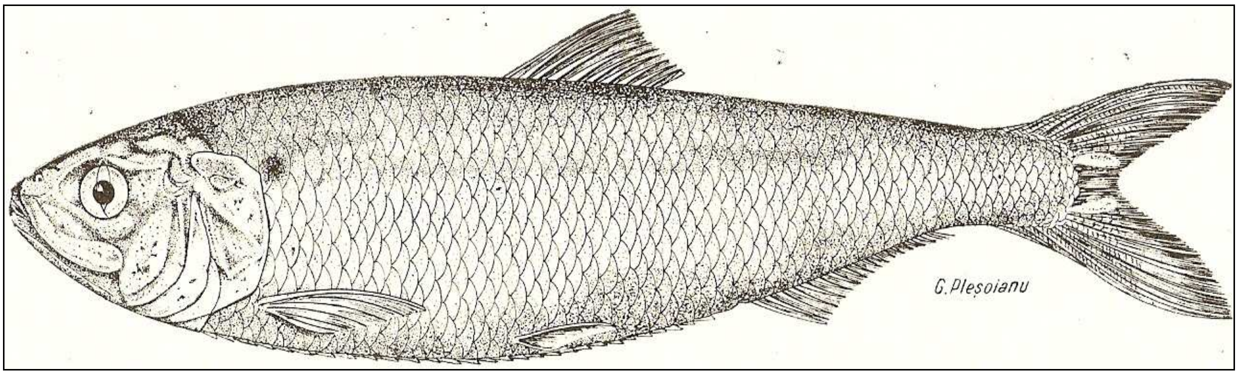

Figure 2: *Alosa tanaica*; (original image - Bănărescu, 1964).

Ecologic elements

This is a pelagic-neritic, anadromous, freshwater - brackish - marine fish species. It stay in the winter season in the sea, appear in the spring near the coast line, when the water have a temperature of 6°C. Usualy this species stay together with other fish species. On the Romanian territory, a small percentage of the individuals ascend on the Danube River, others enter in the Razelm area, others remain probably in the front of the Danube River mouths. The reproduction is happening in April - June months period. The adults and alevine individuals withdrawal from the Danube River in the slack Sea it is happened in August - September months period, and from the Razelm area in August - September months period. In Don River migrates for spawning in its lower reach in April. At the end of April, it enters the delta of the Kuban River and spawns there in June. In winter, it is found along the Caucasian coast as far south as Batumi. Its eggs are bathypelagic or sink to bottom.

Economic elements. This species have a low economic value, the fishing quatities are small.

Distribution elements. The Black Sea, Azov Sea, Marmara Sea, Razelm area and Danube River till Călăraşi in Romania.

Conservation elements. Based on the IUCN Red List Status it is a species of least concern.

Threatening elements. Pollution and damming and the overfishing in its spring-summer migratory period.

1130 *Aspius aspius* (Linnaeus) 1758 (Fig. 3)

Ord. Cypriniformes; Fam. Cyprinidae.

RO-avat, haut, aun, gonaci, peşte-lup, buțoi, guran; DE-Raapf, Rapen, FR-Aspe; GB-Asp, RU-Zherekh, UK-Bilyzna, HU-Balin, CS-Bolen.

Its **terra typica** is Sweden.

Description elements. Elongated body, a litle laterraly compressed. The head dorsal profile smoothly get up till the head is over where it suddenly get up forming a kind of humpback. Te head length represent 22 - 27 % of the body (without caudal fin) length. The eyes are small, are looking lateraly and ahead. The foreheadis almost plain. The snout length represent 25 - 31 % of the head length. The mouth is big, terminal and upward oblique, it ends under the eye. Thin and continuous lips. The inferior jaw have a protuberance which is fitting in a cavity of the superrior jaw, this morphological adaptation help the fish to grab the prey. The dorsal fin insertion is situated closer to the caudal fin base than to the top of the snout. The dorsal fin extremity is concave. The pectoral fins did not touch the base of the ventral fins; their length represent 17 - 20 % of the body length. The ventral fins represent 13 - 17 % of the body length. The anal fin extremity is strong concave. The caudal is deep holed. The scales are thin but well fixed. The back is is dark-olive, hereinafter silvery flanks, the ventral part white. The dorsal and the caudal fins are dun, the ventral and anal fins are colourless or pale reddish, the pectoral fins colourless. The lips are hoary. Usualy it reach a length of 30 - 40 cm and a maximum of 80 cm.

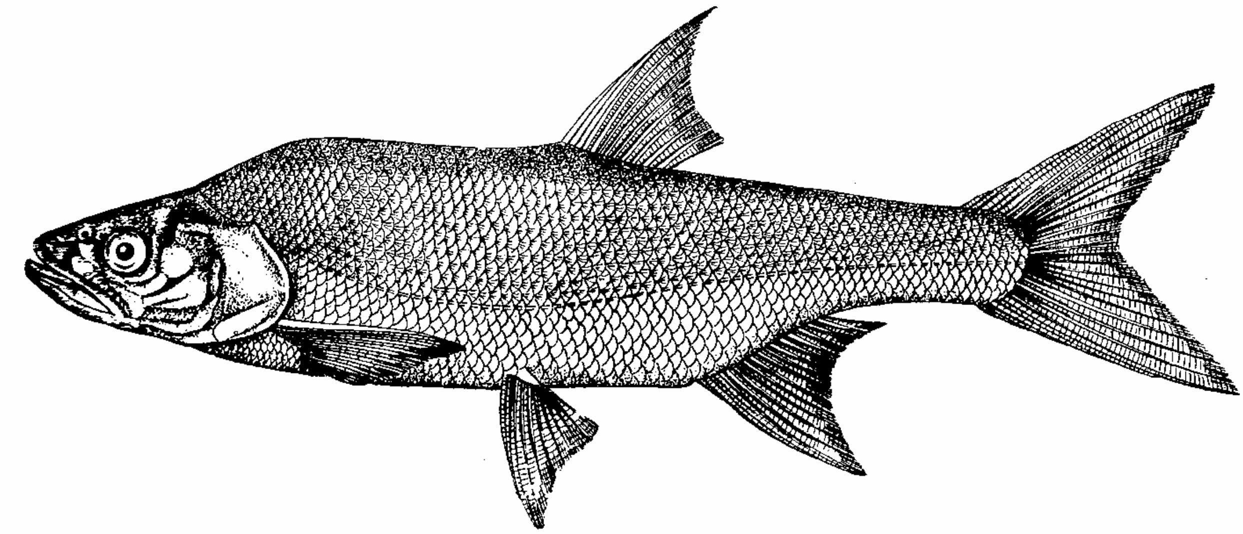

Figure 3: *Aspius aspius*; (original image - Bănărescu, 1964).

Ecologic elements. It is living in the lowland up to hilly big rivers, also in big sweet or a litle salty ponds and lakes. The sexual maturity is reached at 4 or 5 years old. The reproduction is hapened in March to April or May at 6 - 10°C. The spawn are laied down on tough substrata, in flowing or standing water. The allevines eat plankton. The mature individuasl eat only fish. It is a day light active predacious fish.

Economic elements. It has a medium alimentary value, it is fade and has many bones.

Distribution elements. Central Europe from the Rhine to Ural Mountains, also in Struma, Marița, northern Asia, Caucasus. In Romania can be found in the Danube including the Danube Delta, some Black Sea littoral lakes, Tisa, Mureş, Bega, Timiş, Jiu, Olt, Vedea, Argeş, Ialomița, Siret, Prut, Suceava, Moldova basins, etc.

Conservation elements. The IUCN Red List, Bern Convention Annex 3, Habitats Directive annexes 2 and 5.

Threatening elements. Poaching, damming and pollution.

1138 *Barbus meridionalis* Riso, 1827 (Fig. 4).

Ord. Cypriniformes; Fam. Cyprinidae.

RO-moioagă, moiță, cîrcușă, jumugă, jamlă, jamnă, mreană pătată, mreană vânătă, mreană de munte, mreană de vale; BG-Cherna, DE-Forellenbarbe, Semling, Afterbarbe; FR-Barbeau truite, Truitat, Turquan; GB-Mediterranean barbell; HU-Petenyi-márna; CS-Potocna mrena.

This fish species **terra typica** is the Mureş River in Transylvania/Romania.

Description elements. Elongated body. The superior profile of the body is an ascendant curveline from the snout to the dorsal fin, without to reach the dorsal fin. The last simple radia of the dorsal fin is thin, flexible and not jagged. The ventral fins are inserted backward to the dorsal fin insertion. The dorsal fin edge is plain or slightly fluted. The lips are more fleshy and developed in comparison with the species *Barbus barbus*. The posterior whiskers are sometimes long, exceeding the eye. The back of the body is dark brown-rusty colloured, with darker and lighter spots, the flanks are yellow-rusty with spots, the ventral side is light yellow. The dorsal and caudal fins with accentuated spots, the rest of the fins are yellowish. The whiskers are yellowish with no red axis. It can reach a maximum length of 28-30 cm.

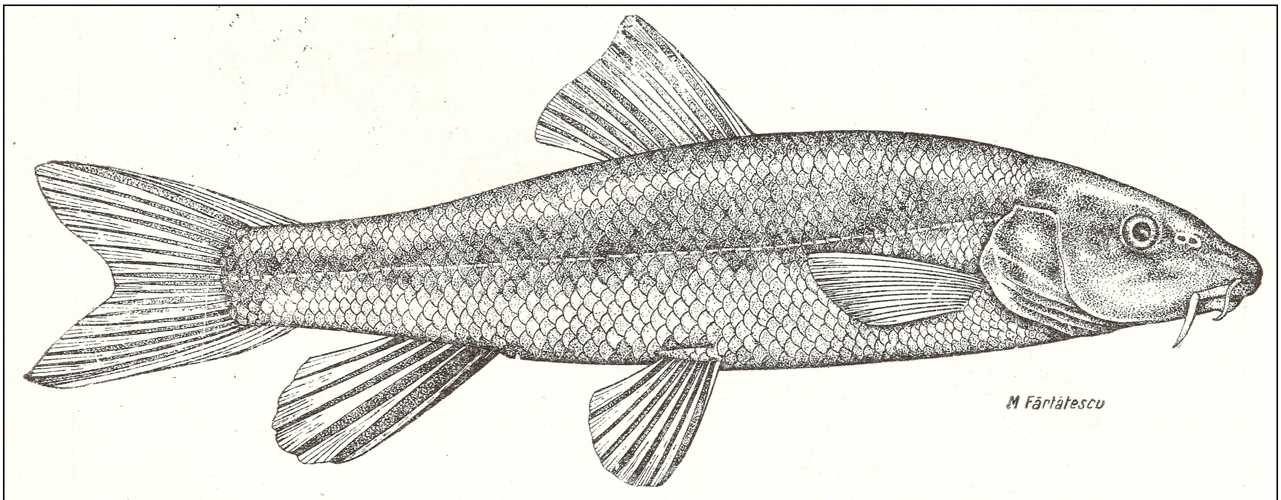

Figure 4: *Barbus meridionalis*; (original image - Bănărescu, 1964).

Ecologic elements. It is a benthopelagic, freshwater fish. A short-lived species which is found in mountainous and hilly rivers, with springs in this area. Prefer the clear and fast flowing water sectors and the hard substrata. No migrations were registered for this species. The reproduction is happened in the spring, sometimes is prolonged till the summer. Its food consist mainly of benthic aquatic invertebrates (tendipedes, ephemeropterans, trichopterans, gamarids, oligochetes and rarely plants).

Economic elements. Its economic value it is strictly local, being apreciated in some areas.

Distribution elements. Danube, Nistru, Odra, Vistula and Vardar basins. Relatively well spreading on the Romanian territory, can be considered in the last decade as being a species with an extending areal here.

Conservation elements. The IUCN Red List, Habitats Directive.

Threatening elements. It is threatened by pollution, habitat destructions and and water abstraction.

2533 *Cobitis elongata* Heckel and Kner, 1858 (Fig. 5).

Ord. Cypriniformes; Fam. Cobitidae.

RO-fâsă mare; GB-Spotted Big Loach, Balkan Loach.

This fish species **terra typica** is the upper Sava River basin.

Description elements. The body is much biger in comparison with the other representatives of the genus reaching a meximum length of 165 mm length. The body is elongated and thik. The body heigh is from the pectoral fins insertion to the annal fin insertion. The interorbitary space is almost plain. The mouth is small and inferiour. The inferior lip form a pair of sharp whiskers-like posteriour elongations. The longest pair of whiskers is the third one. The caudal peduncule is long, low, lateraly compressed, without a dorsal faty crest, with a thin ventral streamline in its posteriour part. The ventral fins insertions is positioned a litle in the back of the dorsal fin insertion. The pectorals, ventrals, and the annal fins are rounded, the dorsal fin with a plain edge and rounded corners, the caudal fin with a plain edge. The scales are oviform. The fundamental colour is white-yelowish on which exist numerous maron-greyish spots, distributed in regular series. A series of 12 - 19 spots on the dorsal median line, rounded and relatively closed. On the flanks of the body are 10 - 13 prolongued spots, rounded at their ends, distributed regularly. Among the dorsal and the lateral spots, the pigmentation is distributed like three longitudinal zones. A blak oblique, very intense spot is present at the caudal base, under this one is a maroon spot. On the head are short winding spots. A broad oblique line exist from the tip of the snout to the eye, rarely prolongued over the eye.

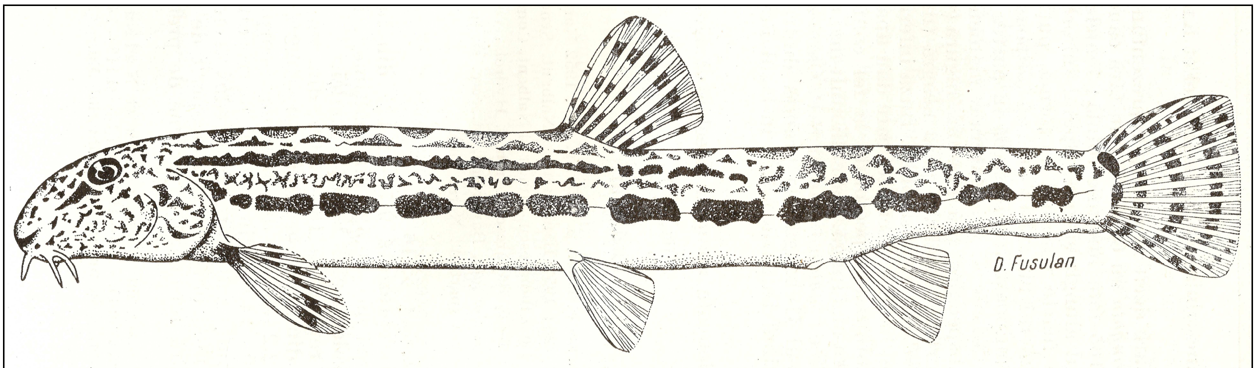

Figure 5: *Cobitis elongata* (original image - Bănărescu, 1964).

Ecologic elements.

Live in hilly areas rivers, on the sandy substrata, rarely on pebbles, it is hiding often in the sand. Are fast moving fish. The reproduction is hapened in May - June. The food consist of: diatomea, insect larvae.

Economic elements. Its economic value it is strictly local, being consumed by the local people in the Nera River area.

Distribution elements. Sava River and its tributaries; Nera and Miniş rivers in Banat region.

Conservation elements. The species is protected by protected by Law 13 of 1993 (through which Romania became a part to the Bern Convention), Annex II of the European Directive 92/43/EEC, through the Law no. 462/2001 (and the last amendaments) regarding the protected natural areas and the habitats and wild flora and fauna conservation.

Threatening elements. It can be threatened by pollution, habitat destructions and and water abstraction.

1149 *Cobitis taenia* Linnaeus, 1758 (Fig. 6).

Ord. Cypriniformes; Fam. Cobitidae.

RO-zvârlugă, fîsă, cîră, zmorlă, rîmbițar; DE-Dorngrundel, Steinbeisser; FR-Loche de rivière; GB-Spined Loach; RU-Shtschipovka; UK-Shtschipovka; HU-Vágó csik; BG-Piskal; CS-Vijun.

This fish species **terra typica** is Sweden.

Description elements. The dorsal and ventral profiles are almost horizontal. The inter-orbitary space is plain. The two halfs of the inferiour lip are subdivided in 3 - 4 lobes. The third pair of whiskers are the longest. The caudal peduncule in its posteriour part have a dorsal and a ventral streamline, the last one more developed. The ventral fin insertion is situated a litle backward in comparison with the dorsal fin insertion. The caudal fin is truncated or slightly holed. The pectoral and ventral fins are rounded. The lateral line is short, in general did not overdraw the pectoral fin. The body background is white-yelowish. The dorsal spots are small, rectangular or rounded, close, in variable number (13 - 24). The lateral pigmentation of the body consist of four zones. At the caudal fin base in the upper corner, is a clear veryical black intense spot. On the head are small spots and an oblique line, from the backhead to the mouth. It can reach 12 centimetersin length.

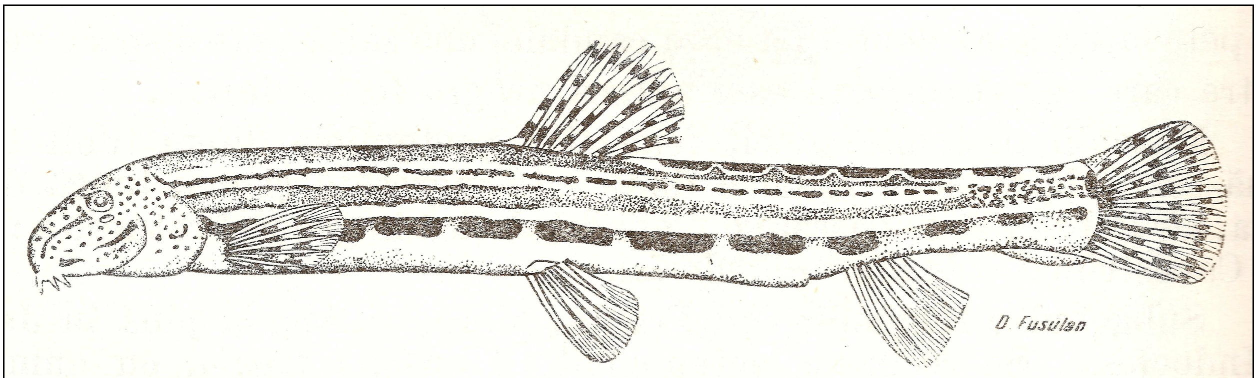

Figure 6: *Cobitis taenia* (original image - Bănărescu, 1964).

Ecologic elements. It is living in slow flowing water and in standing water, with sand or clay as substrata, rarely on stony substrata. Very often it stay under the substratum sand. It can partialy substitute the lack of oxigen in water with intestinal respiration. It is eating in majority in night time worms, insect larvae, algae. The reproduction is happened in April - June. The roes are adhesive.

Economic elements. It have no economic value.

Distribution elements. Europe at the north of the Pirinei, Alps, Dinarics and Balcan Mountains, also in Finland, Crimea, Caucaz, etc. In Romania it present in the basins of: Tur, Someş, Crasna, Crişul Repede, Crişul Alb, Crişul Negru, Mureş, Bega, Timiş, Caraş, Cerna, Jiu, Gilort, Olt, Vedea, Argeş, Dâmbovița, Colentina, Neajlov, Siret, Prut, etc.

Conservation elements. Its protection and conservation is based on Bern Convention annex 3, Habitats Directive annex 2 and Law 462.

Threatening elements. It can be threatened by pollution and habitat destructions.

1163 *Cottus gobio* Linnaeus, 1758 (Fig. 7)

Ord. Scorpaeniformes; Fam. Cottidae.

RO-zglăvoacă, moacă, pălipaş, popă, popete, botăşă; DE-Groppe, Greppe, Gruppe, gewöhnliche Groppe; FR-Botte, Cabot; GB-Miller's thumb, Sculpin, Bullhead; HU-Botos kölönte; RU-Bychok-podkamenschik; UK-Podkamenschchik.

Its **terra typica** is Europe.

Description elements. Elongated and thil body. The profile it is slightly convex between the tip of the snout and the eyes, backward is almost horizonta, the head being just a litle lower than the body. The head is big dorso-ventral flattened and thicker than the body. The eyes are situated in the anteriour part of the head, semi-spheric, looking upward. The superior part of the eye is often covered by a pigmented eyelid easy to be confused with the skin. Two pairs of small, distanced and simple nostrils; the anteriour pair is situated much in the front of the eyes. The inter-orbitary space is slightly holed. The snout is rounded. The mouth is big and terminal, its ends reach an under eye position or near this area. The teeth are small. The caudal peduncule is lateraly compressed. The dorsal fins are close, the first is low with a convex edge, the second with a plain edge. The anal fin is inserted a little after the seconf dorsal fin insertion. The pectoral fins are big and broad, and their tips usualy reach or overdraw the annus. The caudal fin have a convex edge, sometimes almost plain. The lateral line is complete, on the midle of the caudal peduncule, reach the caudal fin base. The dorsal part of the body is brown with marbled-like spots. The ventral part of the body is light-yelowish or white. In the posteriour part of the body are 3 - 4 dark transversal lines. The dorsal, caudal and pectoral fins have brown spots distributed in longitudinal lines. The annal and ventral fins are not spoted. It can reach 13 cm length.

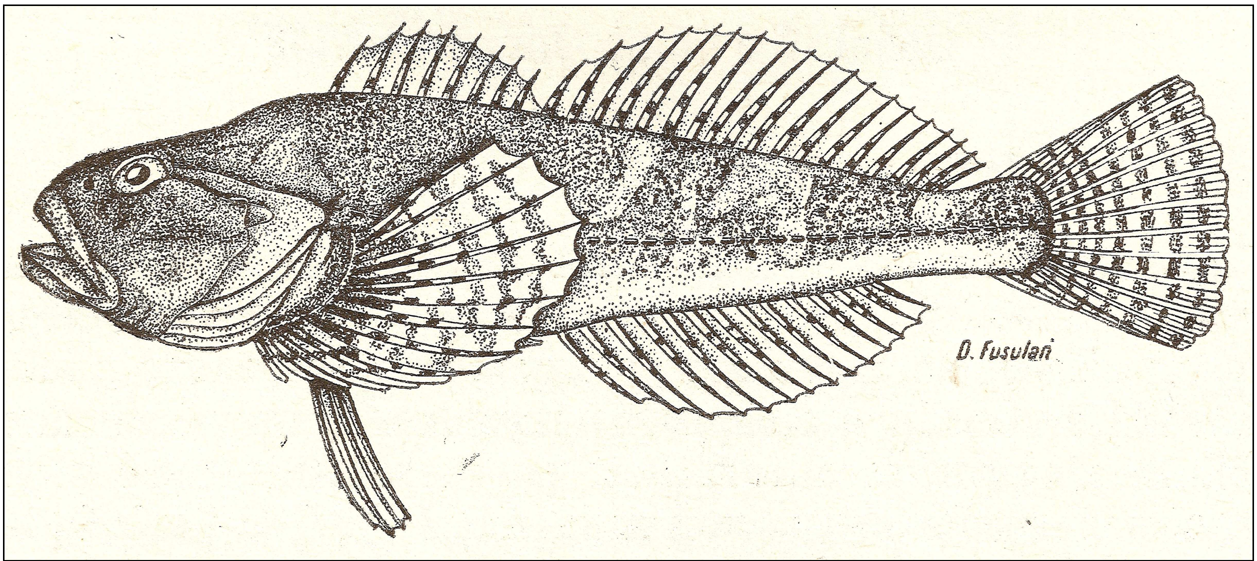

Figure 7: *Cottus gobio* (original image - Bănărescu, 1964).

Ecologic elements. It is living exclusively in warm, mountainous lotic freshwater, rare in lakes. Usualy stay under rocks, in the sectors with not deep water and relatively slow. The sexual maturity is reached at two years old. Its reproduction is happened in March - April. Its food consist of insect larvae, amphipoda, roes and alevines.

Economic elements. Strictly local.

Distribution elements. Europe from England and north of Spain to the Balcans and Crimeea. In Romania is relatively well spreaded in all the Carpathians.

Conservation elements. Law 13 of 1993 through which Romania is a part of the Bern Convention.

Threatening elements. It can be threatened by pollution and habitat destructions.

1124 *Gobio albipinnatus* (Lukasch, 1933) (Fig. 8).

Ord. Cypriniformes; Fam. Cyprinidae.

RO-porcuşor de şes; DE-Weißsflossiger Gründling; GB-White-finned gudgeon; HU-folyani küllö; UK-Pinchkur svitloplavtsovyi; RU-Peskar svetloplavnikovyi.

This fish species **terra typica** is Kahul Lake in the Danube Basin.

Description elements. The body and the caudal peduncule are relatively high and lateraly compressed. The peduncle hight is a litle higher in comparison with the thickness at the level of the annal fin posteriour edge. 7 exceptional 8 divided rays in the dorsal fin. There are four scales between the lateral line and the ventral fins. In Romania can be found *Gobio albipinnatus vladykovi* Fang 1943. Convex dorsal profile. The maximum heigh is situated at the dorsal fin insertion. The snout is short and obtuse. The eyes are big and close, looking more upward. The wisckhlers reach in general the posterior edge of the eye. The caudal peduncule is slightly lateraly compressed. The caudal fin is profound holed, its superior lobe being longer than the inferior one. The pectoral fins did not reach the ventral fins insertion, the ventral fins outgrow the annus but did not reach the annal fin. The annus is more closer to the ventral fins then the anal fin. The superior part is light yelowish-greyish. The dorsal side of the head is darker greyish, with even darker spots and lines. On flanks in general 7 - 8 round spots. The lateral line scales have two blak spots not very well marked. The ventral face is white. On the dorsal and caudal fins rays are two rows of black spots, also not very well marked. It can reach 13 cm in length.

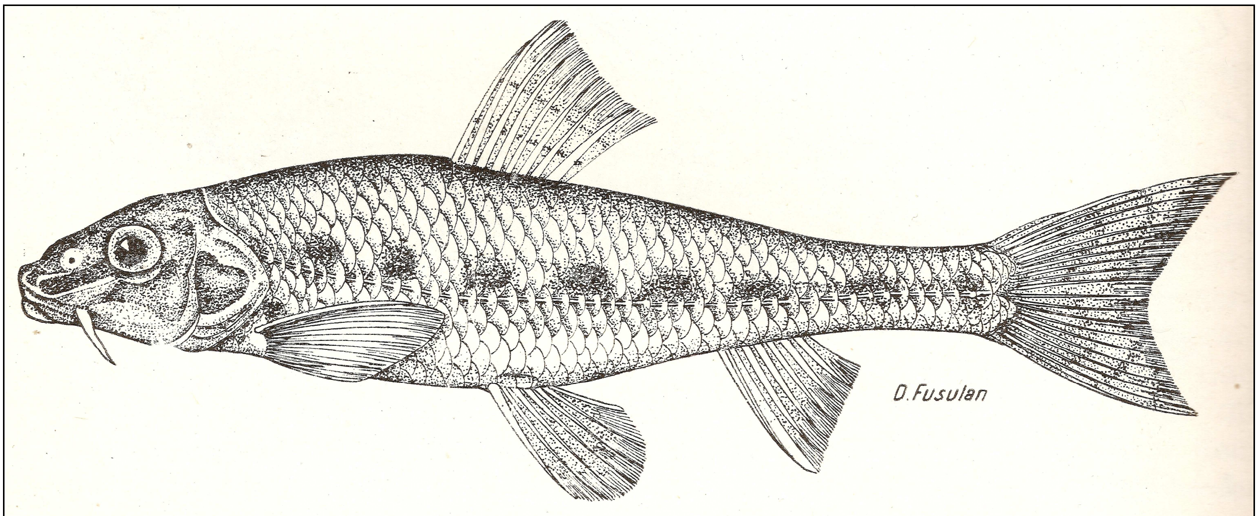

Figure 8: *Gobio albipinnatus* (original image - Bănărescu, 1964).

Ecologic elements. It is living in the Danube and in the low altitude rivers with sand or clay on the bottom. Usualy can be found in sectors with deep water and slow water flow. Avoid the places with stagnant water and muddy bottom or fast flowing water. In general is solitary. Eat benthic macroinvertebrates. The reproduction is in May - July period.

Economic elements. Its economic value is very reduced and strictly localy.

Distribution elements. In the Danube Basin from Bratislava to the Danube Delta. Also can be found in Tur, Someş, Crişul Repede, Crişul Negru, Crişul Alb, Mureş, Bega, Timiş, Bârzava, Caraş, Berzasca, Cerna, Olt, Vedea, Argeş, Siret, Prut, etc.

Conservation elements. This species is under the protection of the Bern Convention annex 3, Habitats Directive annex 2, IUCN Red List and the Law 462.

Threatening elements. It can be threatened by pollution and habitat destructions.

1124 *Gobio kessleri* (Dybowski, 1862) (Fig. 9)

Ord. Cypriniformes; Fam. Cyprinidae.

RO-porcuşor de nisip; DE-Sandgressling, Kessler Gründling; GB-Kessler's gudgeon; RU-Dnestrovskii dlinnuosyi peskar; HU-homoki küllö; UK-Pichkur dunaiskyi dovgousyi.

Description elements. The body is low and thik or relatively high and slightly lateraly compressed. The caudal peduncule is thik and cylindrical, its thikness in general biger than the minimum hight. The eyes have variable dimensions, usualy significant smaller than the interorbitaru space. The lateral scales are much higher than longer. The whiskers have a variable length. The caudal lobes are almost equal (excepting *G. k. banaticus*).

There are three subspecies in Romania: *G. k. kessleri*, *G. k. banaticus* and *G. k. antipai* (see Bănărescu, 1964).

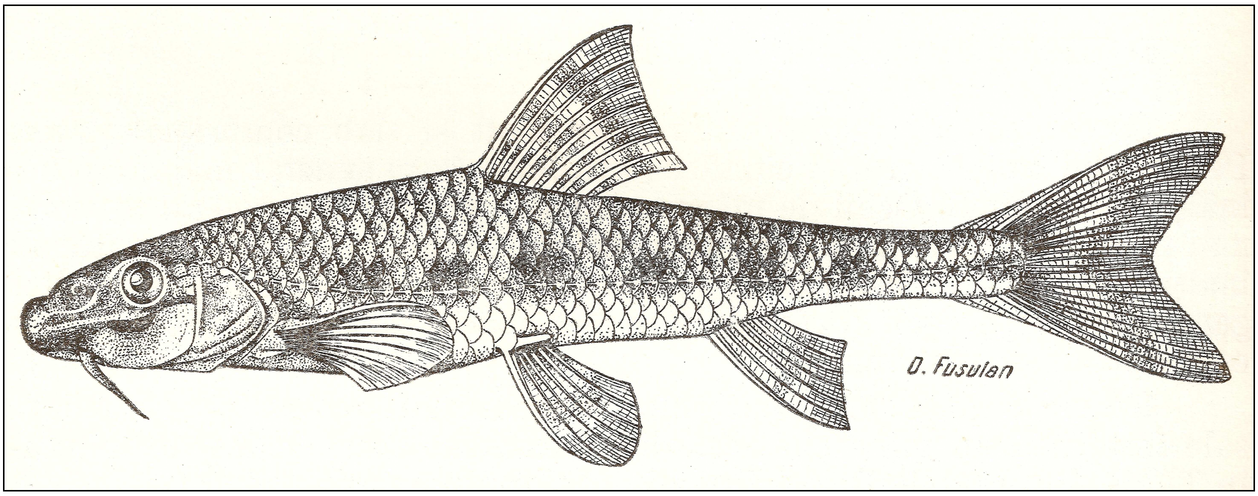

Figure 9: *Gobio kessleri* (original image - Bănărescu, 1964).

Ecologic elements. *G. k. k.* and *G. k. b.* living in the middle course of the big rivers. Prefer a water speed of 45 - 70/90 cm/s, the sandy substrata and not deep water sectors. Usualy many individuals can be foud together. The reproduction seem to hapaned in June. The food consist of diatoms and small psamofilic organisms. *G. k. a.* living in the deep sectors of the Danube River and its lower big tributaries.

Economic elements. Its economic value is reduced and localy.

Distribution elements. *G. k. k.* is present in the following watersheds: Tur, Someş, Crişul Repede, Mureş, Olt, Siret, Moldova, Bistrița Moldovenească, Trotuş, etc. *G. k. b.* is present in: Crişul Negru, Crişul Alb, Bega, Timiş, Bârzava, Caraş, Nera. *G. k. a.* was found by Bănărescu (1964) in: Danube, Danube Delta, Argeş, Ialomița, Milcov, Siret and Prut, in their extreme low sectors.

Conservation elements. This species is under the protection of the Bern Convention annex 3, Habitats Directive annex 2, IUCN Red List and the Law 462.

Threatening elements. It can be threatened by pollution and habitat destructions.

1122 *Gobio uranoscopus* (Agassiz, 1828) (Fig. 10)

Ord. Cypriniformes; Fam. Cyprinidae.

RO-porcuşor de vad, chetrar; DE-Steingressling, Steinkresse; GB-Danube Gudgeon; RU-Peskar-verkhoglyad; HU-Felpillantó külló; UK-Dunaiskii dlinnousyi peskar.

Description elements. The body and the caudal peduncule are thick and cylindrical. At the lips joining points it is a posteriour extension which seem like a second pair of wiskers. The annus orifice is more close to the anal fin than the ventral fins. The chest is completely covered with scales. In Romania is living the subspecies *Gobio uranoscopus friči* Vladykov 1925. The dorsal profile is slightly convex, the ventral profile is horizontal. The snout is relatively sharp. The eyes look much upward. The ventral fins are inserted under the dorsal fin insertion or a litle backward. The caudal fin is deeply holed, the lobes are rounded and equal or almost equal (the inferior lobe a litle longer). The edge of the dorsal fin is slightly holed. The dorsal side is greyish-greenish or brown-redish. The back scales have black edges. Behind the dorsal fin are 2 - 3 big dark spots. On the flanks are 7 - 10 big rounded spots. The ventral side is white-yellowish. At the caudal fin base are two white spots. On the lateral line scales are two small blak spots. On the dorsal and caudal fins are two rows of blak spots. It can reach at 13 cm length.

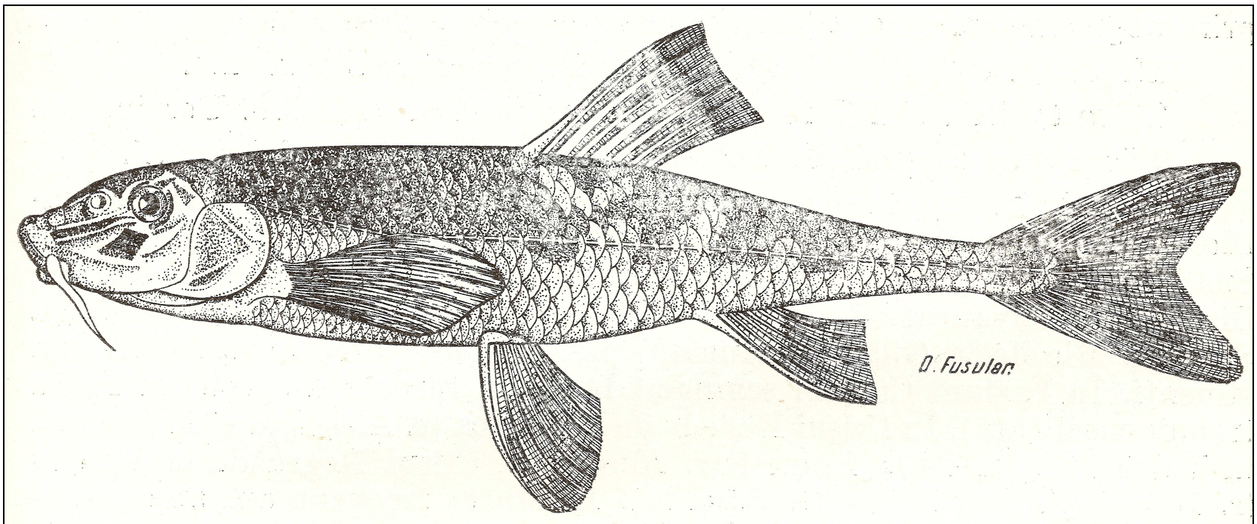

Figure 10: *Gobio uranoscopus* (original image - Bănărescu, 1964).

Ecologic elements. It is living in mountain and hills area, being usualy localised in fords and fast flowing water sectors, where the water can reach 70 - 115 cm/s and the substratum is formed of rocks. The alevines stand in not so fast flowing water sectors with sandy bottom. The reproduction is happened in May - June period. The rows are layed down on the rocks. Its food consist of bioderma and rheophilic invertebrates.

Economic elements. Its economic value is reduced and localy.

Distribution elements. *G. u. f.* can be found in the following basins: Vişeu, Someş, Crasna, Crişul Repede, Crişul Negru, Mureş, Bega, Timiş, Nera, Cerna, Jiu, Olt, Argeş, Dâmbiviţa, Ialomiţa, Suceava, etc.

Conservation elements. Law 13 of 1993 (through which Romania became a part to the Bern Convention), Annex II of the European Directive 92/43/EEC, through the Law no. 462/2001 (and the last amendments) regarding the protected natural areas and the habitats and wild flora and fauna conservation.

Threatening elements. It can be threatened by pollution and habitat destructions.

1157 *Gymnocephalus schraetzer* (Linnaeus, 1758) (Fig. 11)

Ord. Perciformes; Fam. Percidae.

RO-răspăr, şpîrliu, bălos, firizar; DE-Schraitzer, Schratz; GB-Schraetzer, Striped Ruffe; HU-Selymes durbincs; UK-Yersh polosatyi.

The upper Danube is **Terra typica** of this species.

Description elements. The body is relatively prolongued. The dorsal profile draw up almost directly from the tip of the snout to the dorsal fin insertion, afterr which descent. Looking from lateral the head look like a triangular shape. The ventral profile is almost horiyontal. The eyes are located more in the posteriour part of the head, looking more lateraly. The mouth is small and terminal, its opening is situated anteriour to the nostrils. The dorsal side and the flanks are yellow and the ventral side almost white. On the dorsal side of the body are three thin longitudinal black-blueish lines. Two, sometimes three of them are intrerupted. On the hard dorsal fin membrane part are three rows of round, big and black spots. The soft part of the dorsal fin membrane and the other fins are colourless. The iris is black. It can reach a maximum of 24 cm of the body length.

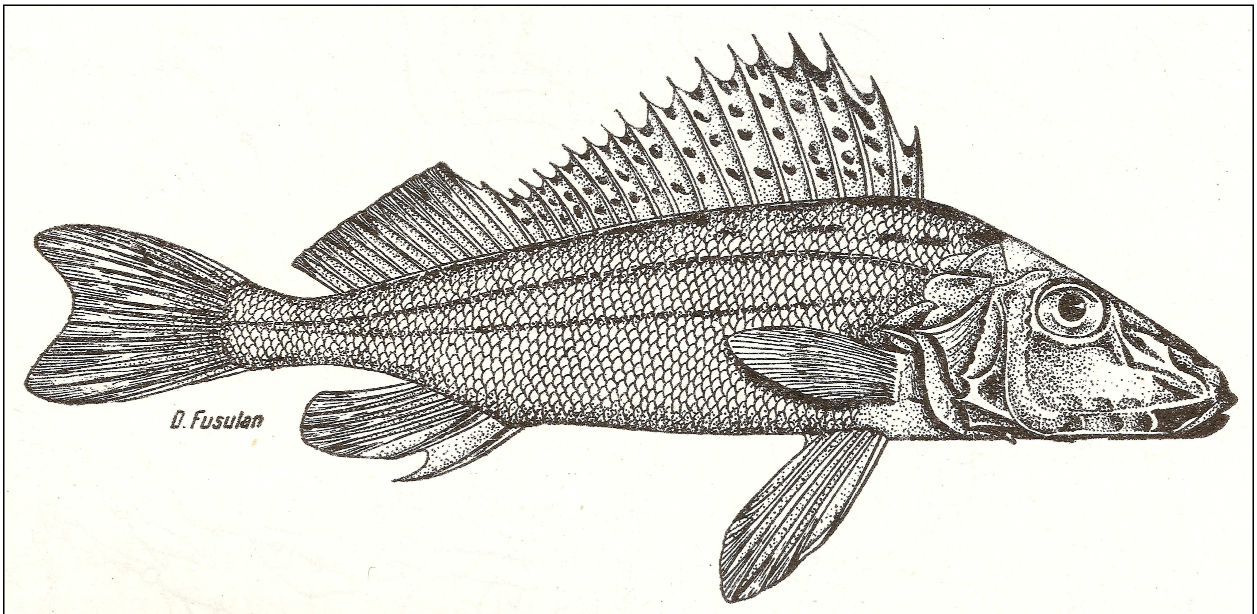

Figure 11: *Gymnocephalus schraetzer* (original image - Bănărescu, 1964).

Ecologic elements. Exclusively lotic species, living in lowland rivers, on the sandy substrata, ocasional on pebbles, sometimes in the hilly areas of the rivers. Usualy it is found together with other tens or hundereds of conspecific individuals, sometimes with other species individuals. Avoid the standing water river sectors. The spring upstream migrations (April - May) are short in distance. The rowes are layed down on hard substratum in water stream. The food consist of aquatic macroinvertebrates, rows and alevines.

Economic elements. It is considered as a species with no economic value.

Distribution elements. This species can be found in the Danube Basin, in Kamcea River from Bulgaria. In Romania can be found in Danube from the Baziaş to its delta; in Someş, Crişul Repede, Crişul Negru, Crişul Alb, Mureş, Bega, Timiş, Cerna, Olt basins etc.

Conservation elements. This species is protected by the Bern Convention annex 3, Habitats Directive annexes 2 and 5, IUCN red list, Law 462 annex 2.

Threatening elements. It can be threatened by pollution and habitat destructions.

2555 *Gymnocephalus baloni* Holcík and Hensel, 1974 (Fig. 12)

Order Perciformes; Family Percidae.

DE-Balons Kaulbarsch, Donau-Kaulbarsch; GB-Balon's ruffe, Danube ruffe; HU-Széles durbincs.

This species' **Terra typica** is Danube.

Description elements. The body is robust, short and deep, nape covered by scales, opercle with two spiny processes. Pored scales in lateral line. Subopercle short, beak-like, with serrated lower edge. Head short, blunt, steeply continuing into body. In bigger specimens there is a characteristic hump. Pelvics, pectorals and anal fin, as well as lower lobe of caudal fin, usually eroded and regenerated. Front edge of base of pelvics situated behind hind edge of base of pectoral fins. Upper edge of soft part of dorsal fin nearly perpendicular to line of caudal peduncle. Spinous rays of anal fin stout, slightly but distinctly bent. A darker irregular band of variable width present along lateral midline of body, but often indistinct, the band usually formed by irregular spots biger than the diameter of the eye. Along the back are four to six spots which continue downwards and gradually lose their intensity. Belly usualy yellowish but always pigmented with small brown spots. Dorsal, caudal anal fins compactly spotted. A large unbordered dark blotch on base of anteriour edge of dorsal fin. A vague V-shaped dark spot on top of the head.

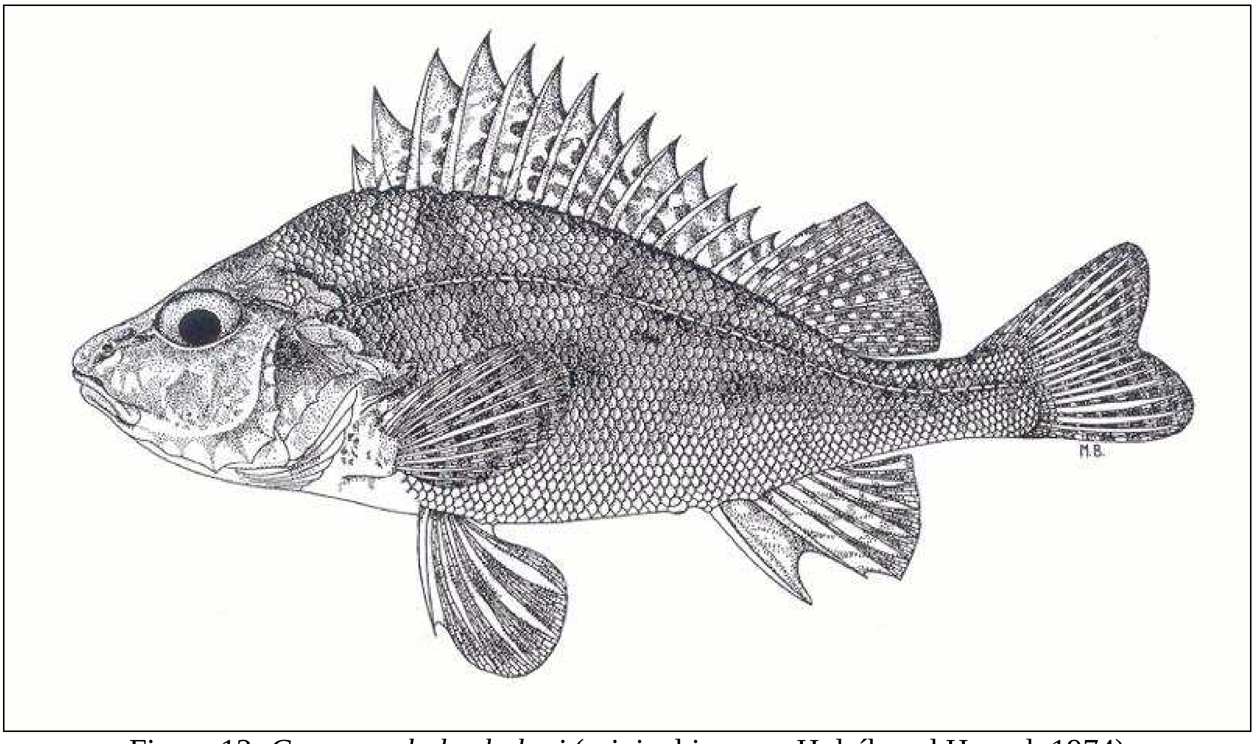

Figure 12: *Gymnocephalus baloni* (original image - Holcík and Hensel, 1974)

Ecologic elements. It is living in lotic systems, preffering the hard bottom and relatively well oxigenated sectors. It is a teritorial and solitary species; diurnal and also nocturnal. The reproduction is in March May period. It lay its stiky roes on the substratum or on different plants. Its food consist mainly of macroinvertebrates.

Economic elements. It is considered as a species with no economic value.

Distribution elements. It can be found in the Danube Basin. In Romania can be found at least in Danube, Someş, Crişul Repede, Crişul Negru, Crişul Alb, Mureş, Bega, Timiş, Olt, Argeş basins.

Conservation elements. This species is protected by the Bern Convention annex 3, Habitats Directive annex 4, IUCN red list, Law 462 annex 2 and 3.

Threatening elements. Threatened by pollution and habitat destructions.

1105 *Hucho hucho* (Linnaeus, 1758) (Fig. 13).

Ord. Salmoniformes, Fam. Salmonidae

RO-Lostriță, lostoză, lostocă, lostruță or puică; GB-Danube salmon, Huchen; DE-Huchen, Donaulachs, Donaulachs, Hauch, Huch, Huchen, Rotfish, Sibirischer Huchen; FR-Huchon; ES-Salmón del Danubio; RU-Taimen, Dunaiskiy taimen, HU-Dunai galóca, UA-Dunaiskii losos.

This species **terra typica** is the upper Danube course.

Description elements. Elongated and thick body, almost round in section. The head is big, its length is longer than the maximum tallness. The snout is conic and poignant. The mouth is very big and terminal. On each side of the tongue are 6 to 8 teeth, 18 to 20 sharp and flexed teeth on the inferior jaw, and 13 to 15 on the superior jaw. The caudal peduncule is low. The ventral fins are inserted under the terminal part of the dorsal fin, the annal fin much behind the dorsal fin and the ventral fins. The lateral line is almost in straight line. The dorsal part is purple, brown or grey, the flanks are silvery, sometimes at the old individuals the flanks are redish. On the head and on the back exist small black round spots. Only the dorsal and caudal fin have some few black spots. It can reach 1.2 to 1.5 m and 10 to 12 kg.

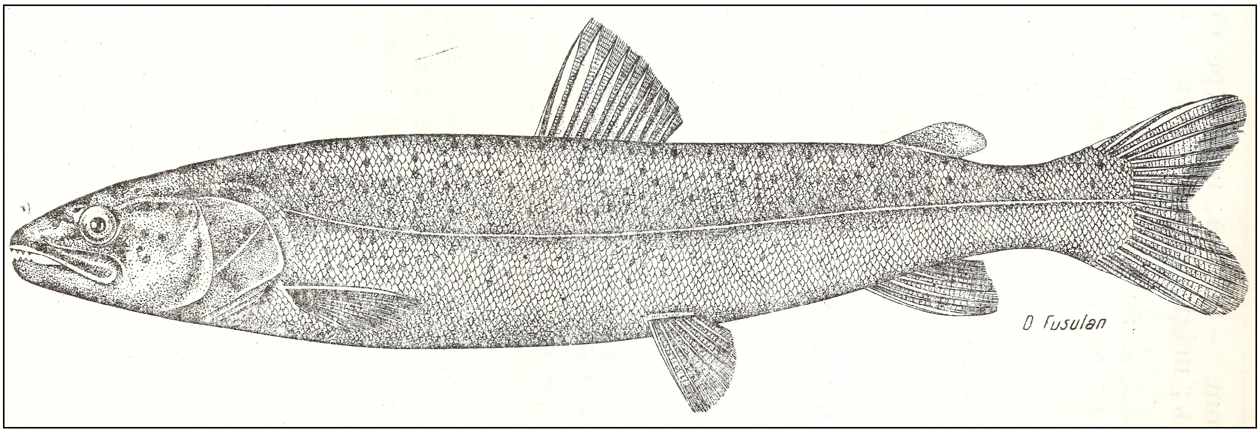

Figure 13: *Hucho hucho* (original image - Bănărescu, 1964).

Ecologic elements.

Live in big mountainous rivers in the grayling and mountainous barbel zone, in deep and fast water streams. Usualy didn't hunt in daylight. The reproduction maturity is reached around 5 years. The reproduction is happened in spring time, at the end of March or in April. The reproduction places are situated in the Grayling area. In this period the female is follow by 3 to 4 males, which fight one against another, only one being choosed in the end for mating. The food is formed almost exclusively of fish.

Economic elements. It is the most apreciated fish species in Romania. Is very, very rare and very, very hunted.

Distribution elements. In natural conditions, the Romanian Carpathians hydrographical nets are highly favourable for salmonids, mainly in their upper parts. This area sheltered in the last part of the XIX Century and the beginning of the XX Century also this valuable salmon species in many river basins: Mureş, Cerna in Banat region, Danube (may be from its tributaries), Jiu, Olt, Lotru, Argeş, Râul Târgului and may be in Crişul Negru, Crişul Alb, Crişul Repede, Strei, Timiş, Râul Doamnei, Buzău, Moldova, Suceava and Siret. In the middle of the XX Century this species was still only in Vişeu, Vaser, Novăț, Ruscova, Bistrița Moldovenească, Dorna, Suceava and Moldova.

Conservation elements. Law 13/1993, Bern Convention), European Directive 92/43/EEC, Law no. 462/2001.

Threatning elements. Keeping in mind the extensive initial range of this species, no other fish species has been decimated by man to such an extent, due to fishing, pollution and habitat destruction.

1131 *Leuciscus souffia* Risso 1827 (Fig. 14).

Ord. Cypriniformes, Fam. Cyprinidae.

RO-clean dungat, albişoară; GB-Vairone; DE-Budd, Strömer, Lauge; FR-Soufie; HU-Vaskos csabak, RU-Andruga; CS-Jelsovka.

This species **terra typica** is the Isar River at München in Germany.

Descriptive elements. The dorsal profile is slightly convex. The ventral profile is in general more convex in comparison with the dorsal one. The mouth is small, subterminal and in a semicrescent form, its opening is under the eye. The dorsal fin is inserted a litle behind the ventral fins insertion. The dorsal fin edge is plain or very slightly concave; the annal fin it is slightly convex in the anteriour part and concave in the posteriour part; the pectoral fins are sharp or slightly rounded, their tips did not reach the ventral fins insertions. The caudal fin is deeply fluted, and the lobes are equal. The lateral line is more closed by the body ventral edge than the dorsal one. The dorsal part of the body is greyish, with a greenish or bluish tinge and the ventral part is silvery. Along the flanks, from the eyes to the caudal fin base, it is a characteristic broad greyish line, with a metalic or sometimes violet tinge (especialy in the reproduction period). The dorsal and the caudal fins are smoky colloured with a litle orange at the base. The other fins has the base intensely orange. The iris, the operculum contour and of the lateral line scales are also orange. On the lateral line scales are also black dots. The peritoneum is black. It can reach 18-20 cm in length on the Romanian territory, in Germany can be longer.

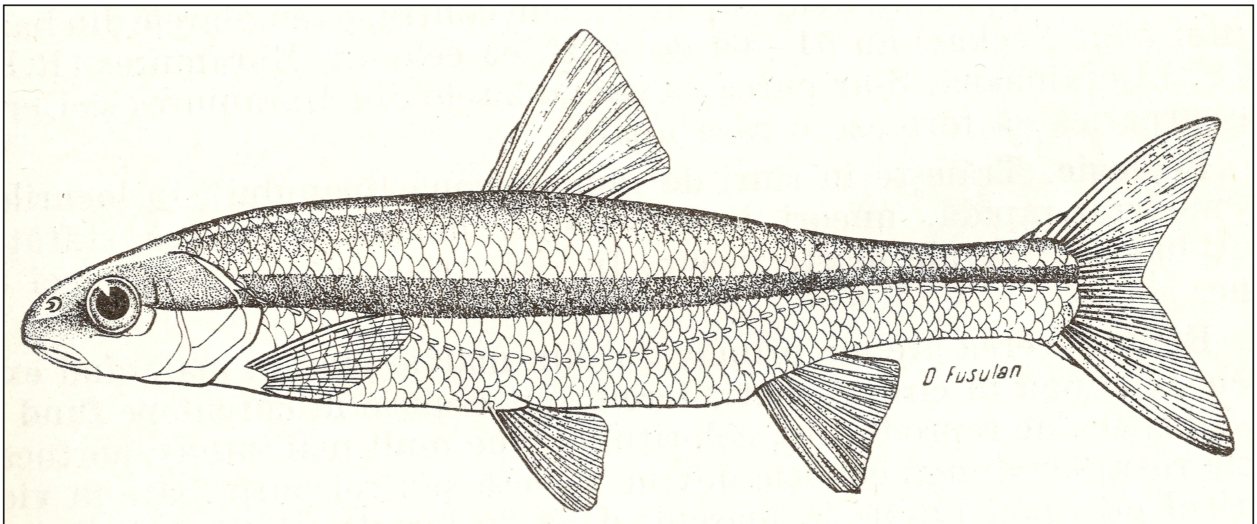

Figure 14: *Leuciscus souffia* (original image - Bănărescu, 1964).

Ecologic elements.

This species is living in mountainous rivers (grayling zone) in lotic sectors with moderate-fast or fast flowing water. The reproduction is happened in the spring, from March to May, when the individuals of this species form intraspecific groups. The spawn are layed down in current on stony substratum. This species food consist of insects, reophilic crustaceans, and also algae and diatoms.

Economic elements. Its economic value it is strictly local, being apreciated in some areas.

Distribution elements. Present in the upper Rhine and Danube basins. In Romania in Tisa, Vişeu, Săpânța and Iza basins.

Conservation elements. Law 13/1993, Bern Convention, European Directive 92/43/EEC, Natura 2000, Law no. 462/2001.

Threatning elements. pollution and habitat destruction.

1145 *Misgurnus fossilis* (Linnaeus, 1758) (Fig. 15).

Order Cypriniformes, Family Cobitidae.

RO-țipar, chişcar, vârlan; GB-Weatherfish; DE-Schlammbeisser; FR-Kerlèche; DE-Wetterfish, Beitzger, Moorgrundel; HU-réti csik, UA-Viun; BG-Zmiorche; HU-Réti csik; CS-Cikov.

Terra typica is the Central Europe.

Descriptive elements. Prolongued and thick body with almost uniform height. The dorsal and the ventral profiles are almost horizontal. The head is thik, slightly compressed lateraly. The nostrils are more closed to the eyes than to the tip of the snout. The anterior nostril is tubular, round, covered by a skiny operculum. The mouth is inferiour and crescent. The upper lip is fleshy and continuous. The lower lip is fleshy with two pairs of flashy lobes; the anteriour pair (and median) short and thick, the posteriour pair long and thin whiskers like. The caudal peduncle is lateraly compressed, mostly in its posteriour part. The caudal dorsal and ventral peduncule edges are straiten and form two faty streamlines which is looking like a elongation of the caudal fin. The dorsal and ventral fins are situated at the same level. Small scales. Hardly visible lateral line. The dorsal side is dark dun, with small sooty spots. This dun area is limited by a narrow longitudinal line, almost black, which lay from the superior corner of the operculum to the caudal fin; in the posterior part this line is interrupted by isolated spots. Under this line, the body is light dun; is following a new sooty line, very broad, continuous from the eye to the caudal fin base. Under this line is yelowish-rusty spoted with brown dots. The head is light-fawn with small dark spots. Smoky fins with dark spots. The females reach 30 cm, the males are smaller.

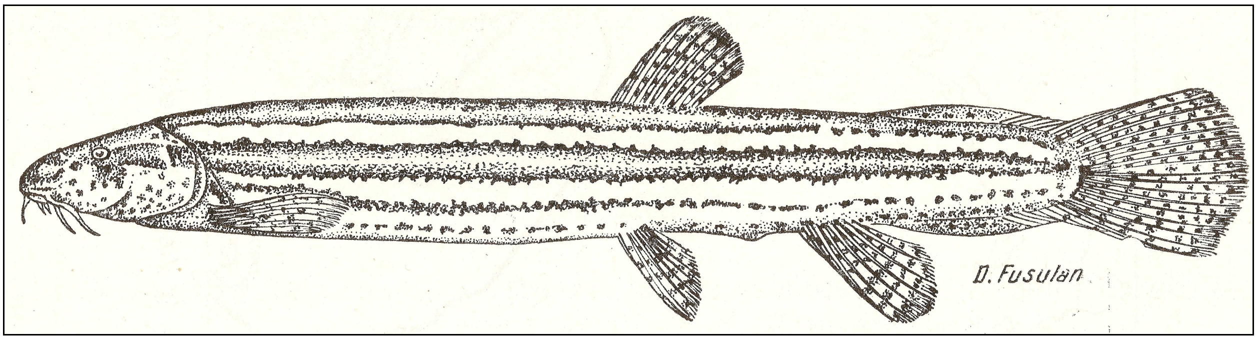

Figure 15: *Misgurnus fossilis* (original image - Bănărescu, 1964).

Ecologic elements. Not flowing or slow flowing freshwater species, relatively well spread in ponds in the hilly areas, rare in lowland rivers. Prefer the river sectors with mudy substratum and vegetation. It has the posibility of intestinal respiration and as a consequence it is very resistant to the lack of Oxigen in water. When the ponds are dryed up this species individuals stay a long time in the mud, also stay in the mud in the winter or when is very hot in the summer. In its reproduction period (March - June) it is much mobile than in other periods but it is not a migratory species. The spawn it is layed on the aquatic vegetation. It is a sensible species at the atmospheric presure changes, before stormes to come it came at the water/air interface. Its food consist of organic detritus, aquatic vegetation, worms, crustaceans, insect larvae, moluscs.

Economic elements. No value.

Distribution elements. It is spread in different areas from France (Loara Basin) to the Volga River. In Romania it can be found in the following watersheeds: Someş, Crasna, Crişul Negru, Crişul Alb, Crişul Repede, Mureş, Bega, Timiş, Caraş, Olt, Vedea, Teleorman, Neajlov, Dâmbovița, Mostiştea, Siret, Suceava, Bârlad, Prut, etc.

Conservation elements. Bern Convention annex 3, Habitats Directive annex 2, IUCN Red List, Law 462.

Threatning elements. Habitat destruction.

2522 *Pelecus cultratus* (Linnaeus, 1758) (Fig. 16).

Ord. Cypriniformes, Fam. Cyprinidae.

RO-sabiță; GB-Sichel; DE-Sichling; HU-Garda, UA-Tschékhon; BG-Sabitza; RU-Chekhon; CS-Sabljarka.

This species **terra typica** is the Baltic Sea.

Descriptive elements. Elongated streamlined body, much compressed on laterals. The body dorsal profile is at the majority of the exemplairs, an almost horizontal line, from the snout to the caudal fin insertion. The eyes are very big, situated on the anterior half of the head. The mouth is superiour and almost vertical, small, did not reach the inferiour edge of the eye. The inferior jow is proeminent in comparison with the superiour one. The dorsal fin is situated very posteriour. The dorsal fin eddge is slightly concave. The annal fin is very long, much higher in its anteriour part then in its posteriour part, with a concave edge. The caudal fin is strong, deep fluted, the inferior lobe is longer than the superior one. The scales are small, thin, cover all the body including the dorsal part of the till the eyes and the chest. The lateral line is very sinuous, especialy at the anteriour part of the body. The superiour side is dark blue or grey-bluish with a strong metalic shine, the flanks are shining silvery, the ventral side is white. The pectoral, dorsal and caudal fins are grey, the other fins are yelowish. It can reach 50 cm and one kilograme.

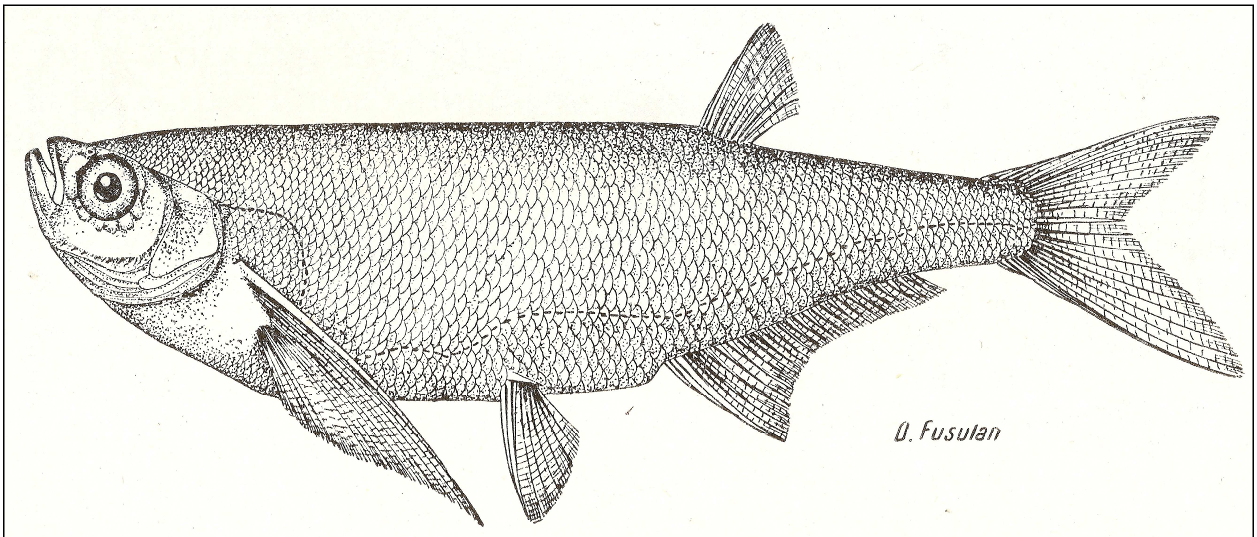

Figure 16: *Pelecus cultratus* (original image - Bănărescu, 1964).

Ecologic elements. A good swimer which live in lowland areas. Frequent in the litoral lakes. The sexual maturity is reached at 3 - 4 years and the reproduction is hapened in April - June, starting at a temperature of 12 °C. It can reach 35 - 37 cm length. Its food consist of plancton, benthic invertebrates, insects and small fish.

Economic elements. Its meat is fat and tasty. In the Romanian waters few tens thousands to few hundered thousands kilograms are fished every year. It is sold fresh or salty.

Distribution elements. Baltic Sea, Black Sea, Caspian Sea, Aral Sea watersheeds. In the Romanian waters can be found on the Danube, Someş, Mureş, Bega, Timiş, Olt, Ialomița, Siret, Prut.

Conservation elements. Bern Convention annex 3, Habitats Directive annexes 2 and 5, IUCN Red List, Law 462.

Threatning elements. Excesive fishing and pollution.

2553 *Proterorhinus marmoratus* (Pallas, 1814) (Fig. 17).

Ord. Perciformes, Fam. Gobiidae.

RO-moacă de brădiş, zimbraş; GB-Tubenose goby; DE-Marmorierte Grundel; FR-Gobie à narine tubulaire; HU-tarka géb, UA-Bychok-tsutsyk.

This species **terra typica** is Sevastopol.

Descriptive elements. Relatively high body, lateraly compressed. The dorsal profile is convex and draw up accentuated from the tip of the snout to the backhead from where draw down. The inferiour side is almost plain. The head is relatively large, lateraly compressed, always more higher than thiker. The mouth is big, terminal, almost horizontal, a litle oblique upward. The jaws are equal, but the superior lipis a litle proeminient. The lips are thick and flashy, the superior one became broader in lateral. For this group the eyes are small, egg-shaped, localised in the anterior half of the head, look on lateral. The forhead between the eyes are plain, the backhead is accentuated cambered. The snout is short and thik. The anteriour nostrils are prolongued in a tube form which hang downward over the superiour lip. The caudal peduncule is short, high, accentuated lateraly compresed. The dorsal fins are touching and have equal hights. The pectoral fins are straiten near the tips, generaly outgrow the annus. The ventral cup is prolongued, straiten near the tip, its membrane without lobes. Big scales. The fundamental colour is brown-grey or yellowish, its ventral face is yellowish-whitish. On the body sides are five transversal stripes, maroon or dun, which almost reach the ventral side. On the head are dark spots. The dorsal, annal, caudal and pectoral fins are grayish with maroon-readish lines; the ventral fin is uniformly grayish. This species can reach 7 - 8 cm in freshwater and 10 cm in the sea.

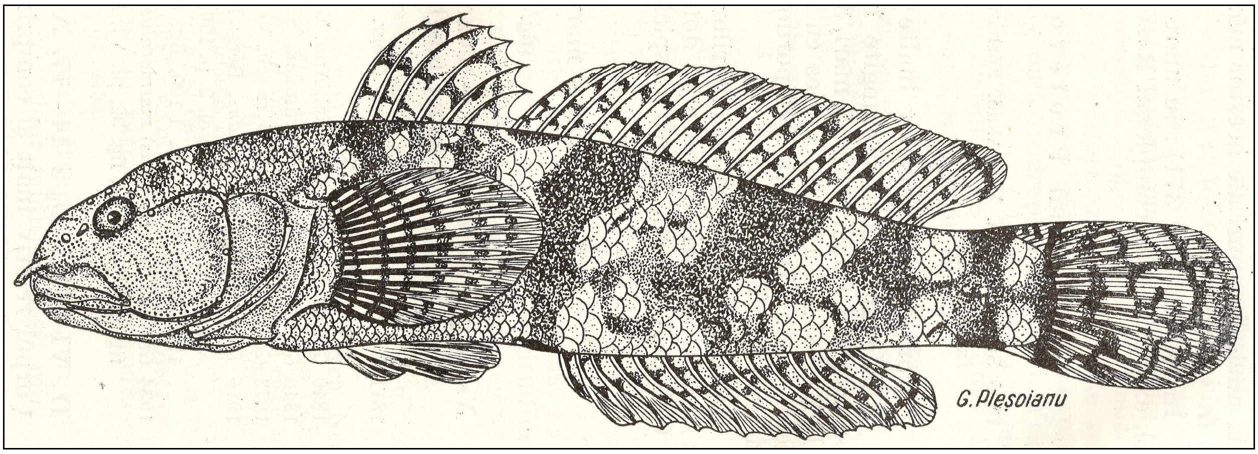

Figure 17: *Proterorhinus marmoratus* (original image - Bănărescu, 1964).

Ecologic elements. This species is unresponsive to the salinity background, living in sea water and also freshwater or intermeriar water. Living in the freswater muddy slow-flowing rivers, in muddy with aquatic vegetation ponds. In the sea can be found more rarely than in the freshwater. Its reproduction period start in the spring till the summe.

Economic elements no economic importance.

Distribution elements. Black Sea and Caspian Sea basins. Beregsău Stream, ponds related with the Danube not only in its delta, Razelm area, the litoral lakes Taşaul, Siutghiol, Tăbăcăria, Mangalia, Ilfov Stream, Snagov Lake, the lakes around Bucureşti, Jijia and Bahlui rivers, etc.

Conservation elements. Bern Convention annex 3, Law 462 annex 3.

Threatning elements. Habitat destruction.

1134 *Rhodeus sericeus amarus* (Bloch, 1782) (Fig. 18).

Ord. Cypriniformes, Fam. Cyprinidae.

RO-boarță, boarcă, blehniță; GB-Bitterling; DE-Bitterfish; FR-Bouvière; HU-szivárványos ökle; UA-Gorchak.

This species **terra typica** is the Elbe.

Descriptive elements. High and accentuated lateral compressed body. The dorsal profile is convex, drawing up from the ti of the snout to the dorsal fin insertion; behind the dorsal fin the profile descent accentuated. Lateraly compressed head. The eyes are situated in the anteriour half of the head. The forehead between the eyes is high, splayed, slightly convex. Small, subterminal, crescent shaped with thin lips mouth. The dorsal fin is inserted in general at equal distances from the tip of the snout and the caudal fin base. The edge of the dorsal fin is slightly convex. The pectoral fins are short, rounded at the top. The ventral fins insertion are situated under the dorsal fin insertion or very little before it; their tops reach or almost reach the anteriour edge of the annal fin. The annal fin insertion is under the middle of the dorsal fin; its edge is slightly concave. The scales are big, more higher than longer, persistent. The chest is covered with smaller scales. The lateral line is short. The dorsal part of the body and of the head are greysh-yellowish, sometimes with a greenish shade, the flanks are white, the dorsal and caudal fins are grey, the other fins with a redish shade. Along the body's posterior half part and of the caudal peduncule is an obvious greenish line. It can reach 7.9 cm in length.

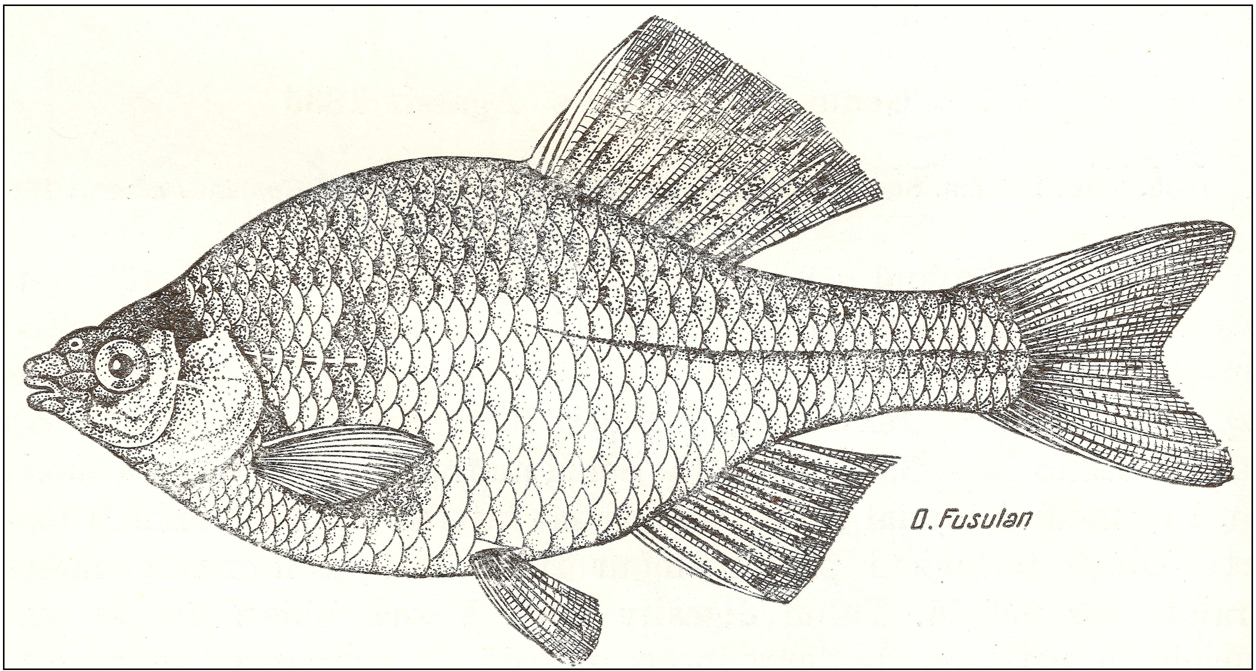

Figure 18: *Rhodeus sericeus amarus* (original image - Bănărescu, 1964).

Ecologic elements. Living in fresh and standing or slow flowing water. Its food consist of unicelular filamentous algae, vegetation debriis. The sexual maturity is reach at one year. Its reproduction is happening in the end of Aprill till August. The roes are layed down in the *Unio* and *Anodonta* mollusks gills cavity. The larval stage is happened also in this cavity.

Economic elements. This species is considered as not important.

Distribution elements. Europe from the East of France, from the Alps and Dinarics mountains to the Ural and Caucasus; also in Macedonia. In Romania in Danube, Tisa, Mureş, Bega, Timiş, Caraş, Nera, Jiu, Olt, Dâmbovița, Colentina, Neajlov, Ialomița, Siret, Prut, basins etc.

Conservation elements. Bern Convention annex 3, Habitats Directive annex 2, Law 462 annex 2.

Threatning elements. Pollution.

1998 *Romanichthys valsanicola* Dumitrescu, Bănărescu and Stoica, 1957 (Fig. 19).

Ord. Perciformes, Fam. Percidae.

RO-asprete, popete, sforete.

This species **terra typica** is the Vâlsan River, an Argeş River tributary, in the Southern Romanian Carpathians.

Descriptive elements. Elongated body, thik in its anteriour part. The dorsal profile ix convex from the tip of the snout to the first dorsal fin insertion, with a small cavity at the backhead. The ventral profile is almost flat. The head is broad, thiker than the body. Big elongated eyes, situated on the dorsal surface of the head, looking upward. The mouth is inferiour, crescent shape; its opening reach under the nostrils area. The edges of the nostrils have a funnel shape skin prolongations. The first dorsal fin is lower than the secon one; these fins are close. The annal fin is very high and short. The pectoral fins are egg-sharp-shaped. The ventral fins are not closed. On the body flanks are uniform, small to medium scales; on the back and on the ventral side small scales. On the head are no scales. The lateral line is almost complete, almost plain, it is a litle prolongued on the caudal fin base. The dorsal part of the body is brown-greysh, with dark spots vaguely delimitated. 6 rows of brown spots on the pectoral fins, 5 on the caudal fin, 4 on the second dorsal fin. The annal and ventral fins with vague small spots. It can reach 12.5 cm.

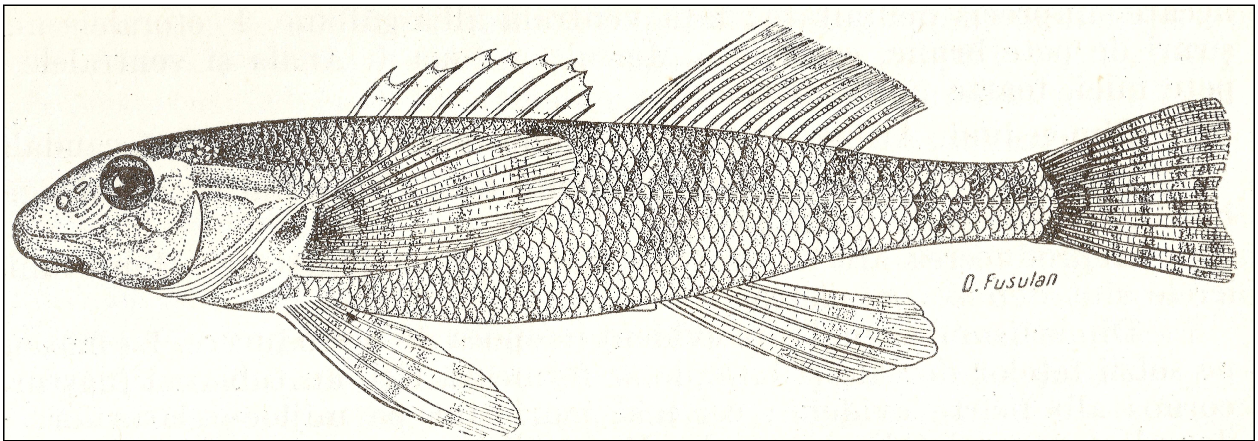

Figure 19: *Romanichthys valsanicola* (original image - Bănărescu, 1964).

Ecologic elements. Living in mountainous river (grayling and mountainous barbel zone) in strong stream near rocks. The sexual maturity is reach at the end of the second summer. The reproduction is happening in May - June, the roes are layed down on the rokcs. The food consist of rheophilic insects larvae, plecopterans, trichopterans and ephemeropterans.

Economic elements. Astoningshly this fish species individuals are still used localy in spite of its great value. It has no economic importance.

Distribution elements. This species was spread in the last half of the XX Century only in Romania, in the upper Argeş River basin. Actualy it is living only in few kilometers sector in the Vâlsan River, an Argeş River tributary.

Conservation elements. The Romanian Law 462/2002.

Threatning elements. Pollution, habitat destruction, the water increasing temperature, the water flow abstractions, illegal fishing, the missing of a management plan for the Vâlsan River which include special activities for this endemic species survival, river bed stones exploatation, the international failure in its reproduction in captivity.

1114 *Rutilus pigus* (Lacepède, 1803)

Ord. Cypriniformes, Fam. Cyprinidae.

RO-ghiborț de Dunăre; GB-Danube Roach; DE-Donaunerfling, Fraufish, Fraunnerfling, Erfle, CS-plotica.

This species **terra typica** is the upper Danube basin.

Descriptive elements. The dorsal and ventral profiles are usualy similarly convex. The interorbitar space is convex. It can reach an over 40 cm length. The snout is short. The mouth is obviously inferiour. The pectoral fins are rounded. The ventral fins are more or les sharpened. The caudal fin is holed. Both the dorsal and pectorals fins are smoky. In the mating season the back became violet, the dorsal fin redish and the pectoral fins yellowish.

Ecologic elements. It is a benthopelagic freshwater species living in big and medium and slow flowing rivers and in deep lakes. Its reproduction is happening in May in the sectors with weeds. Its food consist of plants, crustaceans and mollusks.

Economic elements. It is captured and used as food together with the other species of *Ruttilus*.

Distribution elements. This species is living in the Danube Basin. Its presence in the lower Danube is not certain. In Romania it was founded only in the Tur River.

Conservation elements. 13/1993 Law, Bern Convention anex III, 92/43/EEC European Directive, Natura 2000.

Threatning elements. Pollution and overfishing.

1146 *Sabanejewia aurata* (De Filipi, 1863) (Fig. 20a, b, c, d).

Ord. Cypriniformes, Fam. Cobitidae.

RO-câră, fâță, râmbiță, şărpan, sfârlează, dunărița; GB-Goldside Loach, Golden spined loach; SK-Plž zlatistý; UK-Shchypovka zolotistaya.

This species **terra typica** is the Sefid Rud River in the north of Iran.

Descriptive elements. Moderate lateraly compressed body. Five to twenty dorsal spots, and five to seventeen lateral spots. At the caudal fin base it therea are a dorsal and a ventral small spots, the dorsa one is vertical. It is characterised by an accentuated variability. In the following figures are presented some of the subspecies presented on the Romanian territory. It should be stated the fact that the systematic of this taxonomic group it is still under international scientific debate and byond the Natura 2000 purposes many other names are proposed and used.

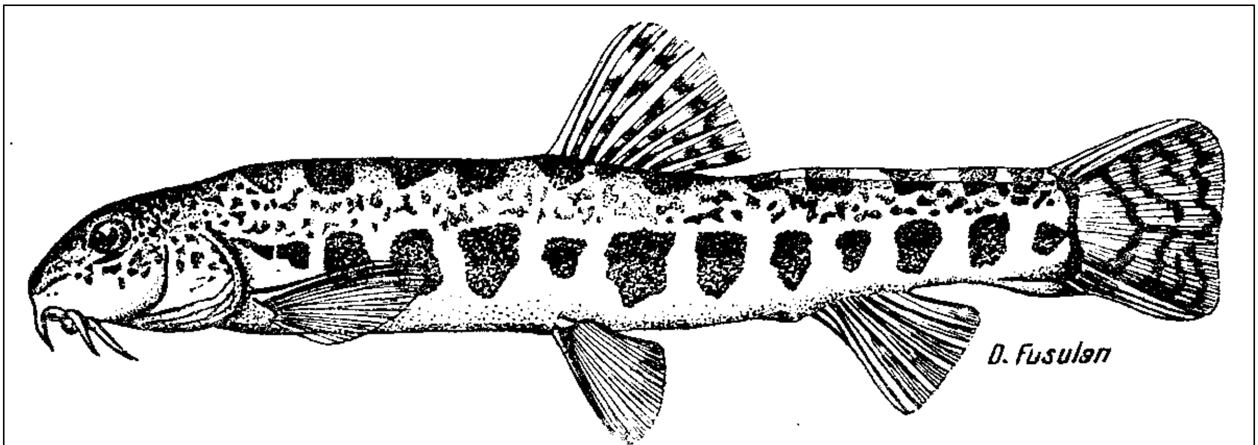

Figure 20a: *Cobitis aurata balcanica* (original image - Bănărescu, 1964).

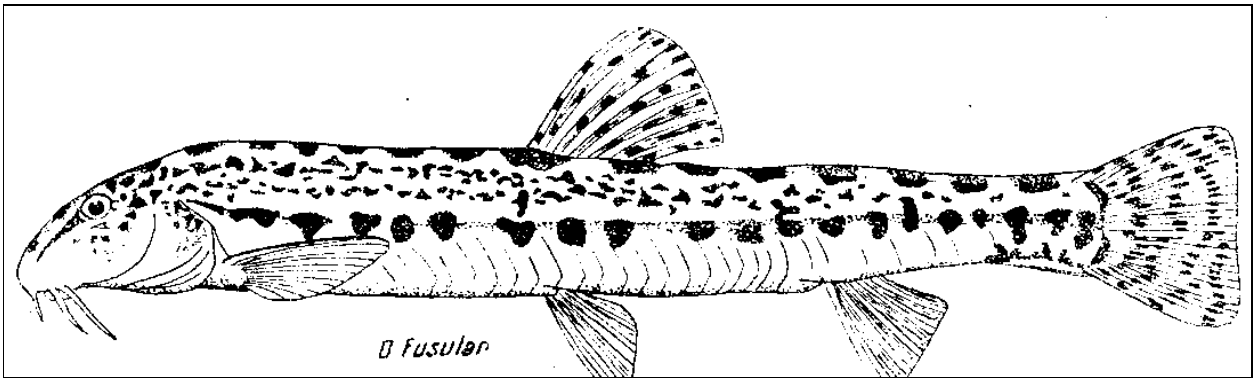

Figure 20b: *Cobitis aurata valachica* (original image - Bănărescu, 1964).

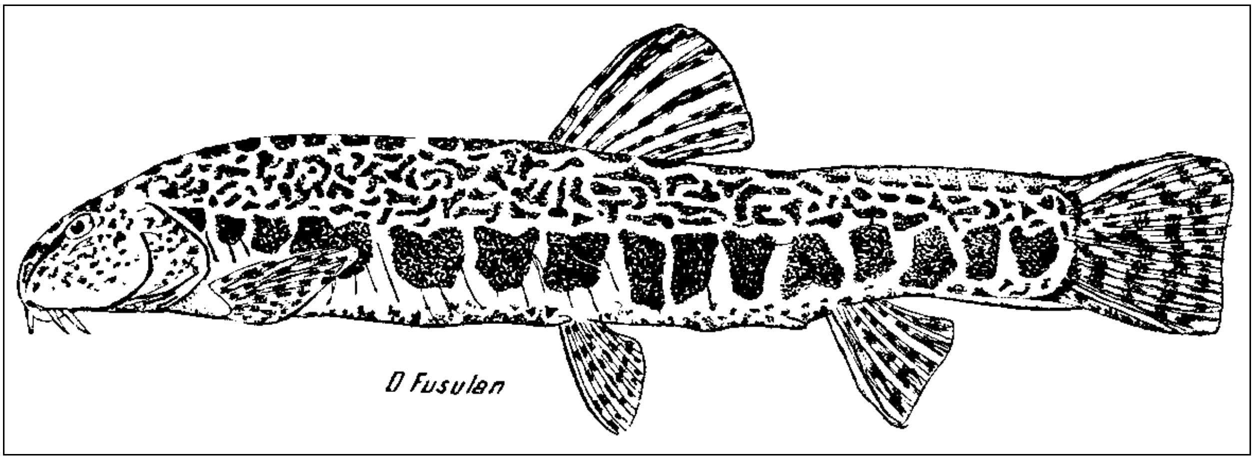

Figure 20c: *Cobitis aurata radnensis* (original image - Bănărescu, 1964).

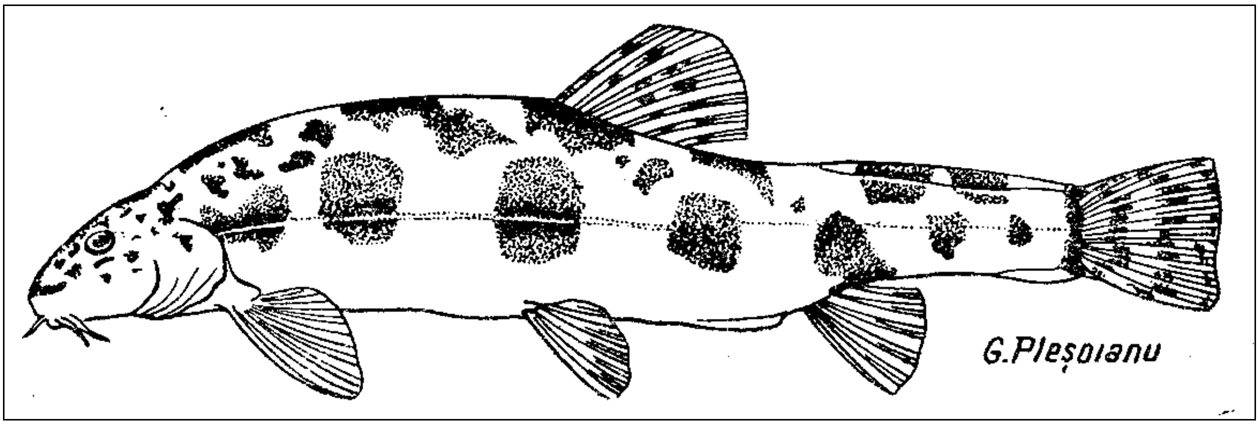

Figure 20d: *Cobitis aurata bulgarica* (original image - Bănărescu, 1964).

Ecologic elements. It is a freshwater and demersal group of fish, apearing usualy in the upper and middle parts of the rivers. The presence of the sand in the river bed is an important habitat condition, the individuals of the majority of the subspecies of this group standing a long time in the sand. The food consist of small macroinvertebrates.

Economic elements. No economic value.

Distribution elements. European and Asian, in the Danube, Kamchiya, Don and Kuban basins. In Romania it can be considered a wide spread species.

Conservation elements. Bern Convention annex III, Habitats Directive annex 2, Law 462 annex 2.

Threatning elements. Pollution and the habitats destruction.

2011 *Umbra krameri* Walbaum, 1792 (Fig. 21).

Ord. Salmoniformes, Fam. Umbridae.

RO-țigănuş bătrân, țigănuş; GB-Mudminnow; DE-Hundfisch; HU-Riba-hál.

This species **terra typica** is the middle Danube basin.

Descriptive elements. The head is lateraly compressed. The body is moderate lateraly compressed. The interorbitary space is slightly convex. The mouth is small, terminal and a litle oblique. Large gill's openings. The caudal peduncule is lateraly compressed. The pectorals are rounded. The anal and caudal fins edges are rounded. The whole body is covered with big scales. No lateral line. The body is brown with dark shadows. The ventral side is yellowish. A series of dark spots of variable shapes, on the body flanks form two longitudinal paralel iregular lines. At the midle of the body is a light coloured line. The fins are yellowish-greysh or brown. At the base of the dorsal and caudal fins is a dark transversal line. It can reach over 15 cm in length.

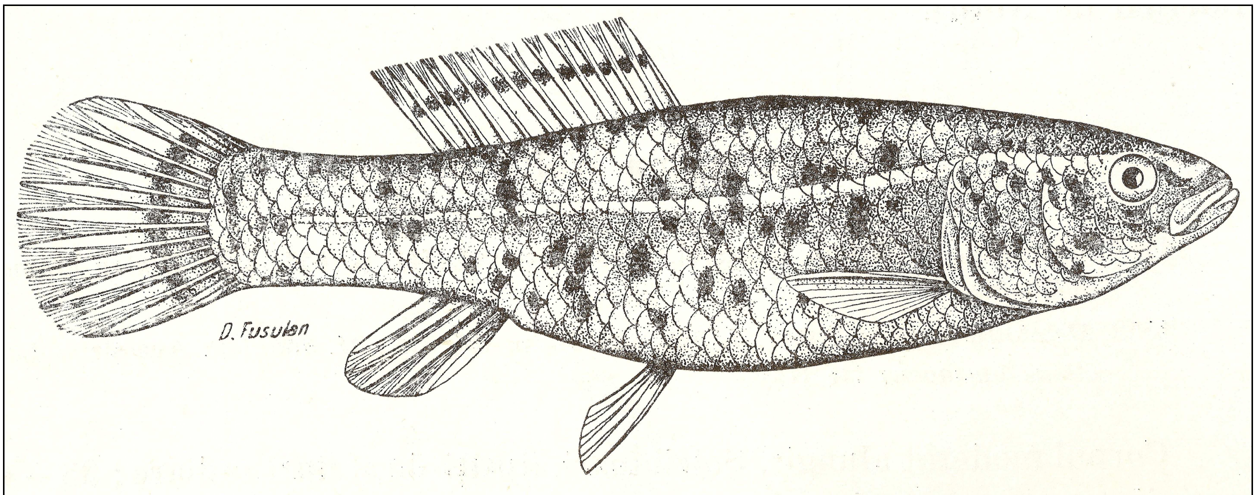

Figure 21: *Umbra krameri* (original image - Bănărescu, 1964 based on Antipa, 1909)

Ecologic elements. It is a slow flowing or standing water species. Usualy can be found in small ponds and wetlands with vegetation. With high resistance at the low levels of oxygen in the water, can inhale the atmospheric oxygen. If the water run dry can stand out a long time in the mud. The sexual maturity is reached at one year. The reproduction period is happened in March - April period, at a temperature of 12-17 °C. For reproduction the females dig nests in the mud/sand and side them with algae. The food consist mainly of aquatic macroinvertebrates and secondary of terestrial macroinvertebrates.

Economic elements. It has only local low value.

Distribution elements. This species is living in the Danube Basin from Austria to the Danube Delta and in the lower Nistru River. In Romania can be found in the Danube Delta and in some wetlands in Satu Mare, Giurgiu, Ilfov, Călăraşi and Iaşi counties.

Conservation elements. Bern Convention anex II, IUCN Red List, Law 462 annex 2, Law 13/1993.

Threatning elements. Pollution, water abstractions, habitat destruction.

1160 *Zingel streber* (Siebold, 1863) (Fig. 22).

Ord. Perciformes, Fam. Percidae.

RO-fusar, fus, prundar, peşte de piatră; GB-Streber, Danube Streber; DE-Streber, Strever, Ströber, Strengkatze, Zagel; HU-kis bucó, német bucó; UK-Chop malyi; SK-Kolok malý

This species **terra typica** is the Danube in Bavaria.

Descriptive elements. Elongated body, skewer-like shape. The dorsal profile of the body ascend slightly, uniform and straight from the tip of the snout to the first dorsal fin insertion. The ventral profile is almost plain. The head is much broad than high, from an above perspective is triangular. The snout is obtuse, width in the posteriour part, narrow in the anteriour part. The mouth is inferious crescent-like shape and small. The caudal peduncle is long and thin, round in section. The dorsal fins are distanced. Both dorsal fins are triangurar shaped, high anteriour and decreasing gradually to the posteriour part. The pectoral fins with truncated edge. The ventral fins are inserted behind the pectoral fins insertions. The scales are small. The lateral line is complete and plain. The superior side of the head and of the body, and the majority of the flancks are brown-greysh with a green nuance. On this background are five wide obvious sooty lines. The ventral side is white and the fins are colourless. It can reach over 20 cm in length.

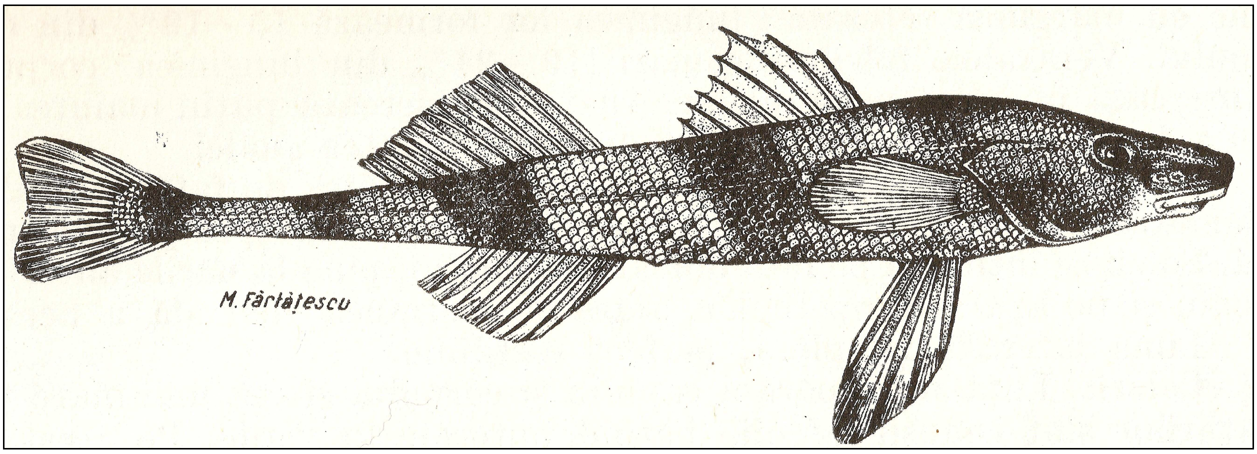

Figure 22: *Zingel streber* (original image - Bănărescu, 1964).

Ecologic elements. This benthopelagic, freshwater and reophilic species it is living in Danube and in the hilly and plain rivers, exclusively in the sectors with high water velocity, with riverbeds of pebbles, sand or clay. Sometimes stay in the sand. The individuals of this species stay usualy alone. No migrations are known. The reproduction is happened in the March - May period. The roes big and are layed down on rocks or on wood pieces. In the reproduction period the females are deformed. The food consist mainly of aquatic insects, amphipods and worms, and ocasional with roes and fish alevines.

Economic elements. Its economic importance is low and strictly local.

Distribution elements. This species is living in the Danube Basin from Bavaria to the Danube Delta. Also in the Vardar basin. In Romania it can be found in Tisa, Someş, Barcău, Crişul Repede, Crişul Negru, Mureş, Bega, Timiş, Nera, Cerna, Olt, Siret, Prut basins etc.

Conservation elements. Bern Convention anex III, Habitats Directive annex 2, IUCN Red List, Law 462 annex 2.

Threatning elements. Pollution and habitat destruction.

1159 *Zingel zingel* (Linnaeus, 1766) (Fig. 23).

Ord. Perciformes, Fam. Percidae.

RO-fusar mare, pietrar, peşte cu două nume; GB-Zingel; DE-Zingel, Zindel, Zink, Zinne, Zint; CS-Veliki vretenac; HU-nagy bucó; BG-Uretenarka; SK-Kolok velký; UK-Chop.

This species **terra typica** is the Danube River.

Descriptive elements. Elongated body, skewer-like shape, almost circular in section. The head is oval. The dorsal fins are relatively close distanced. Both dorsal fins are triangurar shaped, high anteriour and decreasing gradually to the posteriour part. The pectoral fins with truncated edge. The ventral fins are inserted behind the pectoral fins insertions. The scales are small, on the ventral side they reach the ventral fins base. The dorsal side and the majority of the flancks are brown-greysh. The ventral side and the abdomen are yellowish. It can reach a maximum body length of 49 cm.

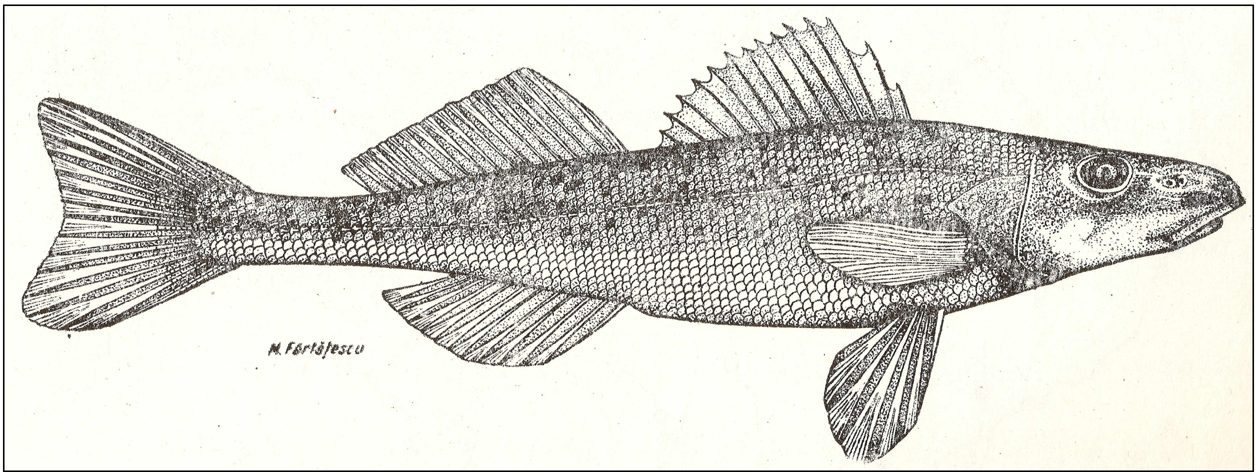

Figure 23: *Zingel zingel* (original image - Bănărescu, 1964).

Ecologic elements. This demersal freshwater fish species is living in Danube and in big and relatively deep rivers, above bottoms with sand, pebbles and clay. The reproduction is happening in March and April in stream, the rows are lyed down on rocks. Its food consist of aquatic insects (especialy efemeropterans), crustaceans, roes and small fish.

Economic elements. The meat is tasty but due to the fact that it is not capured in big quantities (few hundered of kilograms) it can not be considered as an econimic important species.

Distribution elements. It is an endemic species in the Danube and Nistru rivers. In Romania it can be found also in the following basins: Someş, Crişul Repede, Crişul Negru, Crişul Alb, Mureş, Bega, Timiş, Olt, Argeş, Siret, Prut.

Conservation elements. Bern Convention anex III, Habitats Directive annex 5, IUCN Red List, Law 462 annex 3 and 4.

Threatning elements. Pollution and habitat destruction.

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THE CHARACTERISTICS OF THE HUCHEN'S (*HUCHO HUCHO* LINNAEUS, 1758) HABITAT IN MUREŞ RIVER VALLEY (MUREŞ COUNTY, TRANSYLVANIA, ROMANIA) AND CONSERVATION OF THE SPECIES IN THIS SECTOR

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KEYWORDS: Biodiversity, extinction, habitat conservation, Mureş River basin, fish, Salmonide family, Natura 2000.

ABSTRACT

This paper presents several aspects regarding the situation of the huchen's (*Hucho hucho*) habitat in the Superior Mureş Valley, localized in the north of Mureş County, between Toplița and Deda. It also exposes some actions that have contributed to the dynamics of the species in this sector, respectively the chronologic of the repopulation of the Mureş River Valley with the biggest salmonidae.

This paper has been realized in the context in which, in the past years, the huchen's presence has been confirmed in Romania only in Tisa River Basin, this species being considered extinct in Mureş.

Within this context there have been analysed several state parameters of the Mureş River ecosystem since 2003 to 2007 for the evaluation of the habitation potential of the huchen in this area.

A rigorous analysis on the quality of Mureş River's water was made, depending on the expression indicators of the biogenic capacity of the mountain rivers.

This paper also presents both the favourable and restrictive factors that maintain this specie as a viable component of the ecosystem. Among these of great importance are those that determine the quality of the Mureş River, especially the climate and human component.

In the last decade the climate change has induced several important dysfunctions to the ecosystem. This, cumulated with the increased human pressure (the extension of the built space and poaching actions) enforces the elaboration of a coherent conservative strategy in this sector.

Consequently to these researches made, we propose some measures for the maintenement of the huchen's habitat in a favourable conservation state, in the perspective of the management plans that concern Călimani-Gurghiu Natura 2000 site and the Superior Mureş Clough National Park to which this area belongs to.

REZUMAT: Caracteristicile habitatului lostriței (*Hucho hucho*) în valea râului Mureş (județul Mureş, Transilvania, România) şi conservarea acestei specii în acest sector.

Caracristicile habitatului lostriței (*Hucho hucho*) în Defileul Mureşului superior şi coservarea speciei în acest sector.

Această lucrare prezintă câteva aspecte legate de caracteristicile habitatului lostriței în Defileul Mureşului Superior, situat între localitățile Toplița şi Deda, la limita Munților Călimani cu Munții Gurghiului. De asemenea sunt expuse unele acțiuni care în timp au contribuit la dinamica speciei în acest sector, respectiv cronologia repopulărilor văii Mureşului superior cu cel mai mare salmonid.

Lucrarea a fost realizată în contextul în care, în ultimii ani, prezența lostriței a fost confirmată în România numai pe cursul Tisei şi a unor afluenți ai acesteia, în râul Mureş specia fiind considerată extinctă.

În acest context au fost analizați parametri de stare ai ecosistemului Râului Mureş în perioada 2003 - 2007, pentru evaluarea potențialului de habitare al

lostriței (*Hucho hucho*) în acest areal. Astfel a fost efectuată analiza calitătații apei rîului Mureş funcție de indicatorii de exprimare a capacităţii biogene râurilor de munte.

De asemenea lucrarea prezintă factorii de favorabilitate şi cei de restrictivitate ai menţinerii speciei ca o componentă viabilă a acestui ecosistem. Din cadrul acestora, esenţiali sunt cei care determină calitatea apei râului Mureş, în special caracteristicile climatului şi factorul antropic. În ultimul deceniu, efectele schimbărilor climatice au indus ecosistemului disfuncționalități importante. Faptul coroborat cu intensificarea presiunii antropice, prin extinderea spațiului construit şi acțiunilor de braconaj, impune ca o necesitate stringentă elaborarea unei strategii conservative coerente în acest sector.

Urmare a cercetărilor efectuate sunt propuse unele măsuri ce se impun pentru menținerea habitatului lostriței într-o stare favorabilă de conservare, în perspectiva elaborării planurilor de management ale sitului Natura 2000 Călimani-Gurghiu şi Parcului Natural Defileul Mureşului Superior din cadrul cărora aria face parte.

RÉSUMÉ: Les caractéristiques de l'habitat de la truite hucho hucho dans le Défilé du Mureş et la conservation de l'espèce dans ce secteur.

Cet emploi présente quelques aspects sur les caractéristiques de l´ espèce et de l´habitat de l´*Hucho hucho* dans la partie supérieure de la gorge Mureş, située entre les points Toplița et Deda, à la limite de la montagne Călimani avec à la montagne Giurghiu. Il y a également exposé certaines actions qui ont contribué à temps pour la dinamics de l´espèce dans ce secteur, en particulier les cronology du repeuplement de la haute gorges Mureş dans la plus grand saumon.

L´emploi a été faite dans le context dans lequel ces dernières années la présence de l´*Hucho hucho* a été confirmée en Roumanie seulement de la rivière Tisa cours et sur certains affluents de celui - ci (Petre M. Bănărescu, 2005) dans la rivière Mureş l´espèce considérée disparue.

Dans ce contexte, les écosystèmes paramètres de rivière Mureş ont été étudie dans la période 2003 - 2007, pour l´évaluation du potentiel de la vie de l´*hucho hucho* dans cet épandage.

Il en a été faite analyser la qualité des eaux de Mureş, en concordance de les indicateurs de l´énonciation de la capacité biogene des rivières de montagne. Aussi, l´emploi present les facteurs favorables et les facteurs restrictifs pour le maintien des espèces comme une alternative viable composante de ce écosysteme.

Les plus importants sont ceux qui apportent la qualité de l´eau de la rivière Mureş, en particulier les caractéristiques climatiques et le facteur anthropique.

Dans la dernière décennie, les effets des changements climatiques, ont incité les importants dysfonctionnement à l'écosystem. Cet état de fait, corroboré avec l'intensification de la pression anthropique, par l'extension de l'espace bâti et le pocher actes, les forces comme une urgente nécessité l'élaboration d'une stratégie cohérente et conservateur dans ce secteur.

Après les recherches faites certaines mesures proposées sont la force la préservation de l'hucho hucho l'habitat dans un état de conservation favorable, dans la perspective de l'élaboration des plans de gestion du site „Natura 2000 Călimani - Gurghiu et Parc naturel de la partie supérieure de la gorge Mureş", à partir duquel ce domaine appartient.

INTRODUCTION

Although about 15 % of the national river system is favorable as habitat for Salmonides, the presence of huchen in Romania has been confirmed only in the Tisa River and some of its tributaries in the last years. As this species is very sensitive to restrictive factors, identifying these factors is a necessary condition in order to ensure rehabilitation and conservation measures.

The huchen is the most valuable fish in our country, regarded as nature monument, strictly protected under national and international norms. The species is part of the Class Actinopteryg, Order Salmoniformes, Family Salmonidae, and is the greatest representative for Salmonides and mountain fresh waters in Romania. It is an endemic species in the Danube basin, its habitat being in the upper basin of the river, especially in the tributaries. In Romania it used to be widespread on large areas in the past, but today we can only find it (in theory) in the Bistrița, Valea Vişeului, Vaser, Borşa, Tisa and some lakes like Bicaz, Vidra, and Vidraru, where the species has been introduced artificially. Although up until some years ago it used to be a common fish in mountain and hill streams, in Mureş, Olt, Jiu, Lotru, Argeş, Timiş and Cerna (Petre M. Bănărescu, 2005) and even in Suceava, Moldova and Siret (Kaszoni, 1981) excessive fishing and pollution have brought the species to the brink of extinction. Grigore Antipa reported the occurrence of the hutchen in the upper course of the Danube in our country (the area of Valea Cernei) all the way to Balta Brăilei.

Chronology of the reintroduction of Huchen in the upper Mureş River Valley

In September 1962, 9 adult huchens from the Făina - Maramureş fish farm and 32 saplings from Ceahlău fish farm were introduced in Mureş River in the section Toplița Bridge - Stînceni Bridge. It is estimated that the species have survived until 1966, when the last individual was caught in Lunca Bradului. Later, in 1974-1980, as a result of the studies performed by the Faculty for Geography and Geology and the Faculty for Biology in Bucharest, the area was repopulated with saplings from Lăpuşna Trout Fish Farm. Then in 06.06.1991 Mureş Forestry Directorate, Lunca Bradului Management Unit - the manager of the Mureş 3 fish fund introduced in Gudea fishery 10.000 spawns from Ceahlău fishery. The resulting 6794 saplings were introduced in Mureş River on 07.10.1991. The next reintroduction took place in the fall of 1998, when the same administrator introduced 537 saplings in the Ciubotani-Andreneasa section of the river, resulting from the 1000 spawns purchased in the year before from Ceahlău Trout Fishery. The last reintroduction took place in 2003, when 488 saplings were introduced in the Mureş River, resulting from the 500 spawns purchased in 07.06.2002 from the above-mentioned trout fishery. (O. S. Lunca Bradului, 2007). The introduction of the saplings was done in the river section Gura Mărşineț - Pod Sălard, according to the annexed map.

Confirmation of presence in 2007

Although in the last years several unofficial reporting have shown that the huchen occurs in this habitat, after catching some adult individuals injured either during the winter because of the ice blocks or during poaching using electric power, until 2007 there have been no definite confirmations of occurrences within this area.

During 11.05. - 15.05.2007 the representatives of the Forestry Directorate Târgu Mureş, the custodian of the protected area Mureş Toplița-Deda Gorge, have seen 17 adult individuals during prohibition. Photos have been taken and the huchen have been filmed in two sections of the Sălard River, left side tributary of the Mureş River upstream from the village Sălard.

This is a well-earned confirmation for the efforts taken in the last years by the representatives of the Mureş Environmental Protection Agency and Mureş Forestry Directorate to protect and preserve the habitat and maintain the species as a viable component of this ecosystem.

MATERIALS AND METHODS

As working methods we have used the analysis of quality indicators according to GD 563/2006 regarding the technical norms for the quality of surface waters in need of protection and improvement in order to sustain fish. A quality check of the Mureş River's water was also performed, using the determination key for the biogenic capacity of mountain rivers, established by the Institute for Research and Forestry (ICAS) Bucharest. In mapping and studying the area I have used G. I. S. methods and equipment.

RESULTS AND DISCUSSIONS

Description of the habitat of the huchen in the Mureş Gorge

The Deda-Toplița Gorge has a length of 33 km and acts as the delineation between the Călimani and the Gurghiu Mountains, volcanic mountains belonging to the middle group of the East Carpathians. The gorge links Giurgeului depression to the Transylvanian Plane and is the longest break-through in the volcanic chain in our country. Typical for this gorge are very narrow parts, with steep and high slopes and many alluvial cones made up of volcanic rock. In some places the valley becomes larger and makes way for hilly depressions (4 basins), among which Lunca Bradului landslide hollow stands out best.

In cross section, the Mureş Basin in the gorge is lopsided: the gradient of the tributary valleys in Călimani is about 3.5 m/km, with an irregular shape lengthwise, while those in the Gurghiu Mountains, have larger gradients (cca. 5.5 m/km), and shorter tracts. The height of the bed varies between 650 - 600 m, and the overall gradient is just 4.5 %. The narrow parts of the gorge alternate with widenings of the valley into small structural-erosive basins, where people have settled. They act as concentration points of the tributaries.

Riverbed morphology and morphometry

When describing the Mureş River bed in the area of the gorge, we could divide it into three main sections which stand out with different characteristics:

Between Toplița and Sălard valleys, the width of the valley ranges up to 800 m; there are layered terraces, and the tributaries build up alluvial cones clearly shaped. The minor river bed is fairly narrow (under 50 m), with rough gravel, and in the meanders - small banks of fine gravel and course sands. At the confluence of the Mureş River with the larger streams erosive depressions show up, build of less hard rock. (Stînceni, Neagra and Ilva).

Between Sălard and Răstolița the valey becomes narrow, with steep slopes, feeding blocks of stone and rocks into the river bed, which causes the sediment to be course. Here the water stream is faster due to the many rapids and deeper sections.

From Răstolița, the valley widens up again, the major river bed reaches large widths, and the bottom of the minor river bed is made up of gravel interspersed with rocks. The valley builds outrunners here and there, which alternate with narrow sections, depending on the distance from the slopes. In Răstolița, the width of the basin reaches up to 1 km. The last tributary of the Mureş in the Călimani Mountains - Bistra Mureşului acts as the upstream boundary of the gorge, as from here the rivers enters the Transylvanian Depression. In the gorge, the depth of the water ranges from 0.6 to 3 m. The speed of the river flow ranges depending on the debit and the degree of the fall, with sections where the stream flows with 0.6 m/sec, but also areas where the flow speed is no higher than 1.5 m/sec.

The G. I. S. mapping of the river bed in the section Ciubotani-Gălăoaia, during August - September 2006, at low debits, showed a water surface of about 113 325 mp where the depth of the stream is constantly over 0.8 m, an area considered to be an adequate habitat for the huchen. On a horizontal level, this surface corresponds to a lengthwise distance of 4.496 km in the river bed, 12.7 % of the entire river section studied.

Water Debit

The water debit is considered an important factor in ensuring the living conditions for fish, as for the fish it is important that the water debit is as constant as possible, with as small variations as possible.

Therefore, an important condition for the Mureş Gorge area to be a good habitat for huchen has to do with this parameter (see chapter 1), as this species is typical for mountain streams with large and steady debit. When entering the gorge (in the section Stînceni), the Mureş River has an average debit of 13.1 m^3/s., and when coming out (in the section Gălăoaia) 23.4 m^3/s. (according to the Water Directorate Tîrgu Mureş, 2006). The water comes from the following tributaries: Topliței Valley, formed out of the Secu and Lamoş streams, Călimanul, Mermezeu and Zebrac - right-side tributaries; Valea Gudea - left-side tributary upstream from Stînceni, Ilva - one of the most important tributaries of the Mureş River in the Călimani Mountains area, Sălard - the most important left-side tributary in this section, Răstolița - right-side tributary from the village with the same name, Iod and Borzia streams on the left, and then Gălăoaia and Bistra streams are the last tributaries of the Mureş in the gorge area.

In terms of the hydrology, the Mureş River falls under the type Transylvanian Carpathian. This type has large waters in the spring time, for 2-3 months (March to May) when the debit is over 30 m^3/s. in Stînceni and 50 m^3/s. in Gălăoaia, and respectively low debit values in the winter time 6.3 m^3/s. in January in Stînceni and 11.4 m^3/s. in Gălăoaia as a result of retaining a significant quantity of water in solid form and due to the little rain fall that fails to provide the ideal conditions to maintain the river flow. The water supply comes from rain and snow (in winter and spring); respectively moderate rain and underground streams. Water swells usually take place during the spring season due to snow melting and in the beginning of the summer.

Table 1: The pattern of average monthly debit values overall several years in Stînceni section.

Month / Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1994	11.8	13.2	23	22.1	13.2	12.1	6.37	5.67	4.84	9.16	4.16	3.46
1995	4.64	10.4	15.2	19.6	23.9	13.5	8.03	5.49	8.98	5.75	8.99	37.9
1996	14.3	5.37	7.51	45	27.6	9.31	7.46	5.67	17.6	10.4	7.08	13.7
1997	8.67	6.69	18.1	31.9	32.9	19.1	13.1	14.1	18.4	18.8	8.86	12.2
1998	7.57	9.68	9.51	27.3	22.8	30.7	21.6	8.2	10.6	18.7	16.6	6.92
1999	5.08	4.64	33.2	65.5	25.4	16.3	12.8	10.6	8.48	7.97	7.34	7.34
2000	4.64	6.12	38.4	59.6	12.1	8.54	9.1	5.63	7.79	4.87	5.14	6.15
2001	5.25	7.79	26.1	25.4	13.1	12.6	22.8	11.6	29.3	16.3	15	7.93
2002	8.68	31.7	28.1	17.7	12.2	16	14.5	36.7	15.9	21	31	8.58
2003	10.2	5.14	12.5	28.9	11.9	5.62	6.07	6.99	4.24	7.94	7.71	5.11
2004	4.32	7.37	32.5	38.8	20	9.13	9.33	13.8	7.98	9.08	17.8	15.4
2005	6.39	6.13	33.4	46.7	39.8	12	44.9	24.3	8.7	6.03	5.77	5.35
2006	5.59	4.78	42	71.1	21.4	40.7	20.3	18.8	10.6	5.64	6.26	4.75
1950 - 2006	6.03	7.91	19.2	31.6	21.4	16.0	13.2	10.5	8.32	7.83	7.95	7.83

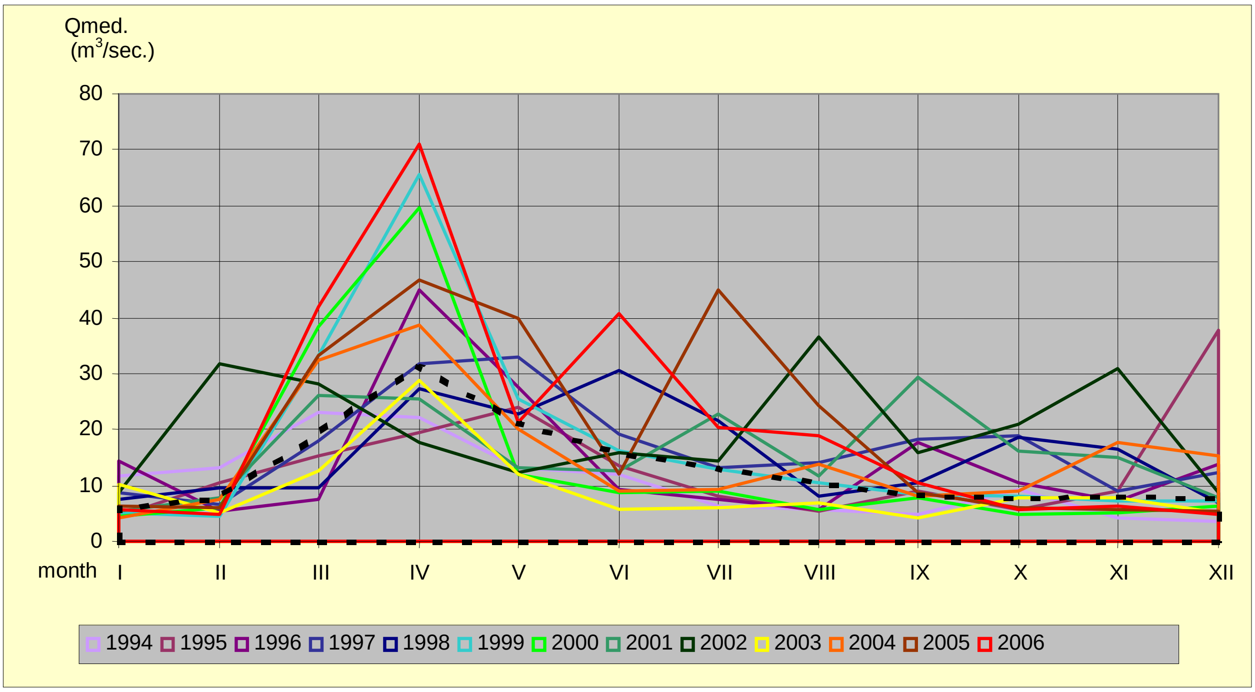

Figure 1: The pattern of average monthly debit values in 1999 - 2006 period in Stînceni section.

Table 2: The pattern of average monthly debit values overall several years in Gălăoaia section.

Month Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1994	20.2	20.5	43.4	54.9	41.2	29.9	13.5	9.58	8.1	11	9.27	10.9
1995	12.9	20.2	36	36.6	46.4	26.6	16.6	10.1	19.7	11.2	17.8	66.4
1996	24.5	8.94	11.7	70.3	51.8	18.8	15	11.1	34	20.8	13.5	24.6
1997	14	14.9	32.1	57.2	72.4	37.6	23.5	28.7	34.1	33.2	15.2	21.6
1998	15.7	18.6	15.4	62.4	45.6	56.9	45.1	15.8	20.8	34.6	31.7	9.84
1999	8.59	7.71	52.7	118	40.8	27.3	20.6	17.2	13.2	12.6	12.9	12.4
2000	5.74	9.5	51.4	100	18.8	12.7	17	10.4	12.9	8.12	7.67	9.13
2001	8.26	12.4	43.1	39.4	19.4	20.3	31.7	14.8	35.4	18.4	23.1	12
2002	15.4	46.2	44	23.9	17.8	24.1	17.8	44.2	21.9	29.8	39.5	12.3
2003	18.4	10.3	19.2	40.5	19	9.77	13.7	11.9	8.16	13.5	12.7	8.06
2004	7.35	12.5	51.6	67.9	27.6	15	14.2	20.8	11.3	12.8	24	25.4
2005	11	108	50.3	82.6	66.6	20.9	66.9	41.8	16	9.95	9.5	9.1
2006	5.59	4.78	42	71.1	21.4	40.7	20.3	18.8	10.6	5.64	6.25	4.75
1950 - 2006	11.4	13.2	32.9	59.9	35.1	26.6	19.2	15.8	17.7	16.3	16.4	16.8

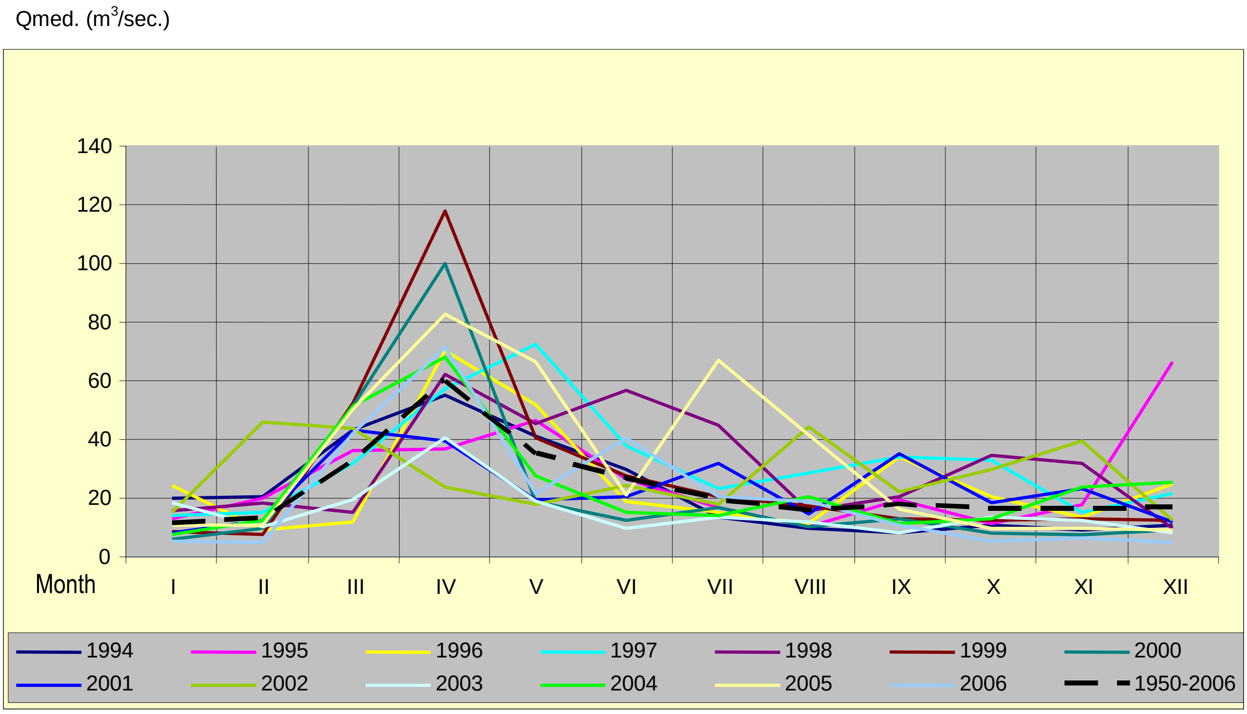

Figure 2: The pattern of average debit values overall several years in Gălăoaia section.

The assessment of the tables 1 and 2 regarding the average monthly debit values in the two reference sections of the gorge reveals a number of significant monthly differences from the multi-annual average (Figs. 1, 2). One of the main causes is the climate change over the recent years, but also the changes in the land use in the Ciucului Depression, where in some situations the forest areas have been reduced, and in others the forestry norms for wood harvesting were disregarded, especially by the new land-owners. Looking at the necessary habitat conditions for Salmonidae populations from this point of view, the negative impact is obvious. The constantly high debit, generated by periods with heavy rain fall, when the vertical index is high, has a negative impact on the species, very sensitive to the increase in the quantity of solid debris (especially over 25 mg/l). Also, the high water swells and the moving ice blocks in thaw (see the winter of 1995) pushes downstream and can destroy both the fish and the flora and fauna they feed on, causing radical changes in the habitat conditions for rather long periods of time.

Analysis of the quality indicators according to G. D. 563/2006 for the technical norms regarding the quality of surface waters in need of protection and improvement in order to sustain fish.

In this chapter we assessed certain quality indicators from the data provided by the National Romanian Water Administration, the Water Directorate Tîrgu-Mureş for the time frame 2004-2006.

A first indicator studied was the dissolved oxygen. The fish metabolism requires the occurrence of a certain quantity of dissolved oxygen, and Salmonides can only live in water with an oxygen content of 9-19 mg O/l. Low concentrations, under 2-3 mg O/l, causes their asphyxiation, and too large quantities cause air embolism.

The assessment of the tables 3 and 4 show that during this time frame there were no values under the minimum accepted limit specific to Salmonide-bearing water (Figs. 3, 4).

Table 3: Pattern of dissolved oxygen in Stînceni section (mg O/l).

Year	Minimum value recorded	Minimum accepted value
2004	8.04	6.00
2005	8.07	6.00
2006	6.04	6.00

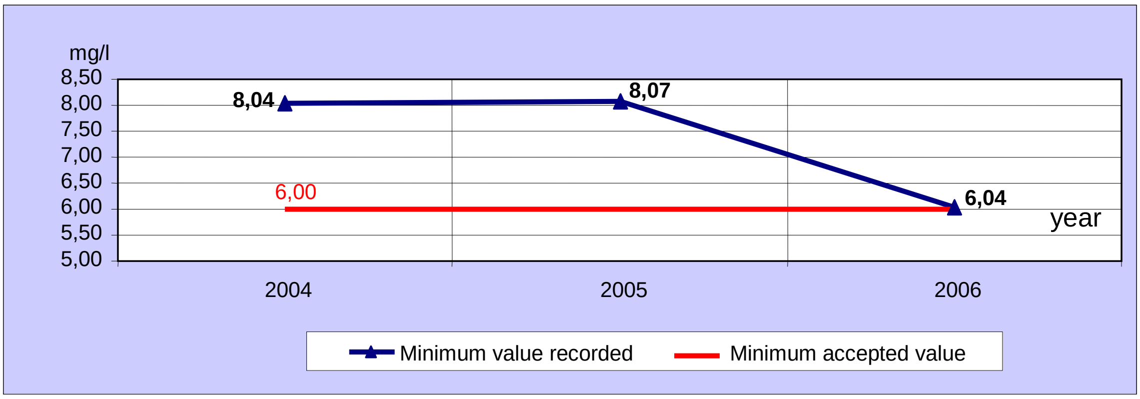

Figure 3: Pattern of dissolved oxygen in Stînceni section (mg O/l).

Table 4: Pattern of dissolved oxygen in Brâncoveneşti section (mg O/l).

Year	Minimum value recorded	Minimum accepted value
2004	8.42	6.00
2005	8.32	6.00
2006	7.00	6.00

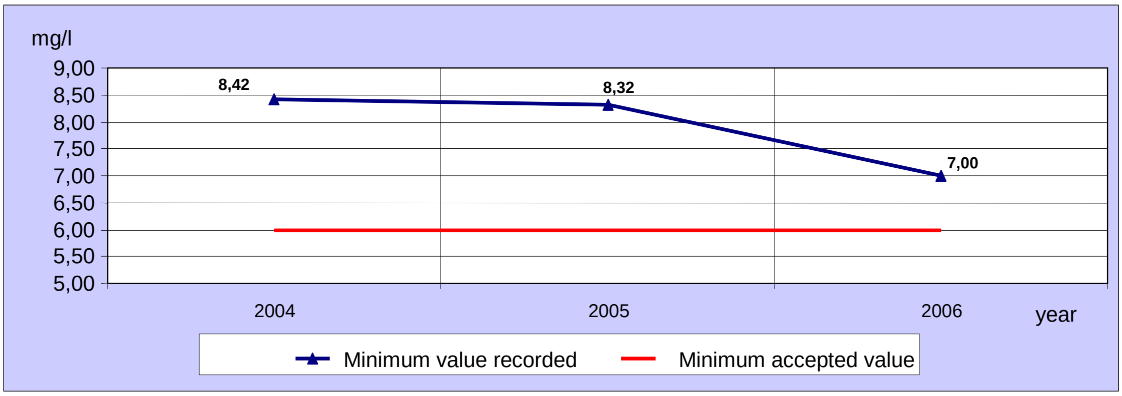

Figure 4: Pattern of dissolved oxygen in Brâncoveneşti section (mg O/l).

Another indicator assessed was the pH, taking into account the fact that Salmonides are very sensitive to pH values over the limits of 6-9.

It is shown that during this time frame such values over the limit were recorded in 2006, in both control points. The average yearly values are within the accepted limits, with a slight indication of alkalinity (Tabs. 5, 6; Figs. 5, 6).

Table 5: Pattern of pH values in Stînceni section.

Year	Minimum recorded value	Maximum recorded value	Annual average value	Minimum accepted value	Maximum accepted value
2004	7.3	8.1	7.7	6	9
2005	7.4	8.0	7.7	6	9
2006	7.3	9.6	7.8	6	9

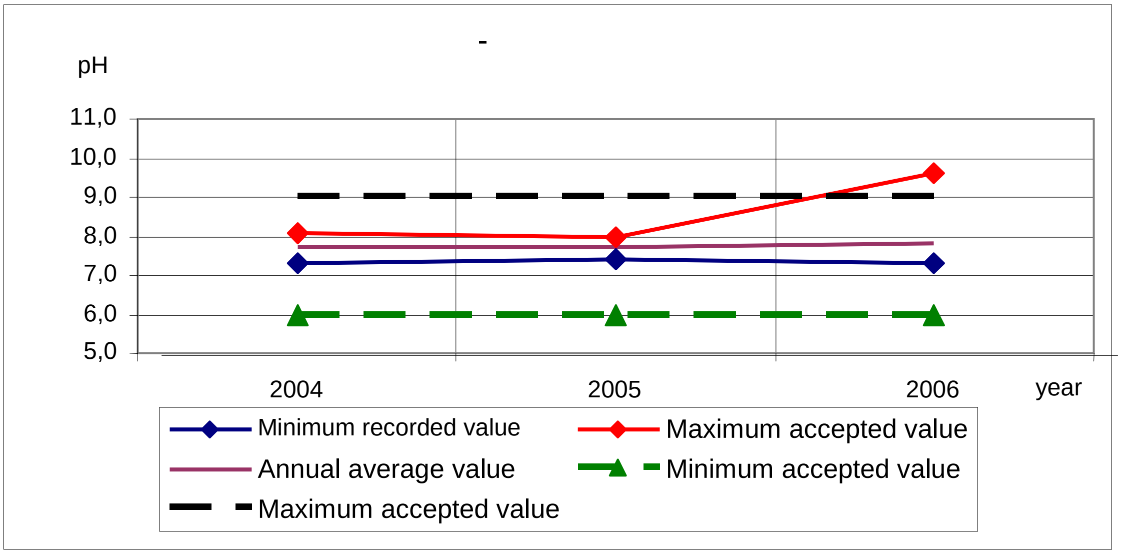

Figure 5: Pattern of pH values in Stînceni section.

Table 6: Pattern of pH values in Brâncoveneşti section.

Year	Minimum recorded value	Maximum recorded value	Annual average value	Minimum accepted value	Maximum accepted value
2004	7.5	7.9	7.8	6	9
2005	7.6	9.0	8	6	9
2006	7.5	9.1	8	6	9

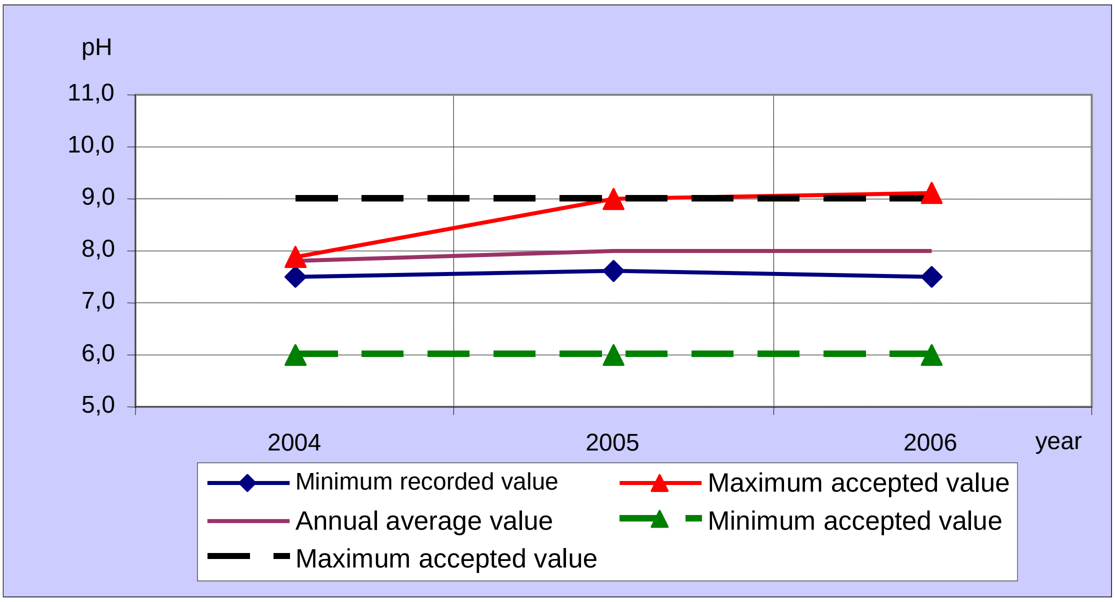

Figure 6: Pattern of pH values in Brâncoveneşti section.

The next parameter assessed was the solid slurry. The clearness of the water has place a great role, because the huchen needs clear and clean water. Waters with large amounts of slurry over long periods of time cause the asphyxiation of the spawn and the death of the saplings. The water's slit charge in this sector is caused either by natural factors, such as water swelling and torrents coming down the slopes after heavy rains, or by the discharge of waste water from the town Toplița, especially the waste from the town's water treatment station, as this station is only provided with mechanical filter. The two tables show values over the accepted limit of 25 mg/l in both section, and in both maximum recorded values and yearly values. The only exception is year 2006, when the average amount of slurry was 18.6 mg/l in Stînceni and 23 mg/l in Gălăoaia (Tabs. 7, 8; Figs. 7, 8). This is especially due to the type of rock in the Călimani and Gurghiului mountains, where volcanic tuff and ash is washed off on large areas and where tree vegetation is missing as a result of cutting.

Table 7: Pattern of the solid slurry values in Stînceni section (mg/l).

Year	Maximum recorded value	Annual average value	Maximum accepted value
2004	280	37.7	25
2005	46	25.5	25
2006	43	18.6	25

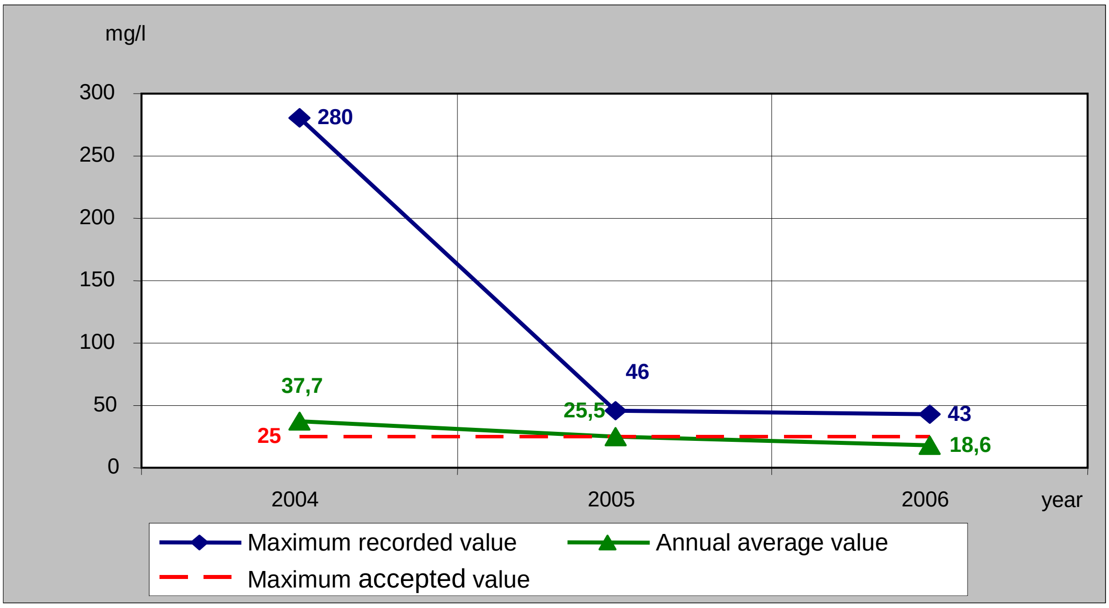

Figure 7: Pattern of the solid slurry values in Stînceni section.

Table 8: Pattern of the solid slurry values in Brâncoveneşti section (mg/l).

Year	Maximum recorded value	Annual average value	Maximum accepted value
2004	39	37.7	25
2005	70	36.0	25
2006	114	23.0	25

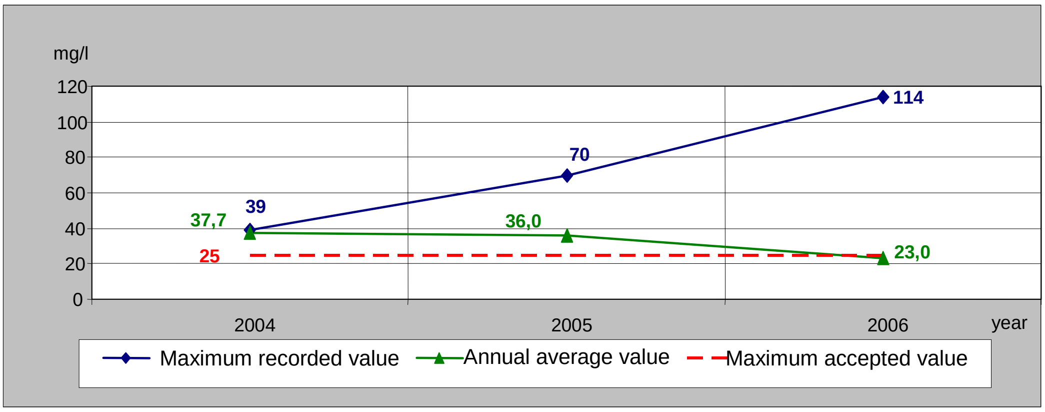

Figure 8: Pattern of the solid slurry values in Brâncoveneşti section.

The last indicator studied was the oxygen biological demand (OBD) (Tabs. 9, 10; Figs. 9, 10), and here the values are around 3 mg O/l - the maximum limit for waters with Salmonides.

Table 9: Pattern of oxygen biological demand in Stînceni section (mg O/l).

Year	Maximum recorded value	Annual average value	Maximum accepted value
2004	5.6	3.14	3
2005	3.6	2.26	3
2006	3.6	2.23	3

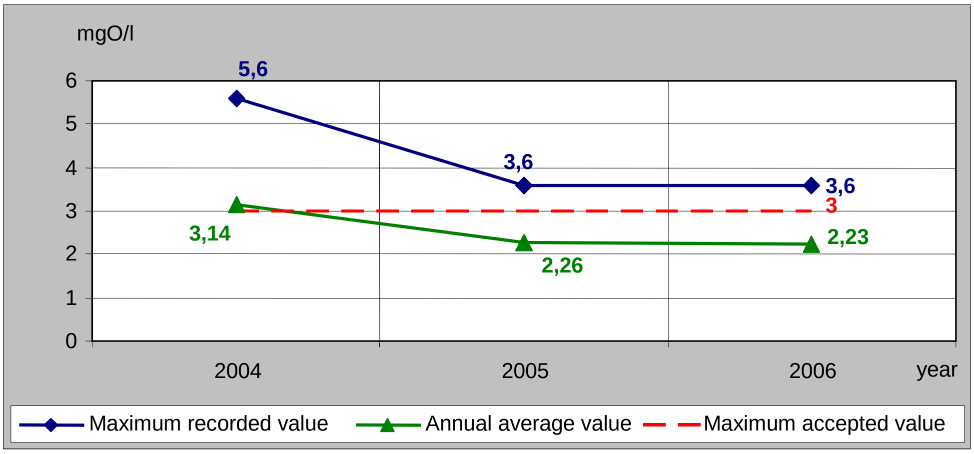

Figure 9: Pattern of the CBO_5 - Stînceni section.

Table 10: Pattern of oxygen biological demand values in Brâncoveneşti section (mg O/l).

Year	Maximum recorded value	Annual average value	Maximum accepted value
2004	3.5	2.53	3
2005	2.3	1.95	3
2006	8.88	4.91	3

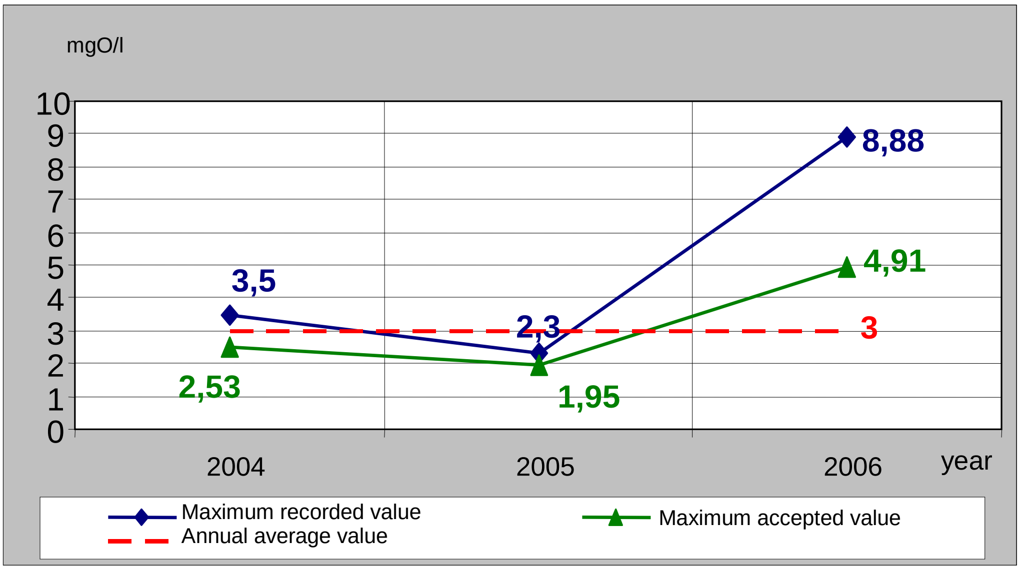

Figure 10: Pattern of the CBO_5 - Brâncoveneşti section.

The assessment of the water quality in Mureş River according to the determination key for biogenic capacity of mountain rivers

This determination key was created by the Institute for Forestry Research (ICAS) Bucharest, based on version Vişoianu and completed by I. Cristea. It includes analysis of biotic and human-related factors that play a determining role in establishing the class of reliability of the water. After going through the 14 points of the questionnaire for the sector studies, a number of 28 points was obtained, which places this water in the 3rd class of reliability. A favorable factors contributed to this classification, such as the geological structure of the river banks and river bed, made up of volcanic rock, the average level of instability of the river bed on horizontal level, the average altitude over 600 m, the small number of pollution sources and the relatively reduced length banks without vegetation cover, trees or meadow.

CONCLUSIONS

The history of the reintroduction of huchen in the upper Mureş Gorge, one superior, shows that the last attempt was made in 2003. The fact that in the last years no mature individuals were introduced, combined with the confirmation of the occurrences of individuals with an age at least 4 years in 2007, demonstrate for this time frame a positive byogene and maintainace capacity of the huchen population, as viable component of the Mureş River ecosystem.

The assessment of the stable condition of the huchen habitat in the Upper Mureş shows some variations in the restrictive factors (a-byotic, byogene and human-related) and despite the great self-cleaning capacity of the Mureş and the important amount of water carried by the above-mentioned tributaries, they can limit or endanger the development or the very occurrences of the species in this area.

In conclusion, there is an urgent need to rehabilitate and preserve the habitat of the huchen and the species all over this river section, especially since the Mureş River has an exceptional natural potential, exceeding the quality of most other trans-Carpathian courses. An active management is necessary for the rehabilitation and conservation of the species habitat. This issue has to be approach in a professional way in the drafting of the management plan for the natural park The Upper Mureş Gorge and of the Natura 2000 Site Călimani-Gurghiu.

Further research on the occurring population is also needed, with evaluation of the number of individuals, age composition, distribution and dynamics, and the situation of the feeding resources.

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COMPARATIVE STUDY OF MUDS CHARACTERISTICS OF FISH PONDS FROM THE LOWER PRUT RIVER WETLAND (MOLDOVA, ROMANIA)

Luiza FLOREA [1] and *Maria CONTOMAN* [2]

KEYWORDS: fish ponds, nitrate, pollution, leaching, Nitrate Directive, wells.

ABSTRACT

The purpose of this study is the comparative analysis of the nutrient charge (humus, NPK) of the shores of the fish production ponds from two fish farms situated in the everglade of the low Prut. The farms Şovârca and Vlădeşti detain and exploit two of the old flood pools of the Prut, converted into fry ponds (SH1, VH4). From each farm four ponds were selected, with different construction and exploitation characteristics, in order to assess a wider scale of situations. The ponds were measured (depth, transparency, thickness of the mud layer), observed and samples were taken from the shores in three different periods, meaning in October 2006, June 2007, August 2007. The shore samples were analyzed to assess the humus concentration (%), the nitrogen (N total %), the phosphorus (P - Al ppm), the potassium (K - Al ppm) and the soil reaction in the laboratory of the Galați County Pedology and Agrochemistry Office. The laboratory analysis results were compared to the fertility levels of the fish production issued soils mentioned in the specialized literature (Dutta O. K., Sarma D. K.). The values surpassing the maximum fertility level have been considered as potentially pollutant leading to the eutrophication of the pond water as well as to the eutrophication of the natural receivers of the water and the sediment discharged from the fray ponds during autumn evacuations. From the analyzed data we can estimate that the humus content surpasses with more than 10-28 % the upper fertility limit for 80 % of the situations in the Şovârca farm and with more than 10-20 % in 30 % of the situations in the Vlădeşti farm.

REZUMAT: Studiu comparativ al mâlurilor caracterstice eleşteelor piscicole din zona umedă a Prutului inferior (Moldova, România).

Scopul acestui studiu este de a analiza comparativ gradul de încărcare cu nutrienți (humus, NPK) a malurilor din heleşteele piscicole de la două ferme situate în lunca inferioară a Prutului. Fermele Şovârca şi Vlădeşti dețin în exploatare doua din fostele bălți inundabile ale Prutului, transformate în bazine de creştere (SH1, VH4). De la fiecare fermă s-au ales patru heleştee, cu caracteristici constructive şi de exploatare diferite, pentru a surprinde o paletă mai mare de situații. Heleşteele au fost supuse unor măsurători (adâncime, transparență, grosimea stratului de mâl) unor observații şi unor prelevări de probe de mâl în trei perioade diferite, respectiv octombrie 2006, iunie 2007, august 2007. Probele de mâl au fost analizate din punct de vedere al conținutului în humus (%), azot (N_{total} %), fosfor (P_{-Al} ppm), potasiu (K_{-Al} ppm) şi al reacției solului de către laboratorul Oficiului județean de Pedologie şi Agrochimie Galați. Rezultatele analizelor de laborator au fost comparate cu nivelul de fertilitate al solurilor piscicole din literatura de specialitate (Dutta O. K., Sarma D. K.,). Valorile care au depăşit nivelul maxin de fertilitate au fost considerate ca potențial poluatoare ducând la eutrofizarea apei din heleşteu şi din receptorii naturali care primesc apele şi sedimentele din heleţtee în timpul golirilor de toamnă. Din datele analizate reiese că conținutul de humus depăşeşte cu 10-28 % limita de fertilitate ridicată în 80 % din situațiile de la ferma Şovârca şi cu 10-20 % peste limita de fertilitate ridicat în 30 % din situațiile de la ferma Vlădeşti.

RÉSUMÉ: Etude comparative des boues caractéristiques des fermes piscicoles de la zone inondable du bas-Prut (Moldavie, Roumanie)

Le but de cette étude a été l'analyse comparative de la charge pourcentuelle de nutriments (humus, NPK) des berges des étangs de culture de deux fermes piscicoles situées dans le pré inondable du bas-Prut. Les fermes Şovârca et Vlădeşti possedent et exploitent deux des anciens étangs inondables du Prut, transformées en bassins de culture (SH1, VH4). Dans chaque ferme ont été sélectionnés quatre bassins avec des caractéristiques de construction et d'exploitation différentes, afin de surprendre une palette plus grande de situations. Les étangs ont été mesurés (profondeur, transparence, épaisseur de la couche de boue), ont été soumises a des observations et des échantillons ont été prélevés sur les berges dans trois périodes différentes: octobre 2006, juin 2007, aout 2007. Les échantillons ont été analysés afin de mesurer la concentration d'humus (%), l'azote (N total %), le phosphore (P - Al ppm), le potassium (K - Al ppm) et la réaction du sol dans le laboratoire du Bureau départemental de Pédologie et Agrochimie de Galaţi. Les analyses de laboratoire ont été comparés aux données de la littérature (Datta O. K., Sarma D. K.). Les valeurs dépassant la valeur de fertilité maximale ont été considérées en tant que potentiellement polluantes, menant a l'eutrophisation de l'eau des étangs ainsi que des récepteurs naturels qui reçoivent les eaux et les sédiments des étangs pendant les vidanges d'automne. Des données analysées résulte le fait que le contenu d'humus dépasse de 10-28 % la limite supérieure de fertilité dans 80 % des cas de la ferme de Şovârca et de 10-20 % la limite supérieure de fertilité en 30 % des cas de la ferme de Vlădeşti.

INTRODUCTION

Muds on the bottom of lakes and fish ponds are a category of soils called limnosoil which are born by accumulation of allochthonous and autochthonous organic matter provided by aquatic fauna and vegetation, from accumulation of ferrous sulphides and of limestone silts and from CO_2 and CH_4 resulted from the anaerobic decomposition of organic substances.

Muds have several functions: aquatic vegetation support and growing factor; aquatic fauna habitat and feeding sources; heavy metal stocking; protection filter against phreatic water pollution; nutrients stocking and water eutrophycation source.

MATERIALS AND METHODS

This research is trying to compare the degree of nutrient values in the fish ponds silts from two fish farm situated in the Lower Prut Wetland, in view of drawing up the average of the anthropic pressure (in this case the fish farming activities) upon the aquatic ecosystem muds.

The fish ponds belong to two fish farms, Şovârca and Vlădeşti, situated near the natural shallow lakes in Galaţi County.

The main characteristics of muds, which show as the degree of eutrophycation process of aquatic ecosystems are the thickness of mud layer, the nutrients amount in mud (NPK), the pH and the humus content.

The average silt samples were studied by the Regional Pedology and Agrochemistry Labs in Galaţi. Organic matter was determined through the titrimetric method of organic carbon and humus, the Gogoasa modification, the mobile phosphorous through the Egner-Riehm - Domingo method, whiles the accessible potassium through flame emission photometry. The total nitrogen was determined through the Kjeldahl method, i. e. the process of wet mineralization of organic compounds with the nitrogen in the soil. Sample gathering and their study were performed in October 2006, July 2007 and August 2007.

RESULTS AND DISCUSSIONS

The Şovârca Fish Pond Farm is situated in the Suceveni and Oancea territories, Galați County, on the right bank of the River Prut between km 100 + 300 and 96 + 450. This unit, with a total surface of 223 ha is managed by SC Singama SRL in Oancea, Galați County.

Water supply and evacuation is achieved mainly gravitationally, the water source being the Prut River through its pumping station SP1 and the reversible flow regulator from E. C. 5.

As the land has an average elevation of 9.5 mr MB, the whole system can be gravitationally supplied with a maximum 20 % of the required volume, while the water gravitational evacuation can be done for a minimum 60 % of the volume.

Both filling and evacuation are made gravitational and/or by pumping up.

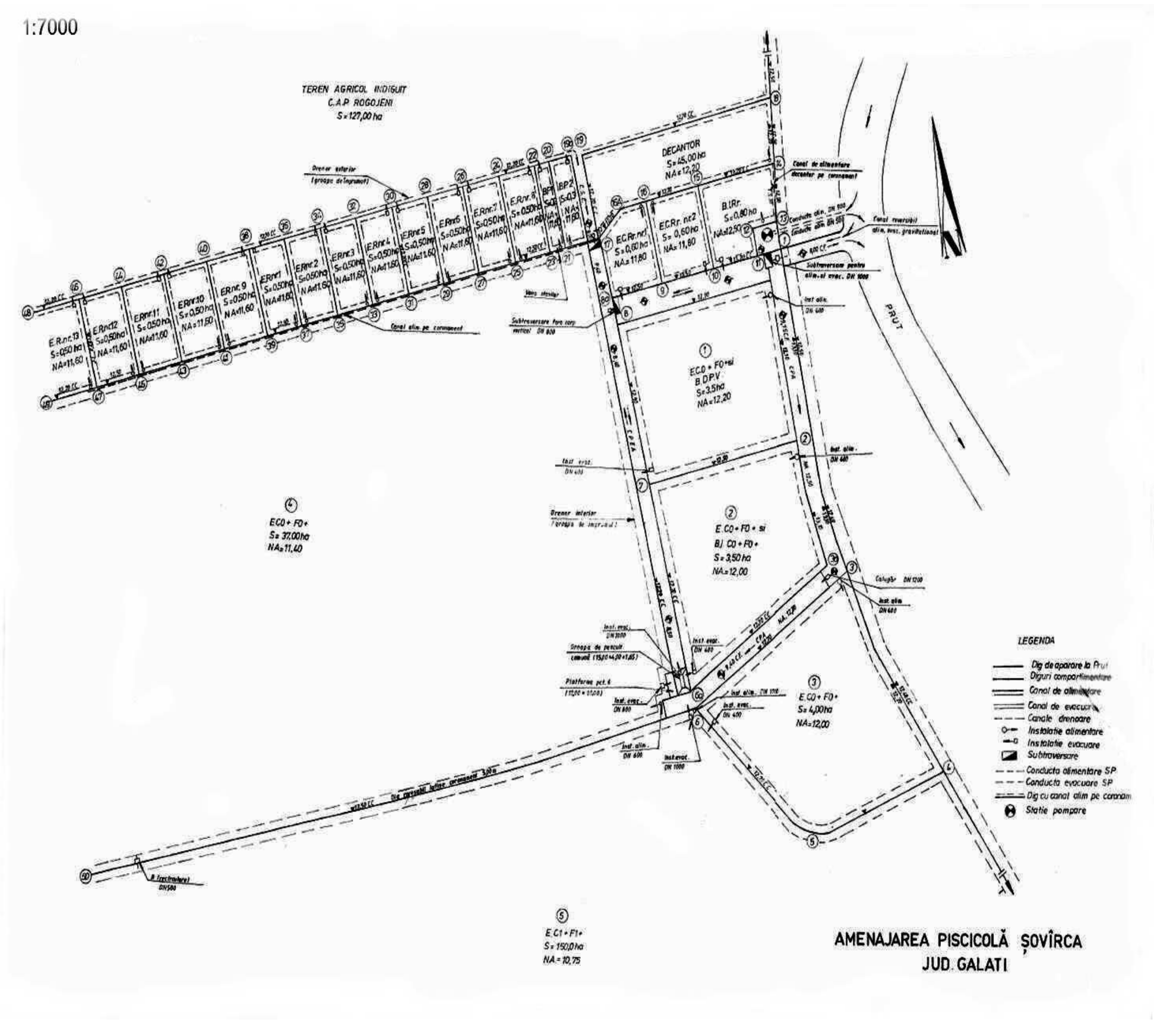

Figure 1: The map of Şovârca farm and te location of sampled ponds.

The Vlădeşti Fish Pond is situated on the right bank of the Prut with an area of 323 ha. The unit is managed by SC Zatun SA. The unit's profile is that of a complex systematic fish and nursery ponds.

The exploitation cycle is two years long, while the production is focused on Cyprinus carpio and other East Asian species, taken from the units that ensure an artificial reproduction of these species.

The upkeep water flow of the fish is of 3 l/sec/ha and of 10 l/sec/ha during winter, a 11,000 m^3 water quantity is necessary. Before the opening of the Stânca Costeşti dam, the Vlădeşti unit no longer benefits from the possibility of having a consistent gravitational supply during all the periods (contrary to the design documentation). As a result the water supply through pumping has great rises in costs as the main effect.

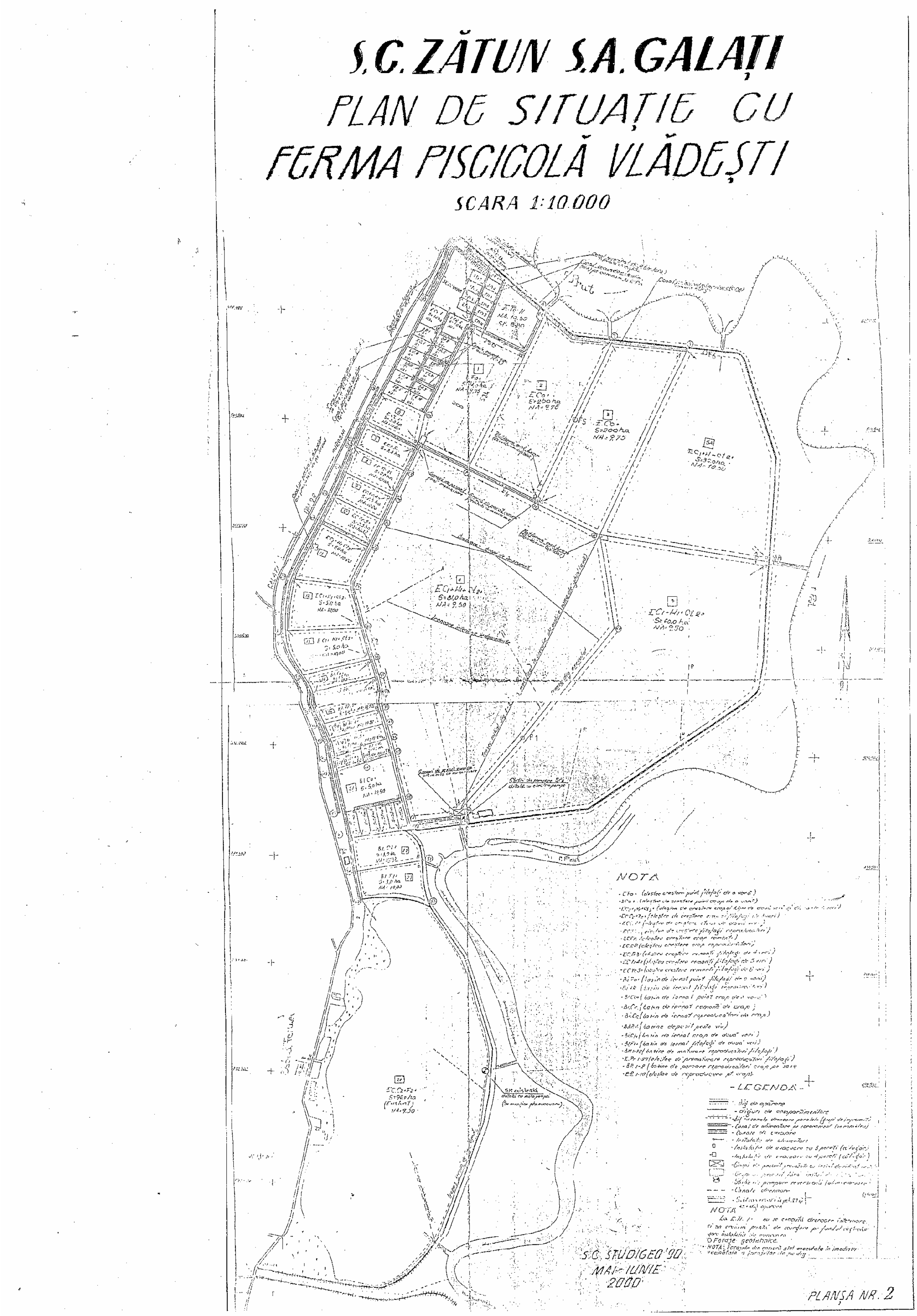

Figure 2: The map of Vlădeşti farm and the location of sampled ponds.

Out of each farm four fish ponds with different construction characteristics were selected. The ponds under investigation are different in point of surface, use, frequency and degree of water evacuation (Tab. 1).

Table 1: The surface, use and draining of monitored ponds from Şovârca farm and Vlădeşti farm.

Şovârca farm	The monitored ponds			
	SH1	**SH2**	**SH3**	**SH4**
Surface: Use: Draining:	157 ha, Growingmarket fish, Partial,	4.5 ha, Growing fish fingerling first year Total,	2 ha, Growing fish adults, Total,	0.5 ha, Wintering Total,
Vlădeşti farm	The monitored ponds			
	VH1	**VH2**	**VH3**	**VH4**
Surface: Use: Draining:	3 ha, Growing fish fingerling first year Total,	1 ha, Growing fish adults, Total,	6 ha Sports fishing no draining,	96 ha, Growing market fish no draining,

Land investigations took place in three different periods, October 2006, June 2007 and August 2007, evincing the variation of important physical parameters in the life of a pond, the proportion between the water depth and transparency (Fig. 1 and Fig. 2) and the proportion between water depth and mud layer thickness (Fig. 3 and Fig. 4).

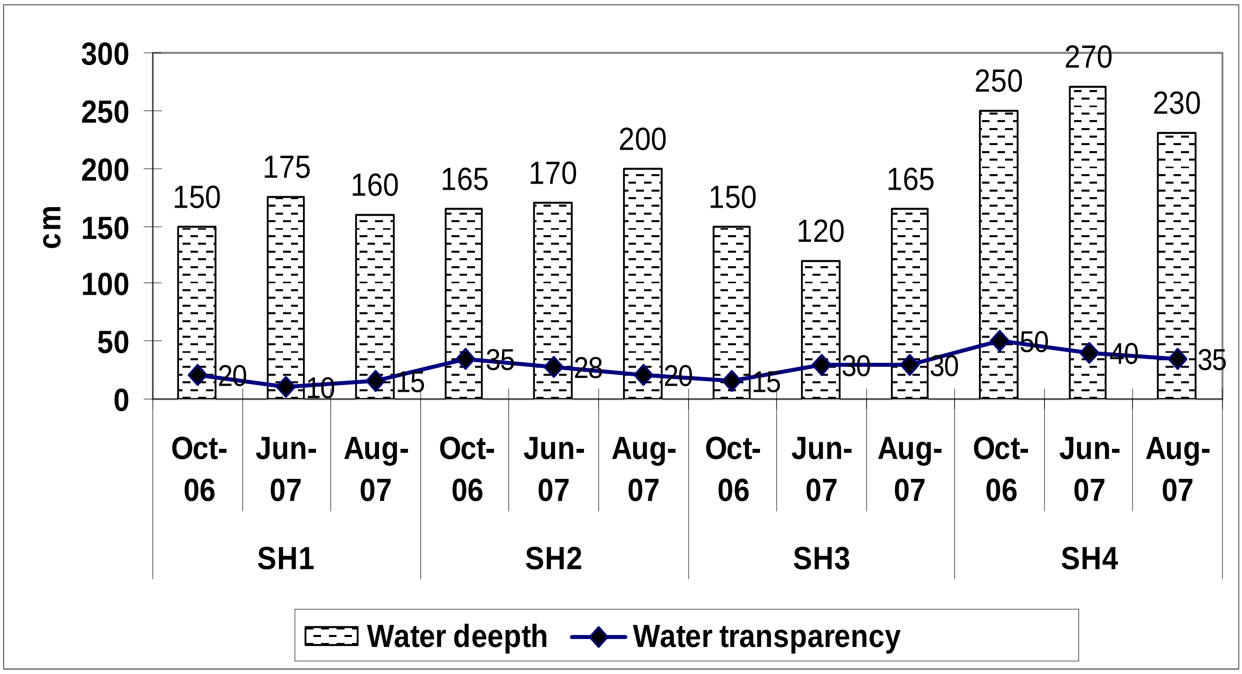

Figure 3: The variation of water depth and transparency in the ponds of the Şovârca farm.

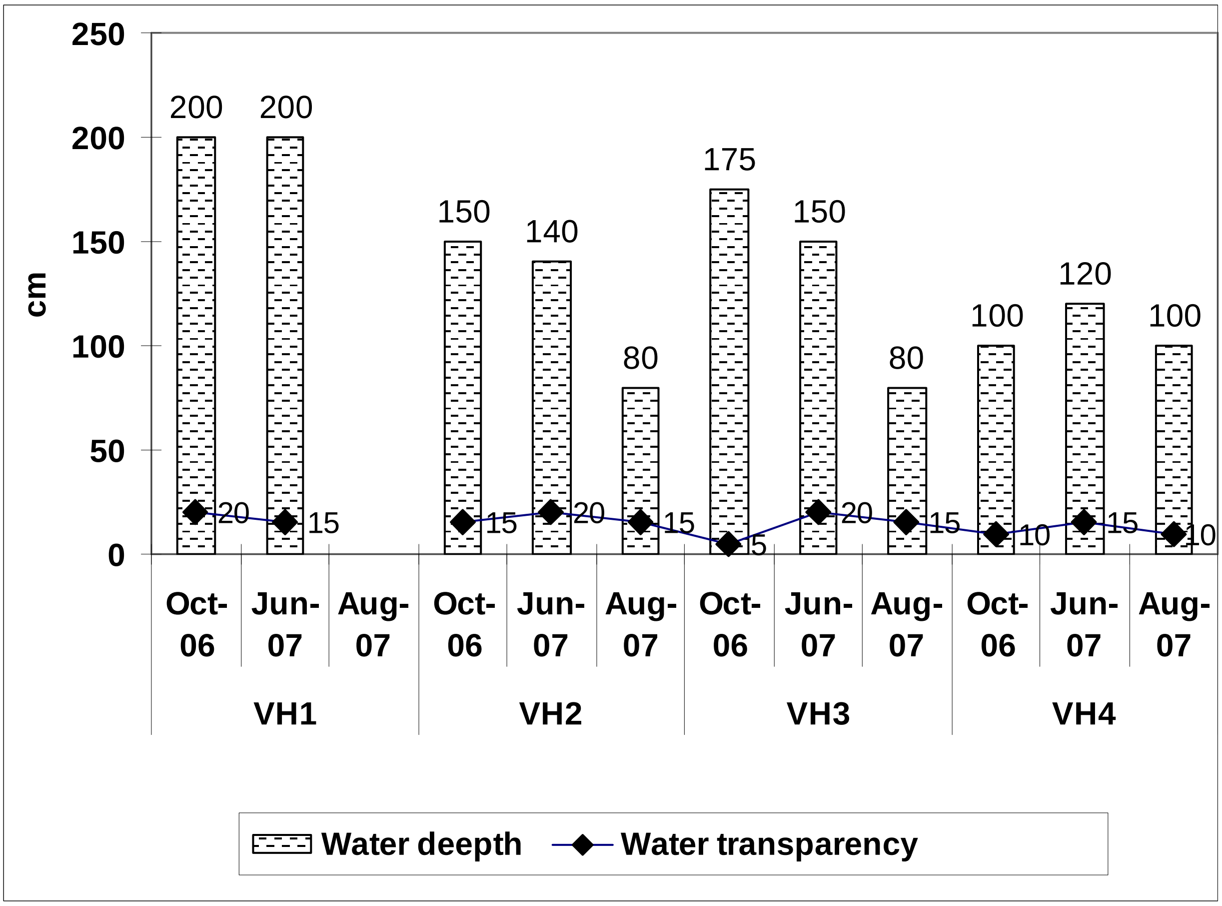

Figure 4: The variation of water deepth and transparency
in the ponds of the Vlădeşti farm.

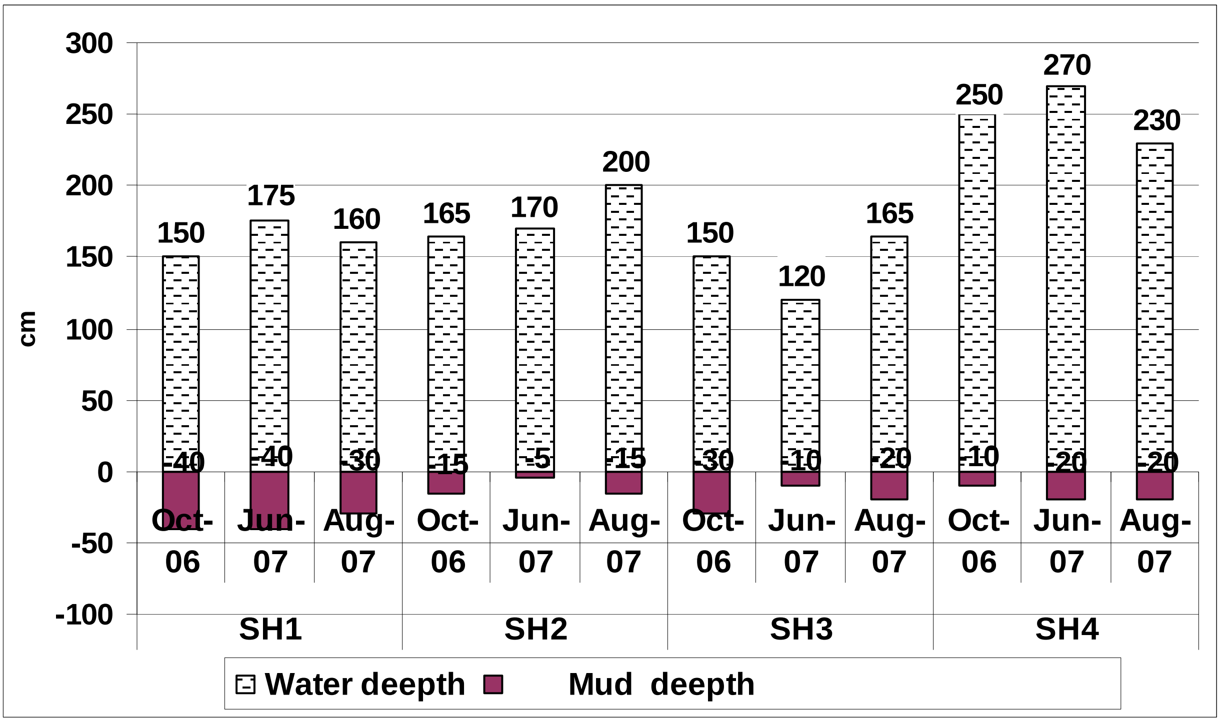

Figure 5: The variation of water depth and mud depth
in the ponds of the Şovârca farm.

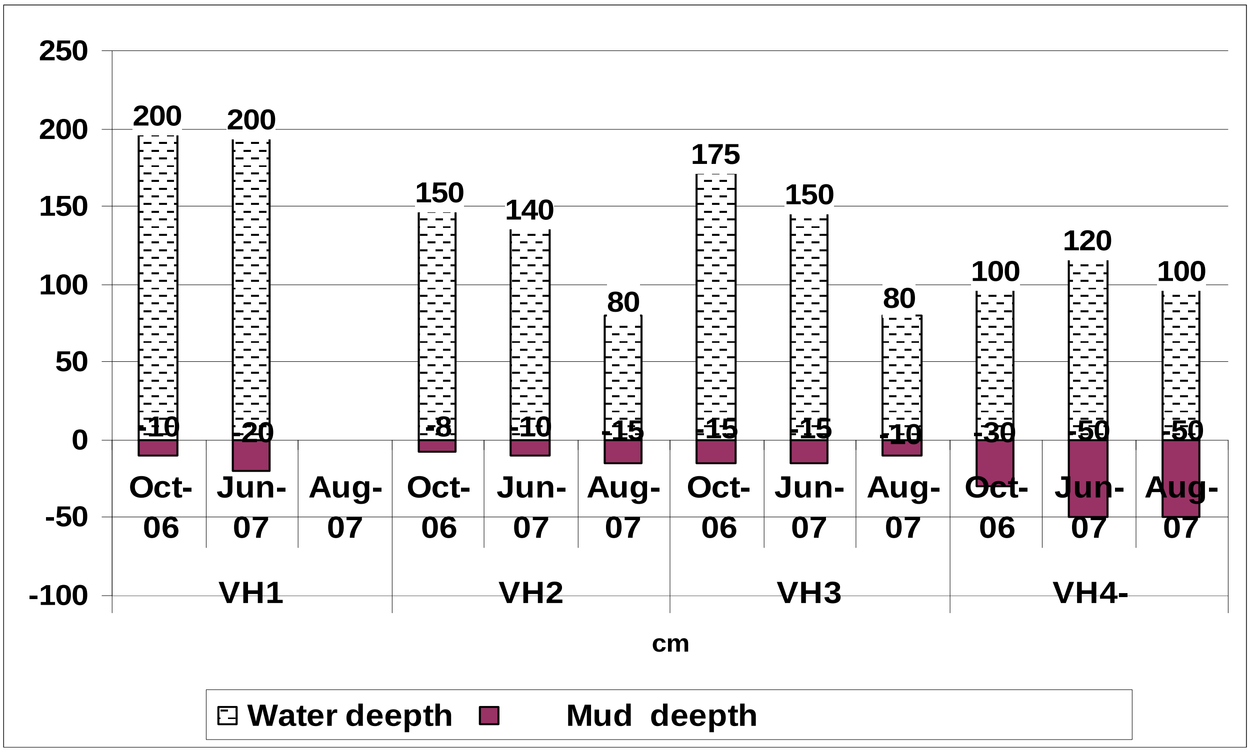

Figure 6: The variation of water depth and mud depth in the ponds of the Vlădeşti farm.

The chemical analysis of the muds collected from these fish ponds during the three periods mentioned above, has aimed at establishing the degree of nutrient charging issued from aquaculture. In order to establish this degree for the muds under study, the results of the analyses carried out have been compared with the fertility level of muds in the specialised literature. Muds that displayed a humus, nitrogen and phosphorus charge higher than the maximum level for the fertility class have been considered as polluted by organic substances, i. e. nitrogen or phosphorus.

Since the expression units of the analyzed parameters have not coincided with the expression manner of the analyses' results, it was necessary to convert the measure unit as follows (Tab. 2).

Table 2: Fertility status of ponds' muds.

Fertility status	(Dutta O. K., Sarma D. K.,)				(Florea L., Contoman M.)		
	pH	C. organic (%)	N (mg/100g)	P_2O_5 (mg/100 g)	Humus (%)	N_{total} (%)	P_{-Al} ppm
High	6.6 - 7.5	1.5 - 2.0	> 50	6 - 12	2.58 - 3.44	> 0.05	26.1 - 52.5
Medium	5.5 - 6.5	0.5 - 1.5	25 - 50	3 - 6	0.86 - 2.57	0.025 - 0.05	13.1 - 26.0
Low	< 5.55	< 0.5	< 25	< 3	< 0.85	< 0.025	< 13.0

Humus content As for the materials that clog fish ponds, they originate from organic matter decomposition processes, from the Prut River alluvia and from fish feeding. The organic matter average content in the Şovârca farm ponds is higher than in the Vlădeşti farm ponds. The booth, natural shadow lake from Şovârca (SH_1) and from Vlădeşti (VH_4) have the highest thickness of mud layer and the highest humus content due to the impossibility of draining up these natural lakes. The Şovârca three ponds contain the similar average of humus as the natural shallow lake from Şovârca (SH_1), but the Vlădeşti three ponds' humus content is lower than in the natural shadow lake from Vlădeşti.

To know the fertility status of pond soil, the humus contents are compared with the following literature data:

Natural fertility status	Low	Medium	High
Humus content %	< 0.85	0.86 - 2.56	2.57 - 3.44

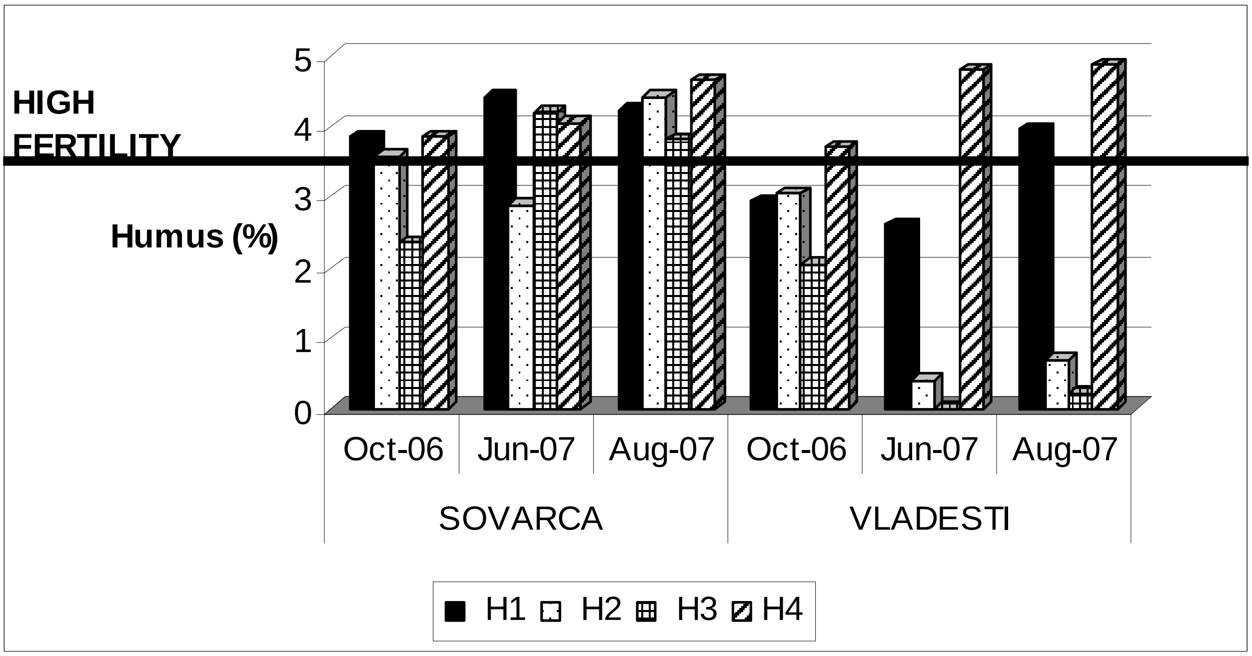

Figure 7: Values of humus content (%) of muds in fish ponds.

The Nitrogen content The nitrogen in fish pond silts is both of organic and mineral origin. This element constitutes one of the most important biogenous factors, ensuring aquatic plant evolution. It cannot be accumulated as reserve, neither in plants nor in soil because it is easily soluble in water. Only about 13 % from the total nitrogen income is present in solids, the most part, about 87 % is present in lake dissolved forms. The nitrogen average content in the Şovârca farm ponds is higher than in the Vlădeşti farm ponds. Also, the booth, natural shadow lake from Şovârca (SH_1) and from Vlădeşti (VH_4) has the highest nitrogen content over 0.2 ppm in the summer period and above 0.2 ppm in the autumn period. The Şovârca three ponds contain the similar average of nitrogen as the natural shadow lake from Şovârca (SH_1), but the Vlădeşti three ponds nitrogen content is lower than in the natural shadow lake from Şovârca.

To know the fertility status of pond soil, the nitrogen contents are compared with the following literature data:

Natural fertility status	Low	Medium	High
Nitogen content %	< 0.024	0.025 - 0.05	> 0.051

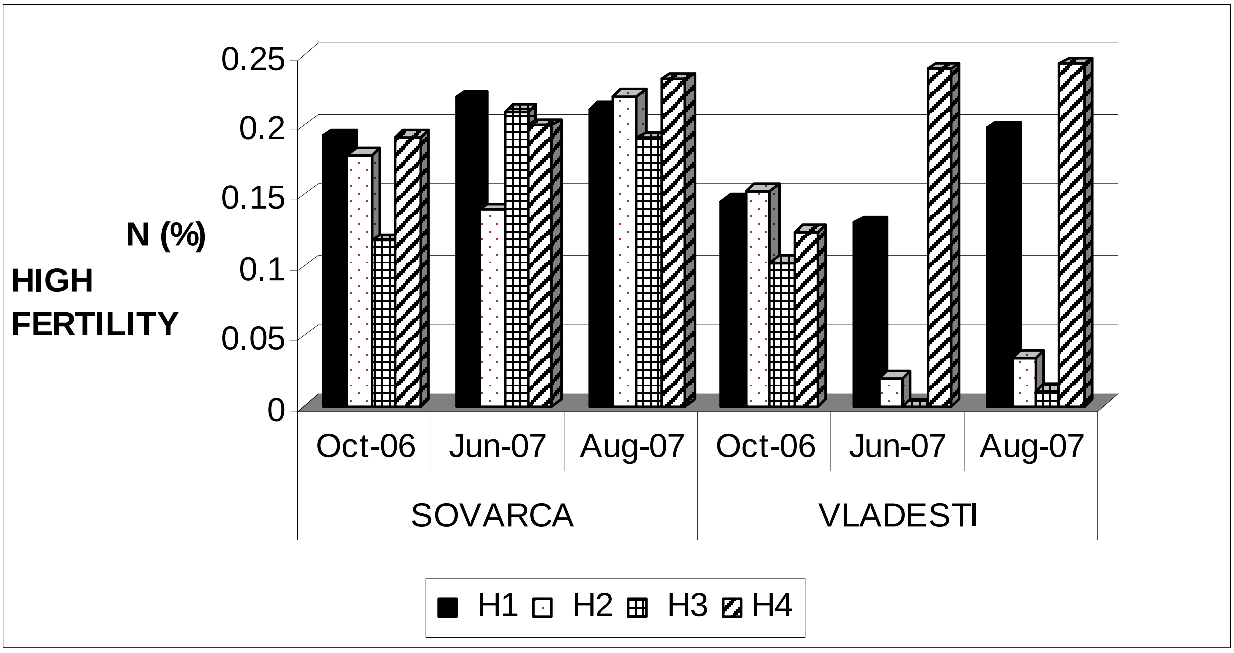

Figure 8: Values of nitrogen content N_{total} (%) of muds in fish ponds.

The Phosphorous content There is a strong interaction between phosphorus and nitrogen, the presence of phosphorus helps nitrogen fixing bacteria to accumulate atmospheric nitrogen, gives birth to ammonification and nitrification, helping the process of mineralization of the nitrogen-based organic substances. The phosphate reserves are restored naturally during the autumn - winter period when plants stop assimilating and they fall on the pond bottom, giving off the phosphates from the dead tissues. From the total phosphorus income about 10-40 % is present as dissolved form, the biggest part, about 60-90 % is present as solid form.

The chemical tests of silts from the ponds under analysis show the fact that the presence of moderate quantities of phosphorus, especially in the Vlădeşti farm case, which is explained by the absence of phosphate fertilizer input in the last years period. There are significant differences between the natural shadow lake from Şovârca (SH_1), which has a low amount of phosphorus and the natural shadow lake from Vlădeşti (VH_4) which contains an amount of phosphorus two or three times higher than in the summer period.

To know the fertility status of pond soil, the phosphorus contents are compared with the following literature data:

Natural fertility status	Low	Medium	High
Phosphorous Content (P-Al ppm)	< 13.0	13.1 - 26.1	26.2 - 52.41

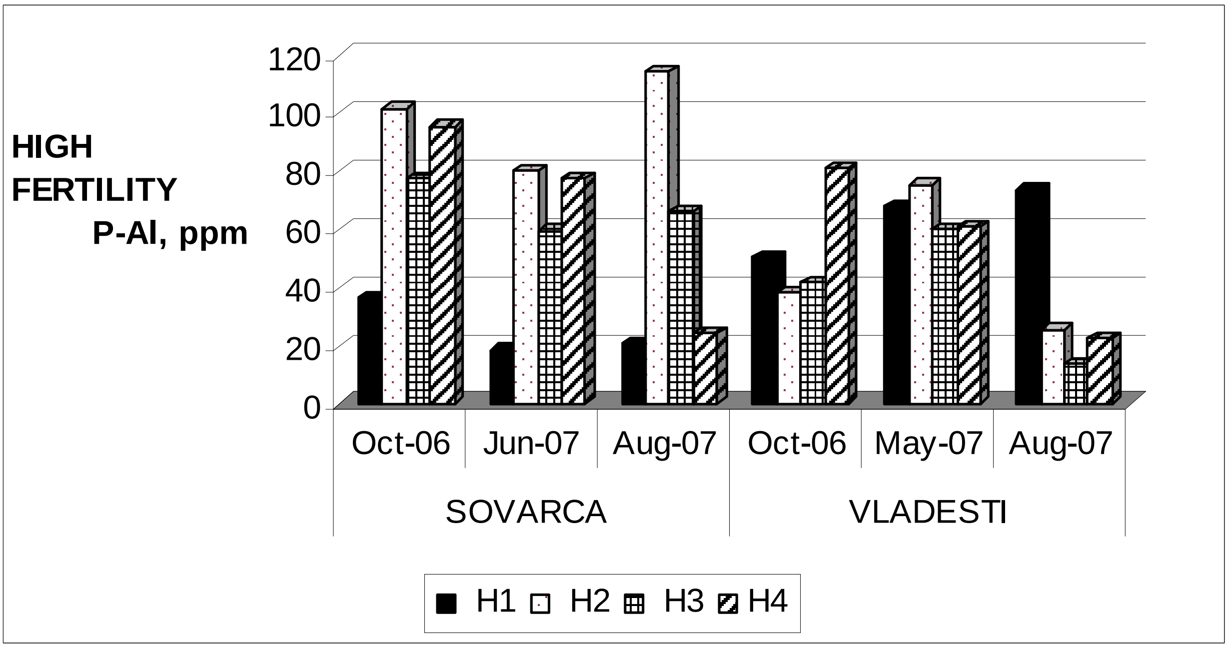

Figure 9: Values of phosphorus content (P_{-Al} ppm) of muds in fish ponds.

The Potassium content The potassium ions are not used to characterize the natural fertility status of pond's muds. In the ponds analyzed the potassium level had a minimum value of 28 K-Al, ppm and a maximum value of 420 K-Al, ppm. The monthly average was between 161 K-Al, ppm (August 2007, Vlădeşti) and 367 K-Al, ppm (August 2007, Şovârca).

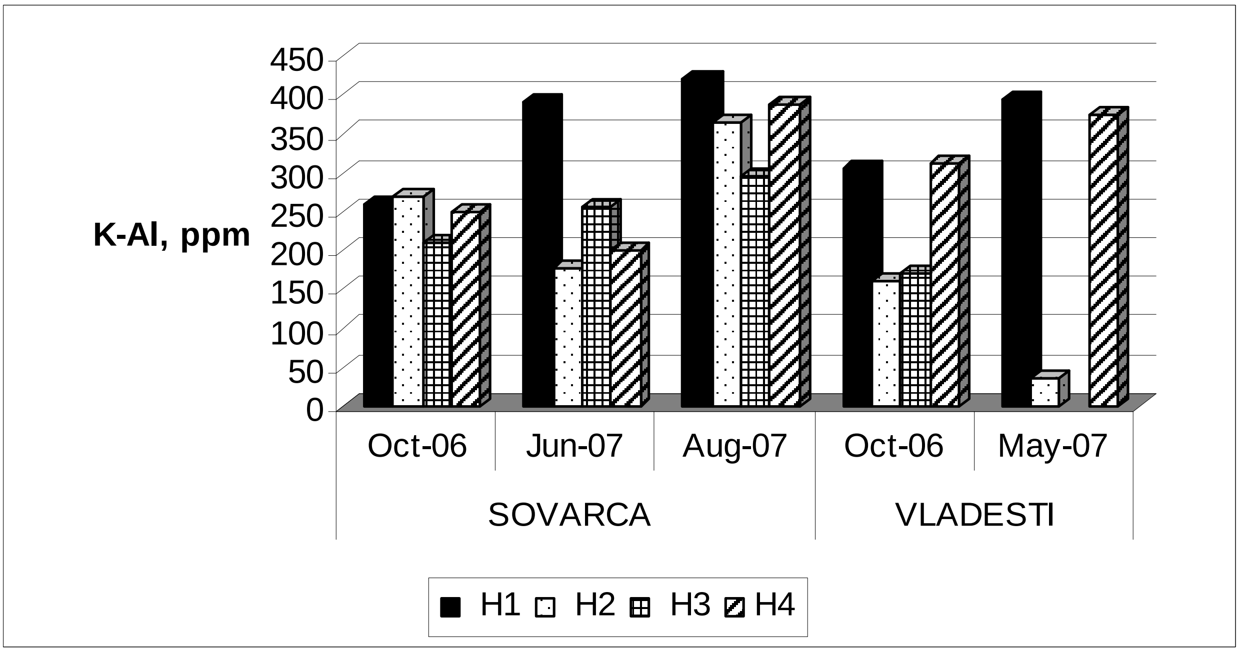

Figure 10: Values of potassium content (K_{-Al} ppm) of muds in fish ponds.

The Soil reaction As in water, the pH of the soil is also one of the critical factors affecting pond productivity. Soil pH influences the transformation of phosphorus into the available form of phosphorus and control the adsorption and release of essential nutrients at the soil water interface. Both for soil and water a slightly alkaline pH is considered favourable for fish pond.

The soil reaction (the pH) varies according to the nature of the pond bottom, of the assimilation and decomposition of organic matter as well as by rain, snow and high floods. Fish life is possible in waters with a pH that varies between 5 - 8.5, the optimum value being 7.2 - 7.8.

The silts analyzed in the fish farms have values between 7.68 and 7.97 which prove that these silts have an adequate pH for optimum fish breeding. When the pH values decrease, it is sure to have decomposition processes on the pond bottom.

To know the fertility status of pond soil, the soil reaction is compared with the following literature data:

Natural fertility status	Low	Medium	High
Soil reaction (u-pH)	< 5.5	5.5 - 6.5	6.6 - 7.5

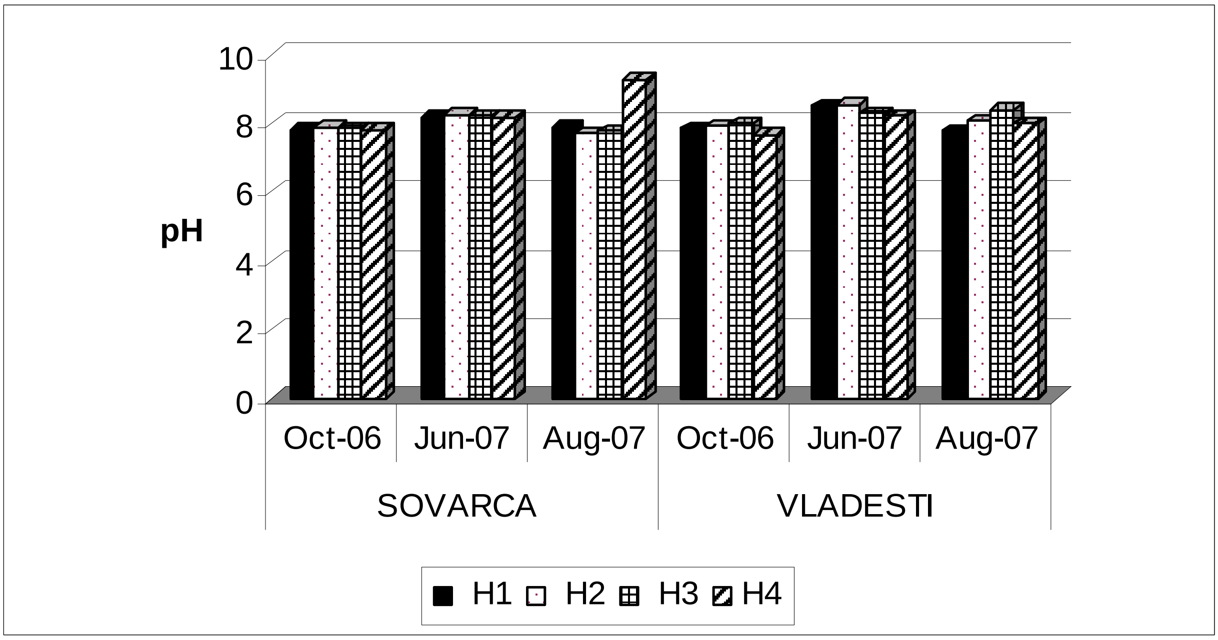

Figure 11: Values of pH of the muds of the fish ponds.

CONCLUSIONS

Water depth The water level in the fish ponds of Şovârca are maintained during the vegetative period close to technological requirements, compensating the losses from evaporation and infiltrations. In the fish farms of Vlădeşti the water level decreases during the vegetative period due to losses resulting from evaporation and infiltrations.

Water transparency Water transparency in the period under study, which corresponds to the vegetative period, of maximum development of phytoplancton, has small values, between 10 - 50 cm at Şovârca farm and 10 - 20 cm at Vlădeşti farm. The higher values of water transparency in SH4 are due to supplying water from the river to the pond destined for the winter period. In general, in the Şovârca farm, the process of water renewal in the fish ponds is more active as compared to the Vlădeşti farm in which the water supply during the vegetative period is more reduced or even null.

Mud depth Grosimea stratului de mal are valori mai mari cele doua balti naturale exploatate acum in scop piscicol, anume în SH1 are în jur de 40 cm şi în VH4 are în jur de 50 cm, acest lucru datorându-se vârstei mari a acestor ecosisteme naturale, a modului de evacuare a apei care nu se face în totalitate.

Humus content. The humus content of silts sampled from fish farm ponds often exceeded the maximum limit of 3.44 % that show a high fertility of muds with positive influences upon fish production. The booth, natural shallow lake from Şovârca (SH1) and from Vlădeşti (VH4) have a highest thickness of mud layer and a highest humus content due to the impossibility of draining up these natural lakes. The Şovârca three ponds have the similar average of humus as the natural shallow lake from Şovârca (SH1), but the Vlădeşti three ponds' humus content is lower than in the natural shallow lake from Vlădeşti.

The Nitrogen content The nitrogen from the samples shows a high level, the maximum limit of 0.05 ppm was exceeded by four times, in most of the ponds. Natural shallow lake from Şovârca (SH1) and from Vlădeşti (VH4) have a highest nitrogen content over 0.2 ppm in the summer period and above 0.2 ppm in the autumn period. The Şovârca three ponds have the similar average of nitrogen as the natural shadow lake from Şovârca (SH1). The Vlădeşti three ponds' nitrogen content is lower than in the natural shallow lake from Vlădeşti. The nitrogen average content in the Şovârca farm ponds is higher than in the Vlădeşti farm ponds.

The Phosphorus content The phosphorus content had a high level; over 56 % of the ponds had a phosphorus level over the maximum limit of 52.41 ppm. The analysis shows the presence of moderate quantities of phosphorus, especially in the Vlădeşti farm, which is explained by the absence of phosphate fertilizer input in the last years. There are significant differences between the natural shallow lake from Şovârca (SH1), which has a low amount of phosphorus and the natural shallow lake from Vlădeşti (VH4) which has a two or three times bigger amount of phosphorus in the summer period.

The Potassium content The potassium ions are not used to characterise the natural fertility status of pond's muds. In the ponds which was analysed the potassium level had a minimum value of 28 K-Al, ppm and a maximum value of 420 K-Al, ppm. The monthly average was between 161 K-Al, ppm (August 2007, Vlădeşti) and 367 K-Al, ppm (August 2007, Şovârca).

The Soil reaction The soil reaction had values between 7.68 and 7.97 which prove that these silts have an adequate pH for optimum fish breeding. Fish life is possible in waters with a pH that varies between 5 - 8.5, the optimum value being 7.2 - 7.8. When the pH values decrease, it is sure to have decomposition processes on the pond bottom.

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SURVEY ON THE ALIEN FRESHWATER FISH SPECIES ENTERED INTO ROMANIA'S FAUNA

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KEYWORDS: alien species, foreign species, freshwater fish, aquaculture.

ABSTRACT

In the present paper some aspects concerning the alien fish of the Romanian ichthyofauna are discussed. For each species we discussed in detail its occurrence in our country, briefly the species biology, importance and possible impact on native fish species. The author did not took into consideration numerous species, subspecies, varieties of exotic fishes kept in aquariums in ornamental purposes, including the goldfish - *Carassius auratus auratus* (Linnaeus, 1758) - which is kept sometimes in small artificial pools.

REZUMAT: Considerații asupra speciilor străine de pești dulcicoli pătrunse în fauna României.

În cadrul acestei lucrări am analizat speciile străine de pești dulcicoli din apele româneşti. La fiecare specie în parte am discutat despre momentul apariției sale în România şi despre modul cum a ajuns aici, date sumare de biologie, importanță şi impactul posibil asupra speciilor autohtone de pești. Nu am luat în considerare nenumăratele specii, subspecii, varietăți etc. de pești ornamentali care fac obiectul acvaristicii, incluzând aici chiar şi carasul auriu - *Carassius auratus auratus* (Linnaeus, 1758), specie care este crescută pe alocuri în mici bazine artificiale în aer liber.

RÉSUMÉ: Consideration sur les especes etrangeres de poisson douces entrées dans la faune de la Roumanie.

Dans ce travail j'ai analisse les especes etrangeres de poisson douces de l'eaux courantes de la Roumanie. A chaque espece j'a discute d'apres le moment de son apparition dans la Roumanie et aussi d'apres la modalite d'arriver ici, des resultates preliminaire de biologie, l'importance et le impact possible sur les especes autohtone des poisson. Je n'ai considere les nombreux especes, subespeces, varieties, etc. des poisson ornamentaux qui sont etudiees par la science aquaristique inclusivement le *Carassius auratus auratus* (Linnaeus, 1758), une espece qui est elevee la et la dans quelque faible bassin d'accumulation.

INTRODUCTION

Out of the vertebrates, fresh water fish species weigh the most in the admissions (be they on purpose or not) of foreign species. In most cases the foreign species of fish have a direct or indirect negative impact on the native species of fish (Holčik, 1991), as the invasive alien organisms have caused considerable unbalancing in the native eco-systems around the world. The admission of foreign species and the loss of the natural habitats are the main factors responsible for the disappearance of some species of living creatures in the past centuries (Strahm and Rietbergen, 2001). The aquatic eco-systems (especially those already disturbed by anthropic activities) seem to be particularly vulnerable to these invasions.

There are around 40 species of fish entered into Europe, however, many more have been transferred from various European countries into some others (Holčik, 1991). As for the penetration of the foreign species of fish in Romania, either naturally or with the help of human, we may consider three large periods: the first one dates back in the early times and lasts until 1956, when the first set of coregon embryoned eggs was brought in for acclimatization purposes, the second period begins in 1956 and lasts until 1989 and the third period begins in 1989 and stretches up to present days. The foreign species entered into Romania originate from North America, Asia (including the former Soviet Union) and Africa. We specify that we have used the scientific names up-dated according to Nalbant (2003).

MATERIALS AND METHODS

This work analyzes the foreign species of fresh water fish from Romanian waters, in separate groups, according to their originating continent. These species have entered the autochthonous ichthyo-fauna either naturally or introduced by human. In case of each and every species we discussed about the moment of its appearance in Romania and about how it has got there, as well as brief data on their biology, their importance and their impact upon the autochthonous species of fish. We have not taken into account the countless species, sub-species, varieties etc. of ornamental fish that are the subject-matter of the aquarium hobby, including here even the golden carp - *Carassius auratus auratus* (Linnaeus, 1758), a species that is raised here and now in small pools in the open air.

RESULTS AND DISCUSSIONS

The foreign freshwater fish species entered into Romania from North America

10 species from this continent are nowadays present in Romania as well. We describe them below in the order of their appearance in the Romanian waters.

Rhabdofario mykiss (Walbaum, 1792) - the rainbow trout - is a species of the Salmonidae family, which comes from the Western part of North America. It was introduced in Europe between 1880 and 1882 thanks to several shippings of embryoned eggs, and in Romania it was introduced by an anonymous person around 1885, from Hungary (Decei, 1972). Its systematic position is not clear yet (Nalbant, 2003). In the Romanian natural waters the rainbow trout is rare and it came down here by artificial introductions or by escaping arranged breeding enclosures, but it is the basic species of the Romanian salmoniculture. We have surprisingly noticed the preservation of a micro-population of rainbow trout in the Teplițe brook, which has a rich and constant flow rate on the Tisa terrace; this small river is only 2.5 km long, being situated near Sighetu Marmației chief town, where this species was colonized in 1930, but no introductions for this species have been made anymore, which leads us suppose that the rainbow trout naturally breeds here by itself (Ardelean and Béres, 2000).

Salvelinus fontinalis Mitchill, 1814 - the brook trout - is a salmonid originating from the Atlantic coast of North America, from the Eastern confluents of the Mississippi River, from the Hudson gulf and from Labrador. In Europe’s waters it was introduced in 1884 (Vasiliu, 1959), and in Romania it was brought in 1900 in Moldavia, in the Putna River and its confluents (Nemeş and Bănărescu, 1954). The brown trout can be found in Romania in some brooks in Moldavia, one in Banat and one in Transylvania, but the species was many times introduced in some other mountain waters, too, but by private people - that would be the reason why this has not been specified in the scientific literature. There is the fear that the brown trout could give sterile hybrids with the native trout (*Salmo trutta fario* Linnaeus, 1758) or that it could ruin this one's babies; however Nemeş and Bănărescu (1954) have not seen that on the field. *Salvelinus fontinalis* populates the most up stream part of the brooks, where the native trout does not live.

Ictalurus nebulosus (Le Sueur, 1819) - the brown bullhead - is a species of the Ictaluridae family, originating from the USA, more specifically from The Great Lakes, the Ohio River towards East up to Maine, towards South-West up to Texas, towards South-East up to Florida (Bănărescu, 1964). In Europe, brown bullhead was presented for the first time in 1880, at a fishing exhibition in Berlin, and 5 years later it was introduced as an ornamental fish in Germany, then in France, Belgium and Central Europe. It penetrated until former Yougoslavia and in the left confluents of the Tisa (Ziemiankowski, 1947). According to Vasiliu (1959), in Romania it can be found since 1908 in the Saint Ann Lake, where it was introduced. He penetrated naturally in 1934 in the Tisa and in its confluents such as Someş, the three Criş, Mureş, Bega, then Timiş, the Beregsău and Sat-Chinez moors, the Pețea brook near Oradea, Ineu, the low stream of the Danube, in Brăila. It subsequently arrived in the Cefa (Bihor) and Zaul de Câmpie ponds. Wilhelm (1980) makes a qualitative and quantitative analysis of the brown bullhead's food, drawing the conclusion that it is an euryphagous species, as the aquatic invertebrates (hirudineas, oligoquettes, insect larvae and crustaceans) were dominant in its food. The presence of the fish in its food is low, as they lack an economical value. Eggs miss almost completely from its food. As a conclusion, the opinions according to which the *I. nebulosus* would be an egg-and a fry fish destroyer are unjustified.

Lepomis gibbosus (Linnaeus, 1758) - the pumpkinseed sunfish - belongs to the Centrarchidae family, autochthonous from North America, in the upper basin of the Mississippi, the Great Lakes and the Atlantic Ocean basin from Saint Lawrence up to South Carolina (Bănărescu, 1964). It was imported in Europe first in France and Germany, at the end of the 19th century, as ornamental fish. From Germany it extended through the Rhine, Oder and Danube towards Eastern Europe. In Romania it was detected, in writing, by Buşniță (1929) for the first time, but Băcescu (1942) tells us that the species was seen in Romania ever since 1918 by the great Romanian naturalist Grigore Antipa. Since then it has spread out in all the moors of the region liable to being flooded and in the lower stream of the rivers that flow into the Danube and even in some lakes on the beach (Popovici, 1942). Now pumpkinseed sunfish is present in the great majority of the limnic eco-systems in Romania (except the mountain ones) and on the lower stream of the rivers, especially on the dead branches. In the piscicultural enclosures it is frequent, but in the large rivers and lakes it can be seen pretty rarely.

Isolated specimens have been recently found in the Danube Delta (Oțel et al., 1992 and 1993), unlike the half of the last century, when full waggons with *L. gibbosus* were transported to the market (P. M. Bănărescu, pers. comm.). So there was a populational explosion in the first years of the colonization of the Romanian waters, but afterwards their amount lowered and the species remained abundent in few places.

Spread out through hydrographical network sometimes thanks to the abundent rain water and floods, as well, especially thanks to the 1941 one (Băcescu, 1943), which help the dispersion in the Danube's everglade. In many lakes it was introduced at the same time with other species such as the silver carp, carp and other species that are interesting to fishing. Specimens of pumpkinseed sunfish have been seldom kept in the amateurs' aquariums and then released in nature in waters other than the ones from which they had been taken.

In Romania there are few studies on the food of the sun perch. Pepieta Spătaru (1967) analyzes the food spectrum of the sun perch in a few moors of the Danube's everglade that is liable to being flooded. It came out pretty clearly that *L. gibbosus* did not consume the food of the native fish species, especially that of those with an economic interest, and that the presence of the fish eggs in the food was not significant. In fact, those were its own eggs.

D. Bănăduc (unpublished data) analyzed the food of several species of fish, including *L. gibbosus*, concluding that pumpkinseed sunfish did not negatively influence native species from the viewpoint of the food spectrum.

Gambusia holbrooki (Agassiz, 1854) - the Eastern mosquitofish - belongs to the Poeciliidae family, which includes viviparous fish, most of the species being bred in aquariums. The natural realm of the gambusia is on the Eastern beach of the USA, from Florida to New Jersey. It is a low-sized fish: the males are short and have a long body - as long as 2.5-3.5 cm, and the females usually measure 4-5 cm as a total length, but we have noticed 7 cm females as well in the lake of Freedom Park in Bucharest. Cornelson (1940) provides us important data on the admission of this species in Europe and then in Romania. In Romania mosquito fishes were brought for the first time in 1927 from Hamburg by Professor Mezincescu; in 1929 a lot is brought in from Bulgaria and in 1930 from Italy. The fishes were introduced in the Pantelimon Lake and in other lakes in Bucharest, in various lakes and moors in Transylvania and in some lakes on the Black Sea littoral. Unfortunately, there are no additional references as to how the local populations have evolved from the moment of their introduction up to present days. At the same time, there are no data relative to either the possible adaptative morpho-physiological variations or to the possible modifications of the feeding ways or in the breeding biology.

Buffalo fishes are fishes of a North American origin from the genus *Ictiobus*, Catostomidae family. They were acclimatized in the former Soviet Union, from which three species were brought in Romania, too, under the form of embryoned eggs, in 1978 and 1980. The three species acclimatized in Romania are *Ictiobus cyprinellus* (Valenciennes, 1844), *Ictiobus niger* (Rafinesque, 1819) and *Ictiobus bubalus* (Rafinesque, 1818). They were all initially introduced in the Piscicultural Station in Nucet, Dâmbovița, from where they were distributed to other fish farms in Romania, as well. During the fourth breeding summer all the three species naturally reproduced in the waters of the Nucet ponds (Manea, 1985). In the past few years the buffalo fish amounts in the Romanian piscicultural stations significantly dropped. Nowadays in Nucet there is only the *Ictiobus niger* species left (I. Simionescu, pers. comm.).

Ictalurus punctatus (Rafinesque, 1818) - the channel catfish - is a species that belongs to the Ictaluridae family, originating from North America, from the area of the Great Lakes and from the basin of the Mississippi River, from where it spread out in the whole America, in Canada and in Mexico. It represents the main culture object in the Southern part of North America. In Europe it was introduced in 1972 in the South of the former Soviet Union, form where it was brought in Romania, too, in July 1978, a first lot of 50,000 embryoned eggs being let go in the Nucet ponds; the lot perished out of unclarified causes. In 1981 the second lot of larvae of this species was imported still from the former Soviet Union; the biological material survived and developed (Manea, 1985). Nowadays in Romania this species is still represented by only a few adult specimens that are living in the ponds of the Piscicultural Station in Nucet, Dâmbovița.

Poecilia reticulata Peters, 1859 - the guppy - is a small-sized species of the Poeciliidae family, bred in aquariums on a large scale all throughout the world. It lives in fresh and salmastre waters, at an approximately 20° C minimum temperature. In the natural waters of Romania it may only be found in the Pețea thermal lake belonging to 1 Mai Spas (Bihor). The guppy has not certainly got there by a natural method, as the fish must have been introduced by some local people passionate about the aquarium science. The author obtained a few grown-up guppy specimens in the summer of 1989. *Poecilia reticulata* in 1 Mai Spas may have a negative impact on a fish species that can only be found in this lake (it is about the thermal red-eye rudd - *Scardinius racovitzai* Müller, 1958), as it consumes its eggs. Research in this area for clarifying this issue is necessary.

Polyodon spathula (Walbaum, 1792) - the paddlefish - belongs to the Acipenseriformes order, the Polyodontidae family, which only includes two species: *Polyodon spathula*, which is the representative of this family in North America, and the latter representative, *Psephurus gladius* (Martens, 1862), is living in Asia, in the basin of the Yang-Tze large river. The natural realm of the paddlefish is in the hydrographical basin of the Mississippi River, with an approximately 2,000 km extension in the North-South. It lives in large rivers, in rivers and lakes. *P. spathula* was imported from the USA for the first time in 1974 into the former Soviet Union, where it was successfully bred and in 1984 its artificial breeding was performed, for which reproducers bred in ponds were used as a world first. The species was also imported on a reduced scale in Germany and Hungary in the ’80s of the last century. In 1993 the action of introducing *P. spathula* in China was carried out. After some quite difficult actions begun in 1988, the action of introducing the species in Romania was commenced by importing in 1992 a lot of 2,000 larvae from the USA. The lot arrived at the Nucet, Dâmbovița Piscicultural Station on May 8th, 1992. Since then new lots of larvae were imported every spring until 1999, all of them being brought and bred in Nucet (Vizitiu et al., 1997). Around 40 older specimens were also brought in 1992 from the Moldavia Republic to S. C. Acvares S. A. in Iaşi. In the spring of 2002 the successful artificial reproduction of the species took place in Nucet by using grown-up specimens from the first lot brought in Romania in 1992. The piscicultual material that came out was disseminated in several fish farms throughout the country and the results obtained at the breeding during summer I were good both as far as the average weight was concerned and as for the living standard. Few individuals of paddlefish were caught in some lakes in Argeş River basin by the anglers, 4-5 years ago.

Ictalurus melas (Rafinesque, 1820) - the black bullhead - is a species that belongs to the Ictaluridae family and which is spread out from the South of Canada to the North of Mexico. In the West of Europe it was introduced by the end of the 19th century and in the areas where it penetrated it gave birth to stunted and dense populations, which made this species unpopular. It was imported from Italy into some Hungarian fish farms, from where it penetrated into the Romanian waters as well, so that it was detected for the first time on the Ier Valley in 1997, and subsequently found in the Barcău River as well (Wilhelm, 1998). Its presence in the three Criş is possible, too. In 2005 a specimen of *I. melas* was fished for in the Danube, at kilometer 929. This was the first notification of the species in the Romanian sector of the Danube (Popa et al., 2006). Seeing the few items of information that exist in Romania, for the time being we do not know how *Ictalurus melas* could influence the native ichthyo-fauna.

The foreign freshwater fish species entered into Romania from Asia

13 species on this continent are now present in Romania, too. We present them below in the order of their appearance in the Romanian waters.

Cyprinus carpio Linnaeus, 1758 - the carp - penetrated in Europe thanks to the Romans, in a tight link with the spreading of Christianity. Alongside with the creation of the 12th-13th century monasteries, keeping the carp in ponds became a fundamental occupation, seeing that fish was an appreciated meal during fasting. In Romania the carp was the first species of fish, in its culture form, that was the subject-matter of acclimatization ever since 1300 (Manea, 1985) and it remained the basic species for the pisciculture practised in the hill and plateau areas until present days.

Carassius gibelio (Bloch, 1783) - the Prussian or silver carp - originates from the Amur basin. It lives however in the largest part of the Siberia, of Eastern Europe and partially in Central Europe, in the Sâr-Daria and Amu-Daria basins, too. It is not autochthonous, but introduced in these regions, but the period when the introduction took place cannot be mentioned (Bănărescu, 1964). In Romania it was brought in 1912 from Bassarabia and introduced in the Fundeni Lake (Pojoga, 1959). From here, in large waters, it passed in the Tătaru Lake and then in Dâmbovița, thus entering the Danube's area liable to being flooded. The strong flood of 1970 significantly contributed to the expansion of the silvery crucian in the Danube Delta (Oțel, 1977). At present this one is living in all categories of stagnant waters from the plains to the hill area, where it gradually replaced a related species, the *Carassius carassius* (the crucian carp) one; it does not quite thrive in the regions too invaded by the vegetation. It also lives in the plain rivers (in the region of the carp, occasionally in that of the dace, as well and in the one of the barbel, but in a pretty reduced number and solely in the areas with calm water. It is a frequent species in fish farms.

Coregonus lavaretus maraenoides Poljakow, 1874 and ***Coregonus albula ladogensis*** Pravdin, 1848, where they were imported in 1956 from the former Soviet Union under the form of embryoned eggs, which were distributed in the ponds of the Nucet and Tarcău piscicultural stations (Buşniță et al., 1957) and in some lakes in Romania, where they are the used for sporting fishing, but we do not have more concrete data on their present situation in Romania.

The **Chinese cyprinides** name includes the cyprinides species introduced in Romania in 1960 and 1962 from the Yang-Tze River in China and they were taken to the Nucet (Dâmbovița) and Cefa (Bihor) piscicultural stations for the aquaculture. Several species were brought in, however only 7 were acclimatized. These ones are: *Ctenopharyngodon idella* Cuvier and Valenciennes, 1848, *Hypophthalmichthys molitrix* Cuvier and Valenciennes, 1848, *Aristichthys nobilis* (Richardson, 1844), *Mylopharyngodon piceus* (Richardson, 1846), *Parabramis pekinensis* (Basilewsky, 1855), *Megalobrama terminalis* (Richardson, 1846) and a species incidentally brought in, namely *Pseudorasbora parva* (Temminck and Schlegel, 1846) (Manea, 1985). Out of these species, to the best of our knowledge, *P. pekinensis* and *M. terminalis* can no longer be found in Romania. It is likely that the *Hypophthalmichthys molitrix* and *Aristichthys nobilis* species reproduce naturally in the lower Danube (Bacalbaşa-Dobrovici, 2002) and *Ctenopharyngodon idella* (Giurcă, 1980), as well. *Mylopharyngodon piceus* is only preserved in fish farms, but in small amounts here, too.

Pseudorasbora parva (Temminck and Schlegel, 1846) - the topmouth gudgeon, is a small-sized (8.5-10.5 cm) bentophagous fish spread out in the entire Eastern Asia, from the Amur basin to the South of The People's Republic of China. The terra typica of this species is Nagasaki, Japan (Bănărescu, 1964). *P. parva* is a species with a high dispersion potential, which succeeded in spreading out in almost all the countries of Europe during the 45 years that passed from its admission into this continent. There were several centers in Europe, out of which the *P. parva* then spread out on almost the entire continent. The two major centers where Romania (from where the species naturally spread out in the whole Danube basin) and Albania (from where the species spread out in the Balkans, still naturally). In the countries of the former Yougoslavia the species penetrated from both centers; in Hungary, Slovakia and the Czech Republic the species penetrated both naturally, from Romania, and artificially, as it was brought straight from China, together with some other species of fish of an economical interest. In Poland and the Northern Bulgaria the species was seemingly brought from the Ukraine. The origin of the populations in Italy and France is unknown, but these populations probably come from the Danube basin. We assume that the species arrived in Denmark from Germany. We do not know how the species got on England's and Spain's territory, but it was most likely artificially introduced from a European country.

The considerable dispersion of this species in Romania was made by the introduction of the carp, of the silver carp etc. in various places. The species actively spread out through the hydrographical network, however the dispersion with the help of human played the most important role. In many cases the species was found for the first time in piscicultural basins and in their linking channels and only 1-2 years later in the adjacent rivers, too. The species also becomes abundent in some recreation lakes, where other species of a interest are introduced for amateur fishermen, such as the Kios Lake in Cluj-Napoca or the Youth Lake in Bucharest. Even the amateur or sporting fishermen contributed to the enlargement of the realm of this species in Romania. The topmouth gudgeon is used as a bait for the predator fish and we sometimes noticed that the specimens that were still alive at the end of the fishing party were simply thrown into the water, but usually into another than the one from which they had been collected.

We have noticed that *P. parva* was highly abundent in the piscicultural enclosures and in the natural areas only in some lakes and small hill- and plain- rivers. We also found this species in the sub-mountain region, in the Gurghiu River, but solely isolated specimens. In the larger rivers and even lakes it is present in small amounts. It feels comfortable in polluted areas, too, where few native species of fish survive (Gavriloaie and Chiş, 2006). Bănărescu (1993) states that the topmouth gudgeon has not yet caused the regression of any native species of fish.

Coregonus peled (Gmelin, 1789) was introduced in 1980 by D. Matei within the Podu Iloaiei Piscicultural Research and Production Station under the form of eggs in the mobile embryo phase, imported from the former Soviet Union. *C. peled* has only been bred in the ponds within the Podu Iloaiei P.R.P.S. (Matei and Manea, 1990) so far. We do not have any further data on this species.

Perccottus glenii (Dybowski, 1877) - the Amur sleeper - belongs to the Odontobutidae family, which is spread out in China, in the North-West of Korea, in the Amur basin and in Russia. In November 2005 a few juvenile specimens were collected from the Suceava River (Nalbant et al., 2004), which may have come from the Ukraine. In 2005 a grown-up *P. glenii* specimen was fished for in the Danube, at kilometer 929. This is the first sign of this species in the Romanian sector of the Danube (Popa et al., 2006). Seeing the scarce information that we possess, wo do not yet know how *P. glenii* could influence the native ichthyofauna.

The foreign freshwater fish species entered into Romania from Africa

There are two species of African catfishes that can now be found in Romania.

Clarias gariepinus (Burchell, 1842) - the North African catfish - is a species belonging to the Clariidae family, whose ditribution is, we could say, pan-African. The species can also be found in some areas of Asia Minor, such as Israel, Syria and the South of Turkey (Teugels, 1986). In 1974 it was introduced into the aquaculture, for the first time in Cyprus and then in the Czech Republic, in Slovakia, The Netherlands (Holčik, 1991), Hungary and probably in some other European countries. In Romania the species was imported in Oradea in 2002 by a private enterprising man. Exclusively babies are imported, which are bred for consumption.

Clarias ngamensis Castelnau, 1861 - the blunt-toothed African catfish (photo 1) is also a species belonging to the Clariidae family; in Africa it does not seem to be too abundent in a certain place, but it is quite common in some regions overwhelmed by vegetation, in permanent swamps and calm waters (Teugels, 1986). In November 2004 a dead specimen of *C. ngamensis* was collected from the lake of the Titan Park in Bucharest (Gavriloaie and Chişamera, 2005). This specimen can be seen preserved in the collections of the 'Grigore Antipa' Natural History Museum in Bucharest.

How the species got in the Romanian waters is not clear at this moment. It could be an isolated case, namely the specimen might have been released in the wild (being alive) from the aquarium of some amateur, but it more likely that this species was the subject-matter of a deliberate introduction action, in larger amounts, in several autochthonous aquatic eco-systems. To the best of our knowledge, the species has not been mentioned on the European continent till now.

Figure 1: The specimen of *Clarias ngamensis* Castelnau, 1861
collected from Titan Park (Bucharest) - photo by Gabriel Chişamera.

CONCLUSIONS

At present in Romania there are 27 foreign fish species, out of which 4 penetrated naturally in virtue of the hydrographical network, 22 species were deliberately or accidentally introduced by human, and as far as one species of African catfish (*Clarias ngamensis*) is concerned, we do not yet know how it has entered the Romanian waters, but we could assume that this is owed to human. Out of the 4 foreign species penetrated naturally, two reproduce in the natural waters (*Ictalurus nebulosus* and *Lepomis gibbosus*), and as for the other two (*Ictalurus melas* and *Perccottus glenii*) we do not have enough information so far because of the fact that they were spotted in the Romanian ichthyofauna a short time ago.

As far as the foreign species of fish that have been artificially introduced are concerned, 9 of them naturalized themselves, which means that they are already reproducing in the natural waters as well, without human's help, locally or on larger areas (*Cyprinus carpio, Rhabdofario mykiss, Carassius gibelio, Gambusia holbrooki, Ctenopharyngodon idella, Hypophthalmichthys molitrix, Aristichthys nobilis, Pseudorasbora parva, Poecilia reticulata*); 5 species only reproduce in piscicultural breeding enclosures, with the help of human (*Salvelinus fontinalis, Mylopharyngodon piceus, Ictiobus niger, Polyodon spathula* and *Clarias gariepinus*); as for the other 8 species of fish that have been artificially introduced, we do not have enough data on their way of reproducing (*Coregonus lavaretus maraenoides, Coregonus albula ladogensis, Ictalurus punctatus, Parabramis pekinensis, Megalobrama terminalis, Ictiobus cyprinellus*, *Ictiobus bubalus* and *Coregonus peled*) and out of these we do not know whether the last 5 species can or cannot still be found in Romania.

The real impact of the foreign fish species upon the native ichtyofauna is difficult to assess, as there are no research on the great majority of the eco-systems that existed before the penetration of the foreign species into them. For the time being we cannot surely allege that some native species have disappeared because of the foreign species of fish that have entered Romania. It is true that the *Carassius carasius* species has disappeared from most of the lakes where the silver carp penetrated, but thorough research studies are needed in order to see whether the silver carp is the only cause of the crucian carp's regression. In some parts of Europe *Leucaspius delineatus* species regressed or even disappeared from the regions where *Pseudorasbora parva* penetrated, but in Romania this was not thoroughly studied.

For the future it is necessary to limit the introduction of new species of fish into the Romanian aquatic eco-systems as much as possible and, in case of the ones already entered, we ought to limit their spreading out in new habitats.

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EFFECTS OF ANIONIC DETERGENT ON BLOOD FACTORS AND LIVER STRUCTURE OF *CYPRINUS CARPIO* LINNAEUS, 1758

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KEYWORDS: Anionic detergent, *Cyprinus carpio*, blood factors, liver tissue.

ABSTRACT

In this investigation, we studied the effects of anionic detergent on blood factors and liver morphology of *Cyprinus carpio*. In this study, 40 fish (10-12 cm and 35-40 gr) were put in one control group and four treatment groups in 150 - litres aquariums. The treatment groups contained 2, 4, 6 and 8 mg/l of anionic detergent respectively. After specimens were exposed to the detergent, blood was taken from the anal fin ventral area on days 1, 2, 3, 5 and 7. Part of the provided blood was stained by Gimsa and studied blood cells. To determine the blood glucose concentration, the enzymatic test of glucoseoxidase and spectrophotometer were applied. To determine the liver glycogen, the liver tissue was hydrolyzed, so that glycogen would shift into glucose. Then, the amount of the glucose and the glycogen of the liver were subsequently measured using the above enzymatic test. Part of the tissues in each treatments were the immediately fixed in Bouin solution. Then, to study the samples, 5 µ sections were made and stained by Hematoxylin-Eosin general staining method.

In the study of blood cells, some variation in the number and form of the cells were observed. So that as the amount of the detergent increased, the number of blood cells increase compared to the control group. Contrary to the control group most of RBC would deform from the natural shape in treatment groups. A relationship was found to be between an increase in the detergent and a decrease of glycogen and also an increase in the blood glucose using ANOVA method ($P<0.05$). In histological study of the liver, hypertrophy was clearly obvious in treatment specimens, so that hypertrophy would increase along with the dose increase of the detergent and in the highest dose; most of the liver cells had been damaged.

REZUMAT: Efectele detergentului anionic asupra factorilor sanguini şi a structurii ficatului la *Cyprinus carpio* Linnaeus, 1758.

În această investigație, am studiat efectele detergentului anionic asupra factorilor sanguini şi a morfologiei ficatului la *Cyprinus carpio*. În acest studiu, 40 de peşti (10 - 12 cm şi 35 - 40 g) au fost puşi într-un grup de control şi patru grupe de tratament în acvarii de 150 de litri. Apa grupelor de tratament au conținut 2, 4, 6 şi 8 mg/l de detergent anionic. După ce indivizii au fost expuşi la detergent, a fost perelevat sânge din zona înotătoarei ventrale în zilele 1, 2, 3, 5 şi 7. O parte a sângelui prelevat a fost colorat cu Gimsa pentru studiul celulelor sanguine. Pentru determinarea concentrației de glucoză din sânge, au fost utilizate testul enzimatic de oxidare a glocozei şi spectrofotometrul. Pentru determinarea glicogenului ficatului, țesuturile ficatului au fost hidrolizate, astfel încât glicogenul să se schimbe în glucoză. După aceea, cantitatea de glucoză şi de glicogen a ficatului au fost măsurate ulterior utilizându-se testul enzimatic amintit. Părți ale țesuturilor din fiecare tratament au fost fixate imediat în soluție Bouin. Apoi, pentru studiul probelor, au fost realizate secțiuni de 5 µ şi colorate prin metoda de colorare generală Hematoxylin-Eosin.

În studiul celulelor de sânge, a fost observată o anumită variație a numărului şi formei celulelor. Cu cât a crescut cantitatea de detergent cu atât a crescut numărul celulelor de sânge în comparaţie cu grupul de control. În mod contrar celulele de sânge din grupurile tratate în comparaţie cu grupul de control, s-au deformat de la forma naturală. A fost găsită o relaţie între creşterea detergentului şi descreşterea glicogenului şi a creşterii glucozei sanguine, utilizându-se metoda ANOVA (P<0.05). În studiul histologic al ficatului, hipertrofia a fost în mod clar evidentă la indivizii trataţi, aceasta crescând odată cu creşterea dozei de detergent iar în cazul celei mai mari doze; cele mai multe celule ale ficatului fiind afectate.

RÉSUMÉ: Les effets du détergent anionique sur les facteurs sanguins et sur la structure du foie chez *Cyprinus carpio* Linnaeus, 1758.

Dans cette investigation, nous avons étudié les effets du détergent anionique sur les facteurs sanguins et sur la morphologie du foie chez *Cyprinus carpio.* Pendant cette étude, 40 poissons (10 - 12 cm et 35 - 40 g) ont été repartis dans un groupe de contrôle et quatre groupes de traitement dans des aquariums de 150 litres. L'eau des groupes de traitement a contenu 2, 4, 6 et 8 mg/l de détergent anionique. Après l'exposition des individus au détergent, du sang a été prélevé de la région de la nageoire ventrale dans les jours 1, 2, 3, 5 et 7. Une partie du sang prélevé a été colorée à Gimsa pour l'étude des cellules sanguines. Afin de déterminer la concentration de glucose dans le sang on a utilisé le dosage enzymatique d'oxydation du glucose ainsi que le spectrophotomètre. Pour la détermination du glycogène hépatique les tissus du foie ont été hydrolysés, afin de changer le glycogène en glucose. En suite, la quantité de glucose et de glycogène hépatiques ont été mesurés par le dosage enzymatique mentionné plus haut. Des échantillons de tissus représentant chaque traitement ont été fixés immediatement avec la solution de Bouin. Ultérieurement, pour l'étude des échantillons, des sections de 5 µm ont été pratiquées et colorées par la méthode de coloration Hématoxyline-Eosine. Pendant l'étude des cellules sanguines une certaine variation du nombre et de la forme des cellules a été remarquée. Plus la quantité de détergent a été grande, plus le nombre des cellules sanguines a été accru par comparaison au groupe de contrôle. Par contre, les cellules sanguines des groupes traitées ont été déformées, comparées à la forme naturelle du groupe de contrôle. Une relation inversement proportionnelle entre la concentration du détergent et celle du glycogène, ainsi qu'une relation directement proportionnelle entre la concentration du détergent et celle du glucose dans le sang ont été obtenues par la méthode ANOVA (P<0.05).

L'hypertrophie du foie chez les individus traités a été mise en évidence clairement pendant l'analyse histologique du foie, cette hypertrophie étant plus accentuée pour des doses de détergent plus grandes et pour la dose la plus concentrée la plupart des cellules hépatiques étant affectées.

INTRODUCTION

The fate of many industrial, agricultural and urban pollutants is aquatic ecosystems. Aquatic ecosystems have different capacities of pollution absorption in different conditions. As long as quantity of pollution is overcapacity of ecosystem, self purification of ecosystem maybe changed or stopped or even has short and long term effect on aquatic animals (Chattopadhyay, 1991). Nektons, planktons, benthos as well as water quality are affected by water poisons. Detergents and petroleum are two important pollutants. Exhausting of these matter lead to some ecological impacts and water pollution (Rogerson and Berger, 1982; Rowe et al., 1983). Among pollutants, due to much consumption, detergents are more important and have harmful effect on aquatic animals. Petroleum matter together with anionic detergent will decrease dissolved oxygen and water hardness and increase free CO_2, alkalinity and phosphate. A concentration of 0.4-40 mg/l of Detergent matter had poisoning effect on tilapia.

What's more, detergent in low concentration caused reduced growth, changing in feeding behavior and increased absorption of other pollutant matters (Chattopadhyay, 1984).

Aquatic ecosystem pollution cause histological deformation in fishes; evident at the fishes in pollutant area with histological changes after examination (freshwater fishes standard method, Roncarati and Melotti, 2006). Detergents in high concentration cause high lesion tissue (gill, kidney, liver) in aquatic animals especially fishes. Gill and kidney are important organs for regulate of body electrolytes, also kidney is a blood maker organ. Lesion of this two organs cause blood change in fishes (Abel, 1974).

In this study we examine effect of anionic detergent matter on blood factors and liver structure of common carp. This is so important, because every year many anionic and cationic detergents are excess to urban and industrial sewage, then this sewage without infiltration exhaust to river and lacks and cause high killing of living organism in this water.

MATERIALS AND METHODS

In this study we selected 40 common carp (*Cyprinus carpio*) with the length of 10-12 cm and weight of 35-40 gram in 4 treatments and distributed in 150 litter aquarium (plus one treatment for control). Treatments groups had respectively 2-4-6-8 mg/l detergent. Physical parameter was measured daily during the experiment. Water temperature, water hardness and dissolved oxygen were 23-24 °C, 196 mg/l and 7.5-8 mg/l, respectively. For examination the effect of pollutant, in days 1-2-3-5-7, we prepared blood from caudal vein and dissected out the liver tissue (for histological study and determination of liver glycogen). For examination the blood globules, we smeared blood and fixed with methyl alcohol, then coloration the slides with Gimsa method and observed with light microscope. Extraction of serum plasma was done with centrifuge 650 per 10 min (Trenzado et al., 2006). We measured glucose with enzyme glucose oxidize method and spectrophotometer in 650 nm. Glycogen of liver was examined with enzyme glucose oxidize method (Ginsburg, 1984; Trenzado et al., 2006).

For examination of tissue toxicology, liver specimen set in Bouin solution for 24 h and carried out to 70 % alcohol (Adams and Bonami, 1991; Luna, 1986), fixed specimens prepared with Shandon Citadel-1000 machine and sliced into 4-5 µm with microtome (Lightner, 1996) and coloration with Hematoxylin-Eosin method and then observed with light microscope (Bell and Lightner, 1988). Statistical analysis carried out with SPSS software, comparing of means was done with variance analysis testes.

RESULTS

The more concentration of detergent, the more amount of blood glucose (Fig. 1) but amount of liver glycogen had decreased (Fig. 2) and coefficient correlation between blood glucose and liver glycogen was invert 96 % ($P<0.000$, $R = 0.96$, Fig. 3).

Liver structure and blood cells change

In the first treatment comparison with the control group, we saw locality necrosis in 2-3 % of liver hepatocyte (Fig. 4-6) as well as pathological changes in 10 % of red globules containing in slides of first treatment fishes. What's more, membrane of red globules was intact but in white globules some black spot was observed (Fig. 7). In second treatment nearly 10-15 % of liver hepatocytes locality necrosis was observed and cynozoids area was stimulated (Fig. 8). Some black spots near the membrane were found but no lymphocyte and monocyte structural alteration were present (Fig. 9).

In third treatment, 30-45 % of liver hepatocytes had necrosis and red globules, which started to degeneration, identified in this region, and central vein was damaged and cytozoids area was not detected (Fig. 10). Membrane of damaged red and white globule was started to hemolyzed (Fig. 11).

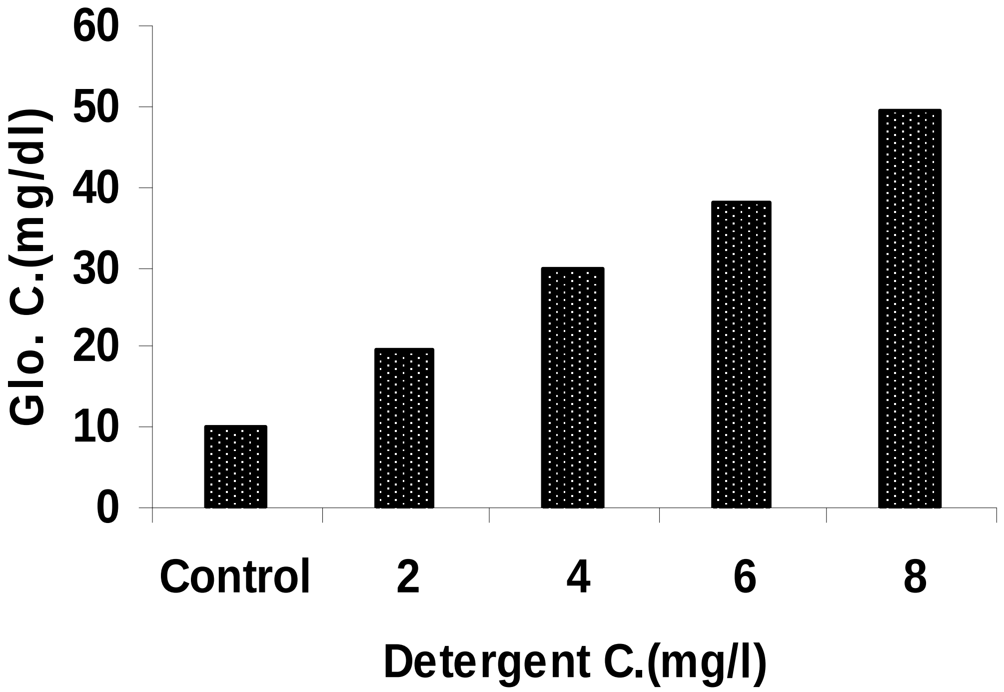

Figure 1: Effect of detergent
on blood glucose.

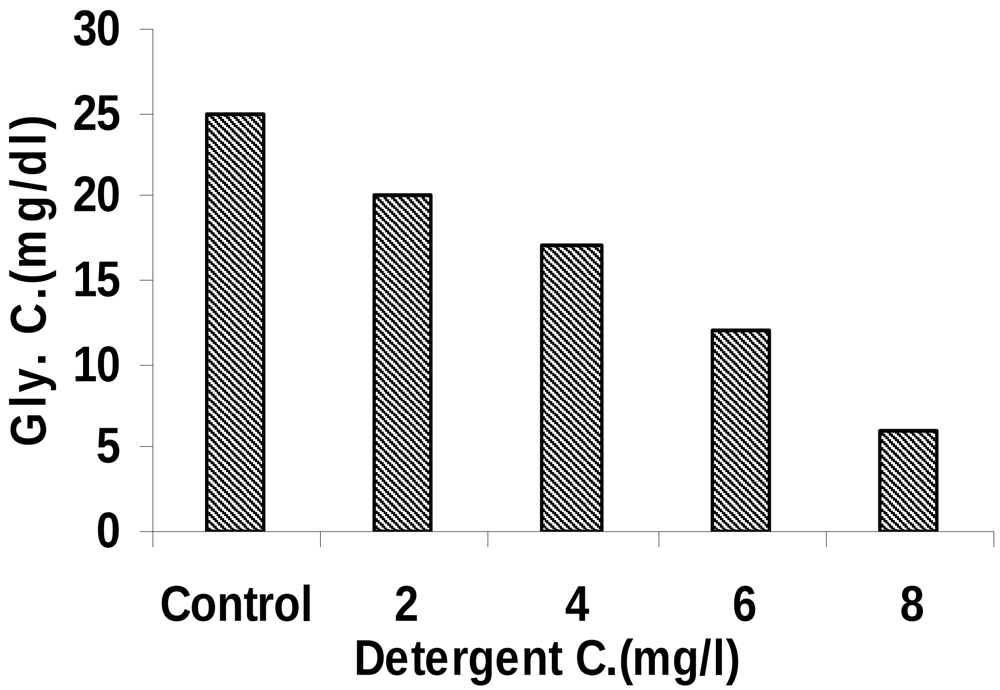

Figure 2: Effect of detergent
on liver glycogen.

In fourth treatment nearly 50-60 % of liver hepatocytes had necrosis and cytoplasms of cells were spotted. Due to damage of hepatocytes, we didn't saw cynozoeids and just a few red globules were observed (Fig. 12). Red globules membrane was totally damaged. It was expected with the hemolyze action in that region. Membrane of white globule was also damaged. Nucleus of both white and red globule were induced, darkened and picosise. In some samples, nucleuses were sectional and did not stain in coloration and were to become invisible (Fig. 13).

DISCUSSIONS

Discharging of different pollutant to aquatic ecosystems is a stressor for organisms and response of organisms to these stressors is behavioral, physical and chemical.

In this study while fishes were affected by different concentration of detergent, amount of blood glucose was increased and this increase along with decrease of liver glycogen are endocrinal response (adrenaline and cortisol) of fish to stressors (Lwaman et al., 2004). Scientists known that all pollutant has important effect on amount of liver glycogen and muscle and cause increased concentration of blood plasma (Ajit, 1986). High concentration of detergent caused tissue damage (liver, gill and kidney) in aquatic animals especially in fishes (Abel, 1974).

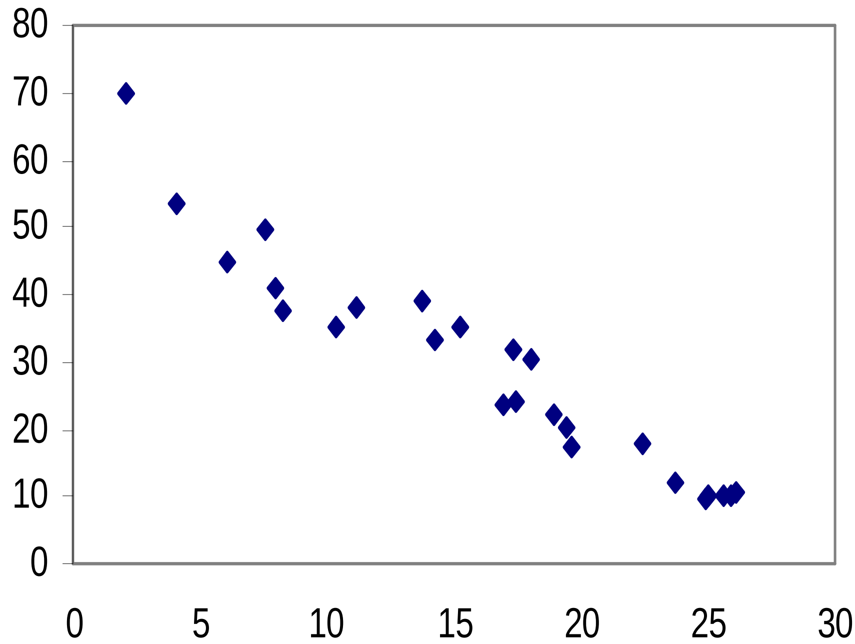

Figure 3: Coefficient correlation between blood glucose and liver glycogen.

When carps affected by 5 ppm of high concentration phenol, could live until 96 h, but with increase concentration of phenol, amount of GOT-GPT-LDH in blood plasma will be increased that is signal of high damaging of liver tissue (Nemcsok and Benedeczky, 1990). Gill tissue of rainbow trout affected by different concentration of ammonia will have high necrosis (Matthiessen and Robets, 1982). Ammonia solution as a pollutant matter with concentration upper than 5 mg/l in stagnant water could damage liver and gill tissue and even cause decrease of liver glycogen (Geoffey, 1976), also in this study we detected damage of liver and gill tissue that confirm result of other studies.

The qquatic ecosystem pollutions are along with fish's individuals pathological change therefore, if fishes are exposed, histological examination could be an indicative way of diagnose of pollution in environment (Roncarati and Melotti, 2006).

The results of this study showed that when common carp expose to pollution, high pathological changes could appear in liver tissue and blood that confirm effect of pollutant on body tissue of common carp.

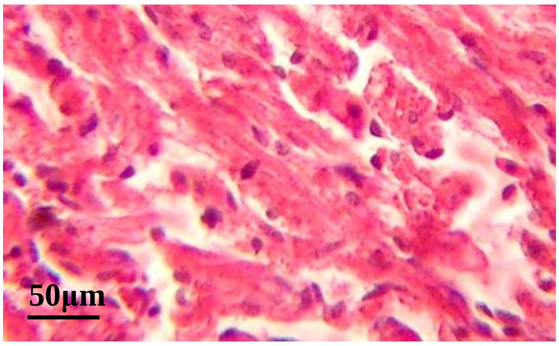

Fig. 4: Liver tissue segment (control specimen)

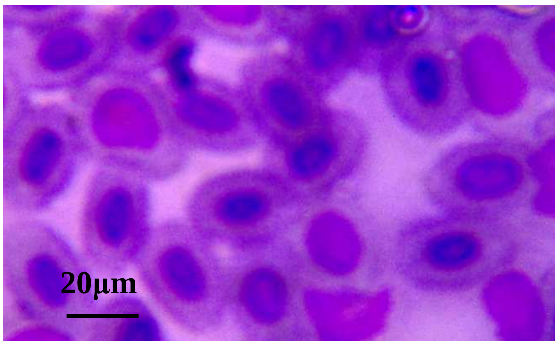

Fig. 5: Blood Spread (control specimen)

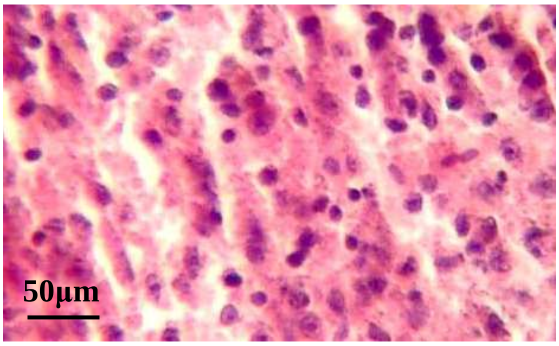

Fig. 6: Liver tissue segment (2 mg/l detergent)

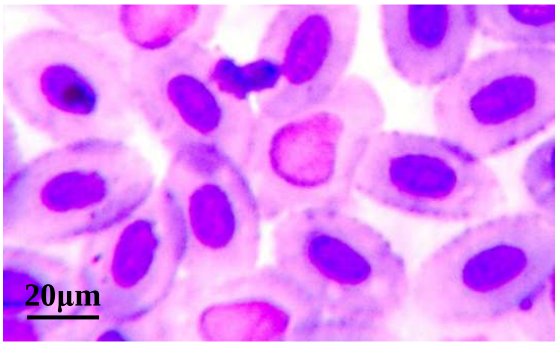

Fig. 7: Blood Spread (2 mg/l detergent)

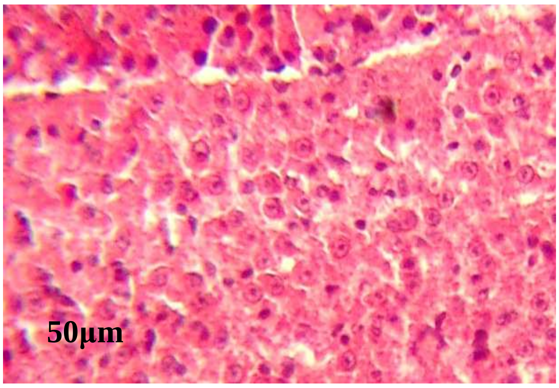

Fig. 8: Liver tissue segment (4 mg/l detergent)

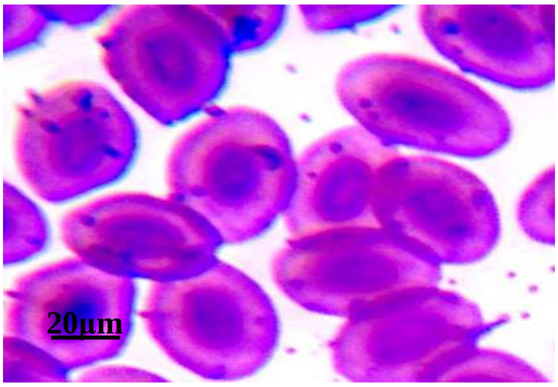

Fig. 9: Blood Spread (4 mg/l detergent)

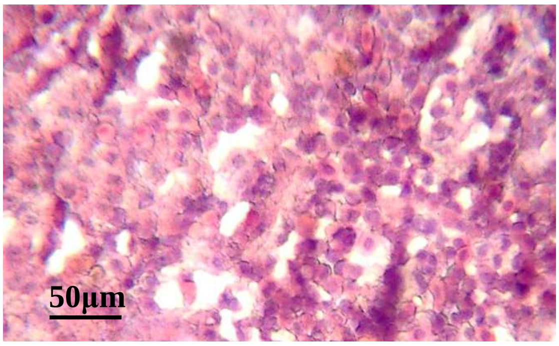

Fig. 10: Liver tissue (6 mg/l detergent).

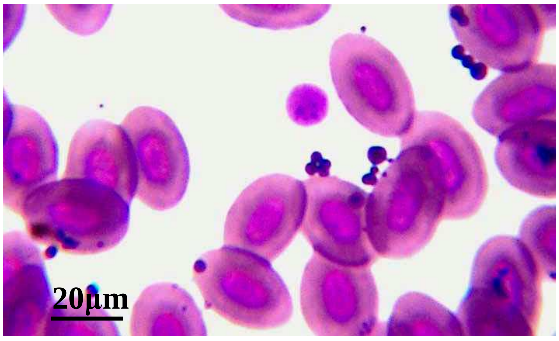

Fig. 11: Blood Spread (6 mg/l detergent).

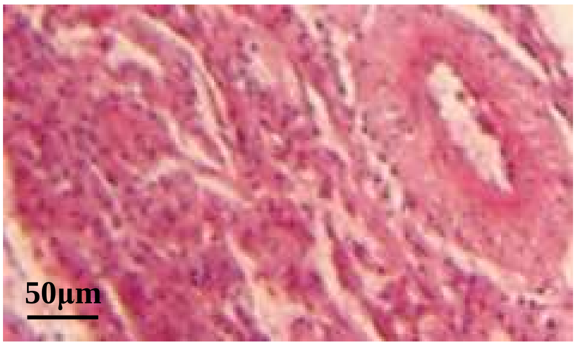

Fig. 12: Liver tissue segment (8 mg/l detergent)

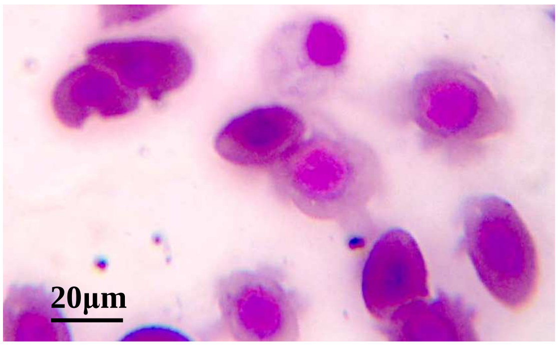

Fig. 13: Blood Spread (8 mg/l detergent).

Increase in pollution concentration; result in necrosis of more than 50 % of liver hepatocyte. Low concentration of pollution appeared black spot in red globule. Increase of pollution concentration result in higher density of black spot as well as hemolyze in red globule in higher concentration (8 mg/l).

The eventually result of this study show that existing of pollutant in aquatic ecosystem is harmful for aquatic animals and lead in locality damage of body tissue.

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THE ROLE OF THE DECREASE OF WATER POLLUTION ON THE FISH FAUNA OF THE HUNGARIAN SECTION OF RIVER SAJÒ

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KEYWORDS: oxygen demand, dissolved oxygen, returned species, natural values.

ABSTRACT

River Sajó/Slaná taking its source in Slovakia is a right tributary of Tisza River. Wide-scale industrialization took place back in the 1950s in the valley of the river and as a result, the Sajó River became one of the most polluted water-courses in Hungary by the mid 70s. In the 1990s, however, with the outdated industrial production gone, the situation improved significantly. The rating of the water classified as V beforehand was changed to classes II-III.

The improvement of water quality had a good impact on the fish fauna as well. Compared to the 26 species seen between 1982 and 1988, 39 species were detected between 2003 and 2007. Out of these species 4 proved to be new regarding the Sajó River: *Vimba vimba, Gymnocephalus baloni, Ameiurus melas, Proterorhinus marmoratus.*

As a result of improving water quality 15 species - which had been observed earlier but disappeared in the 1980s - reappeared in the river: *Anguilla anguilla, Aspius aspius, Scardinius erythrophthalmus, Barbus petenyi, Tinca tinca, Chondrostoma nasus, Carassius carassius, Barbatula barbatula, Silurus glanis, Lota lota, Perca fluviatilis, Gymnocephalus cernuus, G. schraetser, Zingel zingel, Z. streber.*

To date 48 species were found in the Hungarian part of Sajó since 1992. Due to our estimates, the density of fish has doubled or three-fold. Our experience shows that in water-courses where the pollution drops to a sufficient level, the fish fauna is able to regenerate during the span of one - one and a half decade without any main intervention, provided that the possibility of re-population is provided by the connected waters.

REZUMAT: Rolul scăderii poluării apei asupra ihtifaunei sectorului ungar a râului Sjaó.

Râul Sajó/Slaná izvorăşte din Slovacia şi este afluent de dreapta al râului Tisa. O industrializare la scară largă a avut loc în anii 1950 în valea râului şi ca rezultat râul Sajó a devenit unul dintre cele mai poluate cursuride apă din Ungaria la mijlocul anilor 170. În anii 90, datorită reducerii impactului industriei, situația sa înbunătățit semnificativ. Clasificarea calității apei a fost V schimbându-se ulteriorîn II-III.

Îmbunătățirea calității apei a avut un impact de preferat şi asupra ihtiofaunei. În comparație cu cele 26 de specii observate între anii 1982 şi 1988, 39 de specii au fost identifite în perioada 2003 şi 2007. Patru specii sunt specii noi pentru râul Sajó: *Vimba vimba, Gymnocephalus baloni, Ameiurus melas, Proterorhinus marmoratus.*

Ca rezultat a îmbunătățirii calității apei 15 specii - care au fost observate înainte dar au dispărut în anii 80 au reapărut către finalul acestei perioade, de exemplu *Anguilla anguilla, Aspius aspius, Scardinius erythrophthalmus, Barbus peloponnesius petenyi, Tinca tinca, Chondrostoma nasus, Carassius carassius, Barbatula barbatula, Silurus glanis, Lota lota, Perca fluviatilis, Gymnocephalus cernuus, G. schraetser, Zingel zingel, Z. streber.*

Până în prezent 48 de specii au fost găsite în sectorul ungar al râului Sajó din 1992. Conform estimărilor noastre, densitatea peştilor sa dublat sau triplat. Experiența ne arată că în râurile unde poluarea scade suficient, ihtiofauna se poate regenera într-o decadă sau o decadă şi jumătate fără nici o intervenție, aceasta realizându-se prin repopulări naturale din apele conexe.

ZUSAMMENFASSUNG: Der Einfluss der Abnahme der Wasserverschmutzung auf die Fischfauna im ungarischen Teil des Sajó.

Der Sajó/Slaná entspringt in der Slowakei und ist ein rechter Zufluss des Tisza. Während der 1950er Jahre wurde das Flusstal flächendeckend industrialisiert, weshalb der Sajó Mitte der 70er Jahre zu einem der verschmutztesten Gewässer Ungarns wurde. In den 1990er Jahren verbesserte sich die Situation durch das Verschwinden der veralteten Industrieproduktion erheblich. Die Bewertung des Gewässers änderte sich von vorher Klasse V auf II-III.

Die Verbesserung der Wasserqualität hatte auch positiven Einfluss auf die Fischfauna. Wurden zwischen 1982 und 1988 26 Arten gezählt, so wurden 39 Arten von 2003 bis 2007 entdeckt. Vier dieser Arten sind nachweislich neu im Sajó: *Vimba vimba*, *Gymnocephalus baloni*, *Ameiurus melas*, *Proterorhinus marmoratus*.

15 Arten traten als Ergebnis der Wasserqualitätsverbesserung wieder auf, welche in den 1980er Jahren verschwanden: *Anguilla anguilla*, *Aspius aspius*, *Scardinius erythrophthalmus*, *Barbus petenyi*, *Tinca tinca*, *Chondrostoma nasus*, *Carassius carassius*, *Barbatula barbatula*, *Silurus glanis*, *Lota lota*, *Perca fluviatilis*, *Gymnocephalus cernuus*, *G. schraetser*, *Zingel zingel*, *Z. streber*.

Bis heute wurden seit 1992 insgesamt 48 Arten im ungarischen Teil des Sajó gefunden. Die Fischdichte hat sich unseren Schätzungen nach verdoppelt bzw. verdreifacht. Unsere Erfahrungen zeigen, dass in Gewässern, wo die Verschmutzung auf ein hinreichendes Niveau sinkt, die Fischfauna im Stande ist, sich ohne bedeutenden Einfluss innerhalb einer Zeitspanne von ein bis eineinhalb Jahrzehnten zu regenerieren, sofern die Möglichkeit der Wiederbesiedlung von angebundenen Gewässern gegeben ist.

INTRODUCTION

The Sajó/Slaná River - which takes its source in the Szlovák Érc-hegység Sklovak Ore Mountains) 1220 m above the sea level - is the tributary of the Tisza River on the right (Fig. 1).

Its total length is 229 km, out of which 125 kilometers are situated on Hungarian territory. Its medium water discharge is 22 and 66 m^3 per second at the country border and the mouth of the river respectively. The water bed is composed mainly of pebbles from the country border to the mouth of the Hernád/Hornád River, whereas at the lower sections it is predominantly sandy or muddy in some places. The width of the water is around 40 - 60 (20 - 80) meters, whilst its depth fluctuates between 1-3 meters. The average water bed fall is 0.2 - 0.5 m/km, and the water speed is approximately 2 - 5 km/h.

In the second half of the 20^{th} century overwhelming industrialization and urbanization took place in the river valley - both on Hungarian and Slovak territories - during which the protection of environment was neglected. As a result, by 1975 the Sajó River dropped to the last place in terms of oxygen balance and industrial contamination in the Hungarian water system of the Tisza River.

The early 90s however brought an enormous change. The majority of obsolete big industrial plants wound their operation or reduced their production meaning that pollution dropped to the fraction of the previous level.

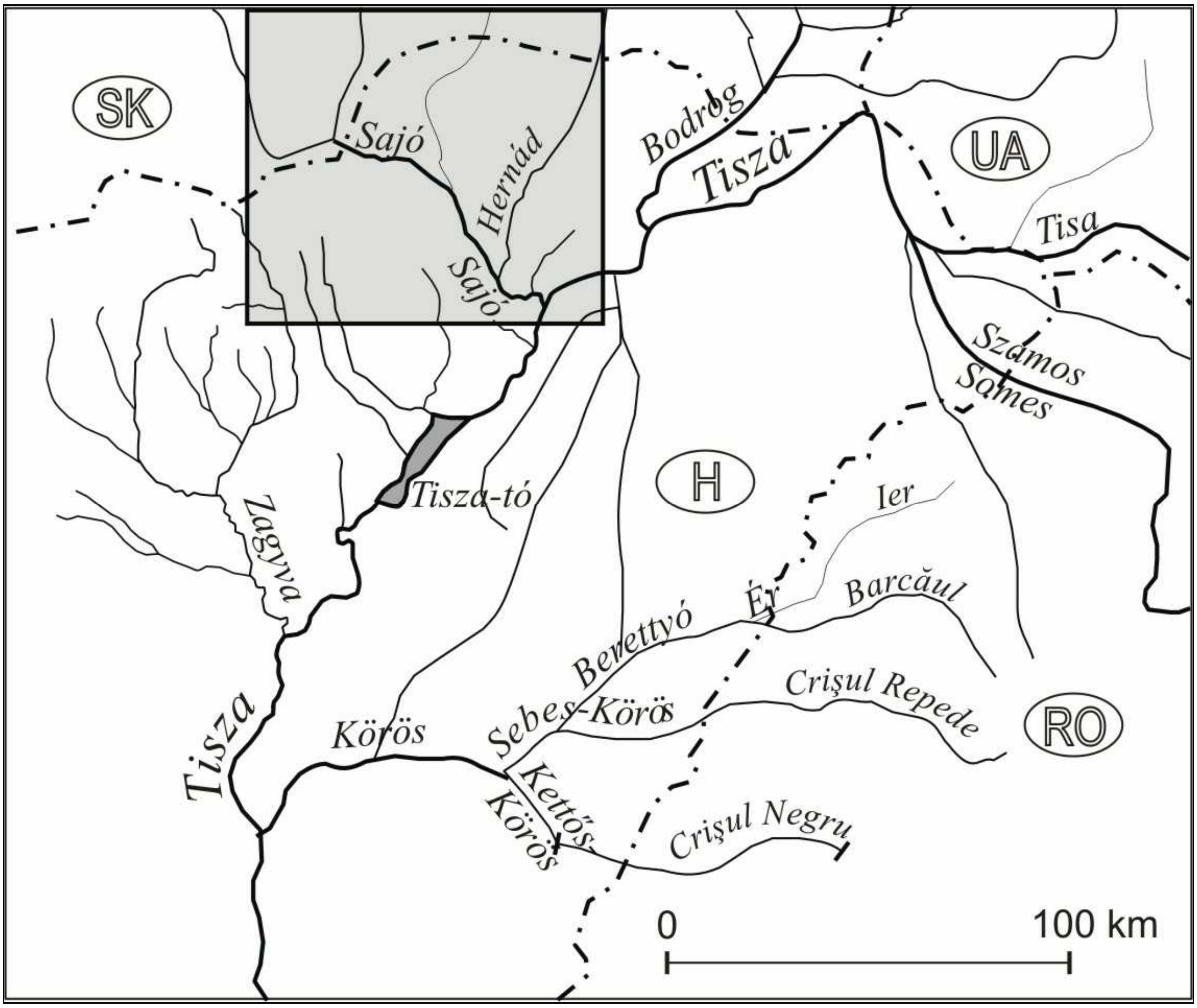

Figure 1: The Sajó, a tributary of Tisza River.

The purification of the river is well reflected by the change in chemical oxygen demand, which is an important indicator of the organic matter content of water (Fig. 2).

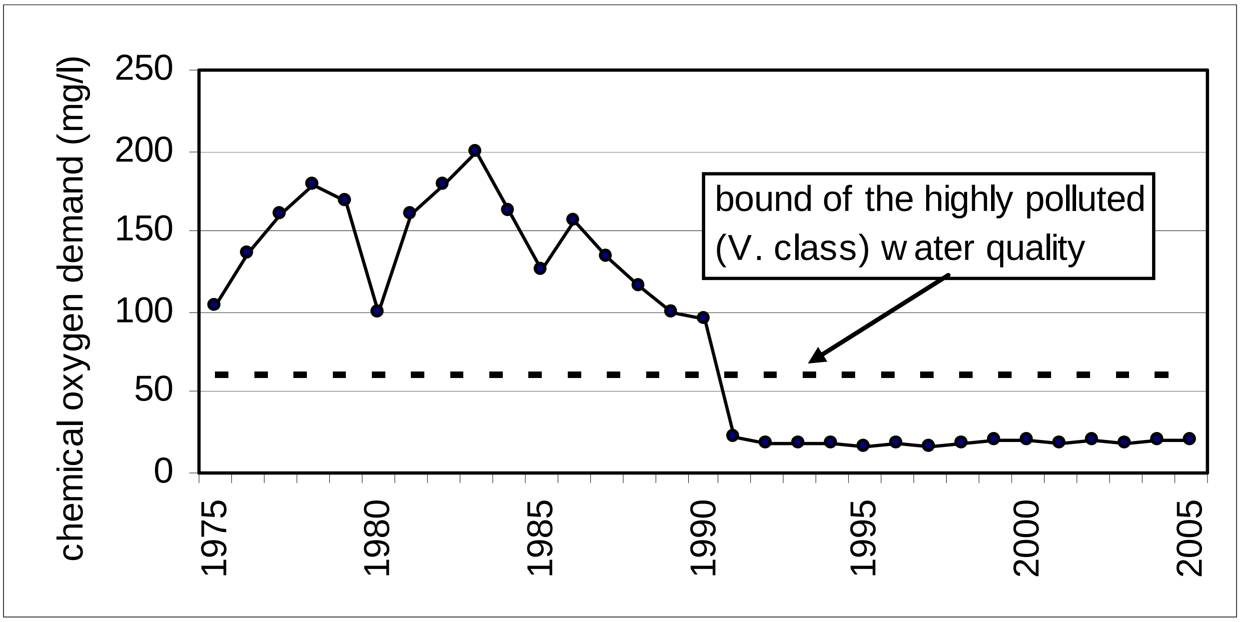

Figure 2: Changes of the values of chemical oxygen demand (COD_d) in Sajó River (1975 - 2005).

Similarly to the organic matter content, the ammonium ion concentration has also fallen to the tenth of the previous values (Fig. 3).

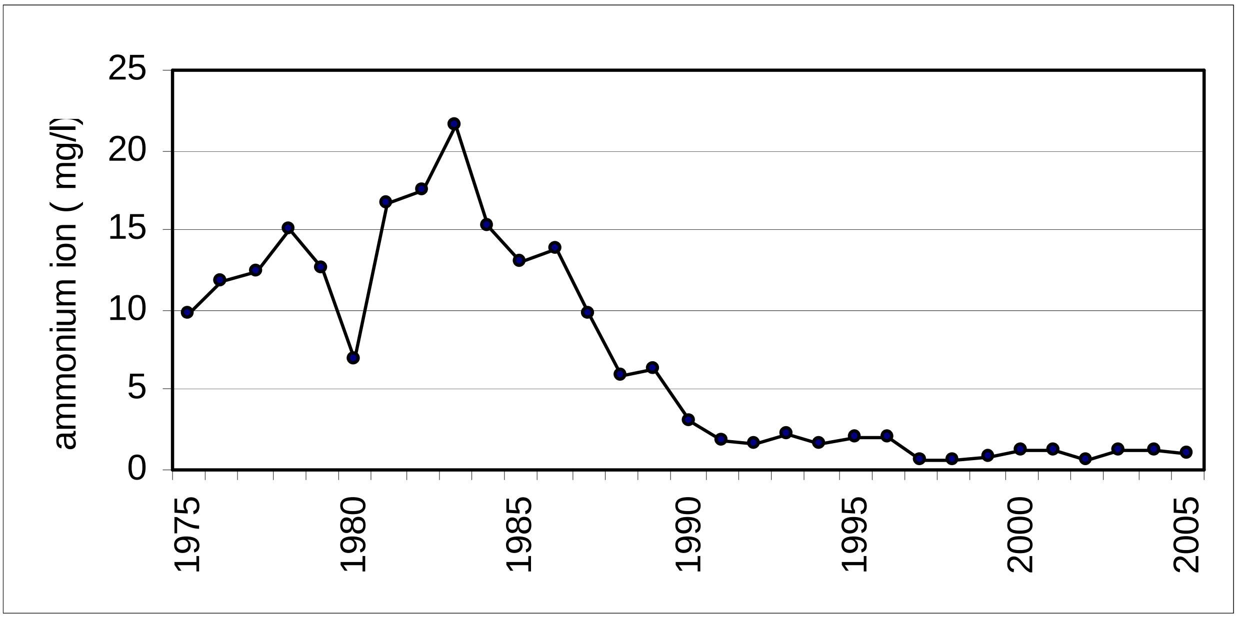

Figure 3: Change of the ammonium ion concentration in the Sajó River (from 1975 - 2005.

As a consequence of reduced organic and non-organic pollution the dissolved oxygen concentration has doubled (Fig. 4).

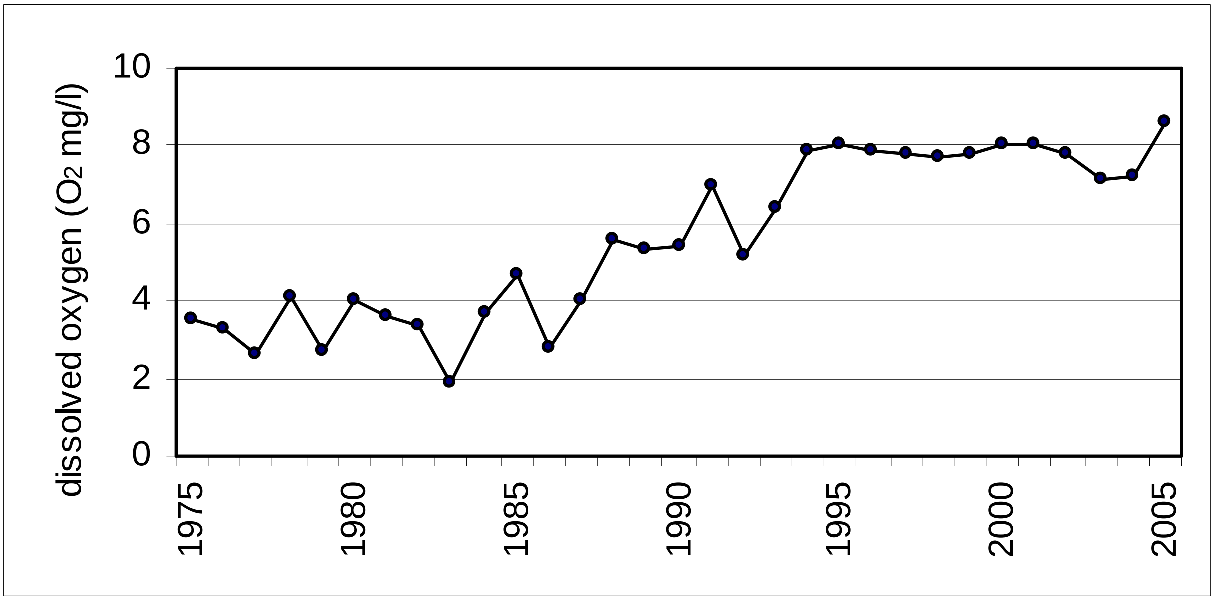

Figure 4: Change of the dissolved oxygen concentration. in the Sajó River from (1975-2005).

Although the water of River Sajó is still not deemed to be in high ecological status, the change in water quality is quite conspicuous. As a result, the water rated as class V previously has improved to class II - III, i. e. being of good-moderate quality.

MATERIALS AND METHODS

The authors carried out faunistical data collection at 20 sites of the Hungarian section of Sajó between 12th October, 2003 and 14th July, 2007 (Fig 5).

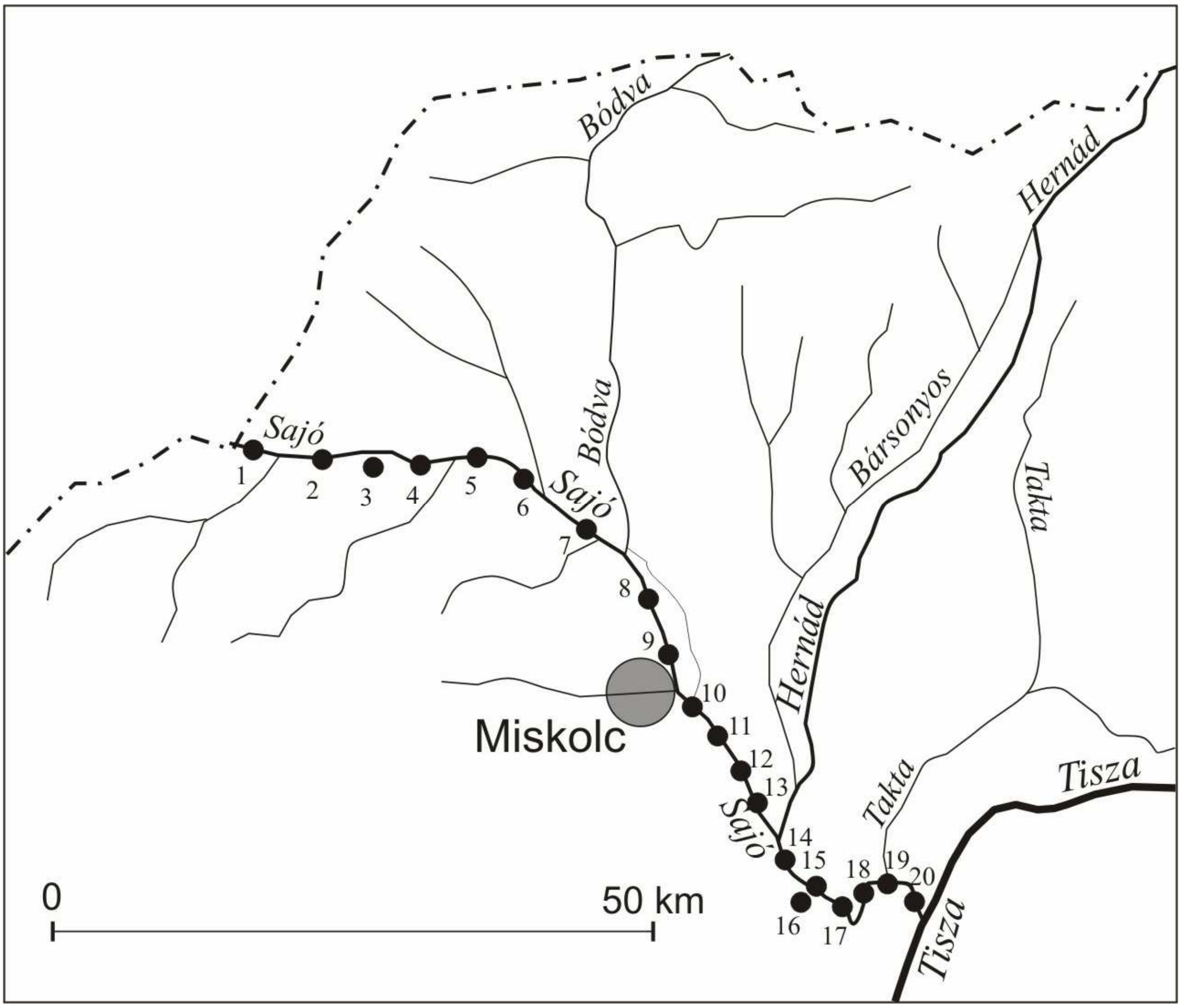

Figure 5: Map of the Hungarian section of the River Sajó with locality Code of locality: 1 - Sajópüspöki, 2 - Putnok, 3 - Sajóvelezd, stagnant water on the flood-plain, 4 - Vadna, 5 -Sajókaza, 6 - Kazincbarcika, 7 - Sajószentpéter, 8 - Szirmabesenyő, 9 - Miskolc, 10 - Felsőzsolca, 11 - Alsózsolca, 12 - Sajópetri, 13 - Ónod, 14 - Köröm, 15 - Nagycsécs, 16 - Nagycsécs stagnant water on the flood-plain, 17 - Kiscsécs, 18 - Sajóörös, 19 - Kesznyéten, 20 - Tiszaújváros.

In the majority of cases (on 26 occasions) a small seine net of size 3 x 2 m with a mesh size 6 mm and being fixed to a pole on both ends was used to collect fish. In addition to it, on 7 occasions (and at 7 sites including: Sajópüspöki, Sajókaza, Sajószentpéter, Miskolc, Felsőzsolca, Alsózsolca, Tiszaújváros) an aggregate-operated electric fishing equipment was also used. The fish specimens caught were released on the spot after identification.

RESULTS

In the course of data collection we investigated in all 9812 specimens of altogether 39 fish species.

Out of the 39 species 34 were caught from the main bed of the River Sajó, whereas additional 5 species were identified in two stagnant waters of the floodplain.

Considering the taxonomical aspect the observed species represent 10 families.

Cyprinidae (23 species)

Rutilus rutilis (Linnaeus, 1758)

Scardinius erythrophthalmus (Linnaeus, 1758)

Leuciscus leuciscus (Linnaeus, 1758)

Leuciscus cephalus (Linnaeus, 1758)

Leuciscus idus (Linnaeus, 1758)

Aspius aspius (Linnaeus, 1758)

Alburnus alburnus (Linnaeus, 1758)

Alburnoides bipunctatus (Bloch, 1782)

Abramis bjoerkna (Linnaeus, 1758)

Abramis brama (Linnaeus, 1758)

Abramis sapa (Pallas, 1814)

Vimba vimba (Linnaeus, 1758)

Barbus barbus (Linnaeus, 1758)

Barbus peloponnesius petenyi Heckel, 1852

Gobio gobio (Linnaeus, 1758)

Gobio albipinnatus Lukash, 1933

Gobio kessleri Dybowski, 1862

Pseudorasbora parva Temminck and Schlegel, 1842

Chondrostoma nasus (Linnaeus, 1758)

Rhodeus sericeus (Pallas, 1776)

Carassius carassius (Linnaeus, 1758)

Carassius gibelio (Bloch, 1872)

Cyprinus carpio Linnaeus, 1758

Cobitidae 2 species

Cobitis elongatoides Băcescu and Maier, 1969

Sabanejewia aurata (Filippi, 1863)

Balitoridae 1 species

Barbatula barbatula (Linnaeus, 1758)

Ictaluridae 1 species

Ameiurus melas (Rafinesque, 1820)

Siluridae 1 species

Silurus glanis (Linnaeus, 1758)

Esocidae 1 species

Esox lucius Linnaeus, 1758

Gadidae 1 species

Lota lota (Linnaeus, 1758)

Centrarchidae 1 species

Lepomis gibbosus (Linnaeus, 1758)

Percidae 7 species

*Perca fluvi*atilis (Linnaeus, 1758)

Gymnocephalus cernuus (Linnaeus, 1758)

Gymnocephalus baloni Holčik and Hensel, 1974

Gymnocephalus schraetser (Linnaeus, 1758)

Sander lucioperca (Linnaeus, 1758)

Zingel zingel (Linnaeus, 1758)

Zingel streber (Siebold, 1863)

Gobiidae 1 species

Proterorhinus marmoratus (Pallas, 1814).

Table 1: Number of fish specimens on the sampling sites (2003-2007). The geographical location and administrative location of the sites bellow can be identified according to the matching serial numbers in the figure 1.

Code of sampling sites / Fish species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Rutilus rutilus					1		6		3		2	1			11	17		19	69	7
Scardinius erythrophthalmus																1		1	1	
Leuciscus leuciscus	34			1	16	8	1	8		2	2	1	10	2						
Leuciscus cephalus	67	9		3	77		55	12	51	47	47	1	33	87	22	49	23	35	4	16
Leuciscus idus										4	1		7					2	79	45
Aspius aspius					1		3		1		2								3	1
Alburnus alburnus	488			2	180	4	223	3	108	45	36	20	127	123	24	62	24	173	440	274
Alburnoides bipunctatus	749	149		207	247	266	170	113		113	54	40	28	74	20		1		11	
Abramis brama							1			33	1					5			16	8
Abrami bjoerkna																4		4	133	6
Abramis sapa							2			1										
Vimba vimba					1		4	2			1	1				10		3	4	
Barbus barbus	218	15		9	60	21	82	47	10	153	80	16	14	12	27		1	6	1	1
Barbus p. petenyi	22				12		1	2					1							
Gobio gobio	27	2		1	13	1			10	3	8		8	17						
Gobio albipinnatus	22	76			10	147	109	9	2	60	2	52	145	103	17	38	34	15	38	2
Gobio kessleri	129	72		166	62	98	133	75		54	5	13	32	20	11	4	31	12	26	
Pseudorasbora parva	5				2															
Chondrostoma nasus	67	26			28	17	45	8	1	27	2							15	15	1
Rhodeus sericeus	43	17	51	3	36		27	29	12		5		185	1	14	84	3	16	1	
Carassius carassius																1				

Code of sampling sites / Fish species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Carassius gibelio			12						5		1			1		1				1
Cyprinus carpio	1				1				2	4	1									
Cobitis elongatoides	2		4			1	1		3	6			2		3		1		1	
Sabanejewia aurata	4			1		1			2	2			3	3	4		1		2	
Barbatula barbatula	1														2					
Ameiurus melas			37													7				
Silurus glanis							1		1	10	5									
Esox lucius	1								2	2	1		2		1				2	1
Lota lota									3	24	28									3
Lepomis gibbosus																2				
Perca fluviatilis			6		3		4	1	6	2	9		1		3	31	1		12	20
Gymnocephalus cernuus																5				
Gymnocephalus baloni																			2	
Gymnocephalus schraetser									1										1	
Sander lucioperca					2		1		8	7	1									
Zingel zingel									1	1				1						
Zingel streber	17	14		2	14	4	3	5		21	8	1		5	5		1		3	
Proterorhinus marmoratus																	1	1	3	

DISCUSSION

Between 1982 and 1988 twenty-six fish species could be identified in the highly polluted Sajó River (Harka, 1992), whereas 39 fish species were observed in today's far clearer water. Out of these latter fish species 17 were not found in the 1980s period which does not necessarily mean that all of these would have disappeared from this river; it is more probable in this case that a part of these species just became a lot more rare.

The table 2 shows species detected but previously not present in the Sajó River, as well as species that re-settled the river following the purification of the water in 1990.

Table 2: Fish species of the Sajó River described from 1887 to date.

Species	Herman (1887)	Vásárhelyi (1961)	Harka (1992) 1982-1988	Hoitsy (1992)	Curernt study 2003-2007
Anguilla anguilla		+		+	
Rutilus rutilus	+	+	+	+	+
Scardinius erythrophthalmus		+		+	+
Leuciscus leuciscus			+	+	+
Leuciscus cephalus	+	+	+	+	+
Leuciscus idus			+		+
Phoxinus phoxinus		+			
Aspius aspius	+	+			+
Leucaspius delineatus			+	+	
Alburnus alburnus		+	+	+	+
Alburnoides bipunctatus			+		+
Abramis bjoerkna		+	+		+
Abramis brama	+	+	+	+	+
Abramis ballerus	+	+	+		
Abramis sapa	+		+		+
Vimba vimba					+
Tinca tinca	+	+		+	
Barbus barbus	+	+	+	+	+
Barbus peloponnesius petenyi		+		+	+
Gobio gobio	+		+	+	+
Gobio albipinnatus			+	+	+
Gobio kessleri			+	+	+
Pseudorasbora parva				+	+

Species	Herman (1887)	Vásárhelyi (1961)	Harka (1992) 1982-1988	Hoitsy (1992)	Curernt study 2003-2007
Chondrostoma nasus	+	+		+	+
Rhodeus sericeus	+	+	+	+	+
Carassius carassius	+	+		+	+
Carassius gibelio			+	+	+
Cyprinus carpio	+		+	+	+
Misgurnus fossilis	+		+		
Cobitis elongatoides	+	+	+	+	+
Sabanejewia aurata			+		+
Barbatula barbatula	+	+			+
Ameiurus nebulosus			+	+	
Ameiurus melas					+
Silurus glanis	+	+		+	+
Salmo trutta m. fario	+		+	+	
Oncorhynchus mykiss				+	
Esox lucius	+	+	+	+	+
Lota lota	+	+		+	+
Lepomis gibbosus			+	+	+
Perca fluviatilis	+	+		+	+
Gymnocephalus cernuus		+			+
Gymnocephalus baloni					+
Gymnocephalus schraetser		+			+
Sander lucioperca			+	+	+
Zingel zingel		+			+

Species	Herman (1887)	Vásárhelyi (1961)	Harka (1992) 1982-1988	Hoitsy (1992)	Curernt study 2003-2007
Zingel streber	+	+			+
Proterorhinus marmoratus					+

The reduction of species number caused by water pollution and later the increase of this number by leaps and bounds following the purification of water were first described by Hoitsy (1992), who found only 6 species on the river section situated between Kazincbarcika (site no. 6) and Sajószentpéter (site no. 7) in the period between 1985 and 1988, whilst he identified twice as many species, i. e. 12, in the year 1992.

As for species known from the Sajó River previously, however disappearing in the 1980s, 15 have returned to date, including protected natural values such as *Barbus peloponnesius petenyi*, *Zingel streber*, *Zingel zingel* and *Gymnocephalus schraetser*. Although the latter two are rare today, the other species mentioned are present in the river with a great and vital population (Halasi-Kovács, 2005). The natural value of the 15 returned species (Guti, 1993) is especially high (on average 2.46); i. e. the purification of the water has facilitated the return of mainly rare and endangered fish species. Among fish species relevant for angling purposes, in addition to barbel, nase and burbot, the increase of the asp, carp and european catfish stands is noteworthy. The population of the latter species is also supported by the anglers' society responsible for managing the water area via the introduction of fish into the river, nevertheless, considering the entire Sajó, the relevance of such introduction is rather low and normal reproduction proves to be a lot more significant. The increase in species number is especially conspicuous on the section of the river located above the Hernád mouth. In the 1980s not more than 11 species could be observed here, whilst nowadays 32 have been detected. Whereas the rise on the entire Hungarian section of the river was 50 % (from 26 to 39), it was 191 % (from 11 to 32) on the section located above the Hernád River mouth. This stronger change is attributable to the fact that the pollution concentration of the Sajó River was a lot higher on the upper section causing a more drastic drop in the number of species compared to the lower section, where the diluting effect of the Hernád River could prevail. This is reflected in the fact that whereas 58 % of the species (15 in 26) found in the river could only be observed under the inflow of the Hernád River (Harka, 1992), today this ratio is not more than 18 % (7 in 39).

Our observations regarding the health condition of fish are also positive. We have not encountered a single specimen with irregular fin, although in the 1980s nearly half of the gudgeons showed aberration neither did we notice fish with ulcer or developing in a distorted manner.

According to our experience, in water-courses where pollution drops to an appropriate level the fish fauna is able to regenerate during the span of one - one and a half decade without any significant intervention, provided that the possibility of re-population is provided by the connected waters. It goes without saying that the limitation of pollution is not a neglectable task either, and it is imperative to ensure that the process bringing positive changes will not turn backward.

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ICHTHIODIVERSITY FROM BRATEŞ LAKE (ROMANIA)

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KEYWORDS: Ichtiodiversity, Brateş Lake, freshwater fish.

ABSTRACT

Brateş Lake is a part of the Lower Prut River Flood Plain protected area (8247 ha.), according to the Government Decision no. 2151/2004 regarding the protected natural area regime for new area.

Large area of the lower Prut and close to its mouth has been dammed and drained, e. g. the larger part of the Brateş Lake. As a result of the damming actions begun in 1965 the aquatic ecosystem decreased, turning into a fishery complex.

Now, the Brateş fishponds complex, encompassing 2442 ha. total surface which included a 320 ha. fish nursery and a basin of 2120 ha.

The Brateş Lake geographical coordinate are: N 45^0 30’ 28’’, S 45^0 27’ 04’’, E 28^0 05’ 52’’, V 28^0 02’ 54’’, there is situated in the north-eastern part of Galați municipal.

The varied and rich ichthyofauna of the Brateş Lake contains 46 fish species of which 21 species with economical importance.

In period 1949-1962 the biggest production was registered in 1956 (1264 tons) out of which 18.2 % predatory species.

After that damming the catches are dominated by the Asian cyprinids 86 % followed by carp 9 %, Prusian carp 2 %, bream 2 % and predatory species 1 %.

The evolution of the Brateş aquatic ecosystem demonstrated that man’s active intervention brought about a lack of balance in the mechanism of production on natural basis of the local wild icthyofauna menaced nowadays with extinction.

REZUMAT: Ichthiodiversitatea Lacului Brateş (județul Galați, România).

În conformitate cu Decizia Guvernamentală nr, 2151/2004 cu privire la ariile protejate, Lacu Brateş este o parte din aria protejată Lunca inundabilă a Prutului inferior. Suparafețe importante din bazinul hidrografic al Prutului inferior, până aproape de gura de vărsare, adică o mare parte din lacul Brateş, au fost îndiguite şi desecate. Ca urmare a acțiunilor de îndiguire, începute în anul 1965, ecosistemul acvatic şi-a redus considerabil aria, restrângându-se la un complex piscicol.

Acum, suprafața totaă a complexului piscicol Brateş măsoară 2442 ha., din care 320 ha. Pepiniera şi 2120 ha. Lacul Brateş propriuzis.

Lacul Brateş este situate în partea de nord-est a minicipiului Galați, având următoarele coordonate geografice: N 45^0 30’ 28’’, S 45^0 27’ 04’’, E 28^0 05’ 52’’, V 28^0 02’ 54’’.

Ihtiofauna lacului Brateş, variată şi bogată în taxoni, conține 46 de specii de peşti, dintre care 21 cu importanță economică.

Între anii 1949-1962, cea mai mare producție s-a înregistrat în 1956 (1264 tone), din care 18.2 % specii răpitoare.

După îndiguire, urmare a populărilor, producția era dominată de specii de ciprinide est-asiatice 86 %, urmate de crap 9 %, caras 2 %, plătică 2 % şi specii răpitoare 1 %.

Evoluția ecosistemului acvatic Brateş demonstrează că intervențiile antropice conduc la dezechilibre în mecanismele trofice ale bazinelor naturale, iar ihtiofauna sălbatică endemică este amenințată cu extincția.

RESUME: L'ichthyodiversitee du Lac Brateş (Departement Galați, Roumanie).

Conforme a la Décision Gouvernamentalle no. 2151/2004 a propos des zones protégée, le Lac Brateş est un part constituant de la zone protégée" Praierie basse du Prut inférieur".

Des importantes surfaces de bassin hydrographique du Prut inférieur jusque approche de débouche, c'est a dire un grande surface de lac Brateş ont été endiguées et desschees.

A conséquence de l'actions de endiguer et desscher débute dans l'année 1965, la zone de l'ecosystheme aquatique a été réduit considérable au niveau d'un complexe de pisciculture.

En pressent, la surface totale destine a pisciculture mesure 2442 ha, parmi quelle 320 ha pépinière et 2110 ha le lac Brateş proprement dit.

Le lac Brateş est situe au nord-est du ville Galati a coordonnée: N 45^0 30' 28'', S 45^0 27' 04'', E 28^0 05' 52'', V 28^0 02' 54''.

L'Ichthyofaune de lac Brateş est diversifiée et riche en taxons, contenait 46 des espèces, dans lesquelles 21 d'importance économique.

Entre l'années 1949-1962, la plus grande production de pêche a été enregistrée en 1956 (1264 t), dans laquelle 18,2 % des espèces ravisseuses.

Apres l'endigue, a conséquence de l'introduction des espèces de cyprinidés est-asiatiques in ratio: 86 % cyprinidés asiatique, 9 % carpe, 2 % carassin, 2 % brème et des espèces ravisseuses.

L'Evolution de l'ecosystem aquatique Brateş relève que les interventions anthropiques provoquent des déséquilibres dans les mécanismes trophiques naturelle et l'ichthyofaune sauvage endémique est menace à l'extinction.

INTRODUCTION

The ecosystem of stagnant waters, Brateş Lake, located in flooded area of the lower course of Prut River, at junction with Danube River, was supply with water first from Prut River through channel Ghimia, secondary from Chineja Spring and from rainfall.

Since the third decade of XX century, Brateş Pool with his big flooded area coming to be transforming by human activities, according to economic interest, social and territory systematization.

This area conversion started with construction of Galați - Prut railway who separate Badalan Pool from Brateş, and after this, the Sivița - Prut Dam was separate this ecosystem in two areas: High Brateş (upstream of dam) used for agriculture and Lower Brateş (located under dam and Galați - Prut railway) containing 7,900 ha water area, 3,000 ha pasture, 2,800 ha water macrophytes. (Vasilescu, 1995).

Since 1965 year, as result of the damming of Lower Brateş actions, the aquatic ecosystem decrease, turning into fishery center of 2,441 ha, including a 320 ha fish nursery and a basin of 2,120 ha. (Fig. 1.)

The varied and rich ichthyofauna of the Brateş Lake contained 50 fish species, belongs of 31 genuses and 11 family, form by species characteristic of plain static water area and reophilic species, witch 21 species with economical importance. During the time variations of fish capture was determinate by: level fluctuations of Danube and Prut rivers, weather conditions (affecting quality of reproduction and rearing), type of exploitation of aquatic resource and water intensive quantities used in agriculture.

To describe the qualitative structure of the fishes population existing in lake in the spring of 2007 was the main objective of this study.

Figure 1: Brateş Lake - satellite view.

MATERIALS AND METHODS

The processed data were gained from three sources: for period before damming (until 1964) - different bibliographical material; personal data collection at the Fish culture enterprise Galați - analysis of fisheries data; directly observations through experimental fishing and information collected from fishermen.

RESULTS AND DISCUSSIONS

In 2007 were identified 46 fish species (21 with commercial value). Comparative to Vasilescu et al. (1995), it was identified in addition two species, without commercial importance: *Pseudorasbora parva* (Temminck and Schlegel, 1846) and *Leucaspius delineatus* (Heckel, 1843) and disappear 6 species: four sturgeons species: *Acipenser guldenstaedti* (Brandt and Ratzeberg, 1833), *A. ruthenus* (Linnaeus, 1758), *A. stellatus* and *Huso huso* (L., 1758); and *Anguilla anguilla* and *Carassius carassius* (L. 1758).

The *Pseudorasbora parva* (Temminck and Schlegel, 1846), Stone moroko, native in Asia, is an invasive species which was accidentally introduced in the 1960's among the fingerling of Chinese carp, imported from China (Bănărescu, 1964).

The distribution area for *Leucaspius delineatus* is Europe and Asia. This species are included in Appendix III of the Bern Convention (protected fauna).

Nowaday, the following species are dominants in Brateş Lake: Prusian carp, Common bream, Pikeperch and Roach. (Tab. 1., Fig. 2).

Table 1: Qualitative assay of ichtiofauna from Brateş Lake; √ - been, 0 - absent, x - rare, xx - frequently, xxx - dominant.

No.	Species (Scientific name)	Popular English name	Popular Romanian name	1949-1994 (Vasilescu, 1995)	Spring 2007
Fam. Cyprinidae					
1.	*Abramis ballerus* (Linnaeus, 1758).	Blue bream	Cosac	√	x
2.	*Abramis brama* (Linnaeus, 1758)	Common bream	Platica	√	xxx
3.	*Abramis sapa* (Pallas, 1814)	White-eye bream	Cosac cu bot turtit	√	x
4.	*Alburnus alburnus* (Linnaeus, 1758)	Bleak	Oblet	√	xx
5.	*Aristichthys nobilis* (Richardson, 1845)	Bighead carp	Novac	√	xx
6.	*Aspius aspius* (Linnaeus, 1758)	Aral asp	Avat	√	x
7.	*Barbus barbus* (Linnaeus, 1758)	Barbel	Mreana	√	x
8.	*Blicca björkna* (Linnaeus, 1758)	Silver (White) bream	Batca	√	x
9.	*Carassius gibelio* (Bloch, 1782)	Prusian carp	Caras	√	xxx
10.	*Carassius carassius* (Linnaeus, 1758)	Crucian carp	Caracuda	√	0
11.	*Chondrostoma nasus* (Linnaeus, 1758)	Sneep	Scobar	√	x
12.	*Ctenopharyngodon idella* (Valenciennes, 1844)	Grass carp	Cosaş	√	xx
13.	*Cyprinus carpio* (Linnaeus, 1758)	Common Carp	Crap sälbatec	√	xx
14.	*Cyprinus carpio* (morpha Galician)	Culture mirror carp	Crap de culturä	√	x
15.	*Cyprinus carpio* (morpha Lausitzer)	Culture scale carp	Crap de culturä	√	x
16.	*Gobio gobio* (V.)	Gudgeon	Porcusor	√	xx
17.	*Hypophthalmichthys molitrix* (V.)	Silver carp	Sanger	√	xx
	Leucaspius delineatus (Heckel, 1843)	Belica	Plevuşca	0	xx
18.	*Leuciscus idus* (Linnaeus, 1758)	Ide	Văduvița	√	x
19.	*Pelecus cultratus* (Linnaeus, 1758)	Ziege	Sabița	√	x

No.	Species (Scientific name)	Popular English name	Popular Romanian name	1949-1994 (Vasilescu, 1995)	Spring 2007
	Pseudorasbora parva (Temminck & Schlegel, 1846)	Stone moroko	Porcuşor	0	xx
20.	*Rhodeus amarus* (Bloch, 1782)	Bitterling	Boarța	√	x
21.	*Rutilus r. carpathorossicus* (Vladykov, 1930)	Roach	Babuşca	√	xxx
22.	*Scardinius erythrophthalmus* (Linnaeus, 1758)	Rudd	Rosioara	√	xx
23.	*Tinca tinca* (Linnaeus, 1758)	Tench	Lin	√	x
24.	*Vimba vimba carinata* (Pallas, 1814)	Vimba	Morunaş	√	x
Fam. Catostomidae					
25.	*Ictiobus buballus* (Rafinesque, 1818)	Smallmouth buffalo	Bufalo	√	x
26.	*Ictiobus cyprinellus* (Valenciennes, 1844)	Bigmouth buffalo	Bufalo	√	x
Fam. Percidae					
27.	*Gymnocephalus cernus* (Linnaeus, 1758)	Ruffe	Ghiborț	√	xx
28.	*Gymnocephalus) schraetser* (Linnaeus, 1758)	Schraetzer	Răspăr	√	x
29.	*Zingel zingel* (Linnaeus, 1758)	Zingel	Pietrar	√	x
30.	*Zingel streber* (Siebold, 1863)	Danube streber	Fusar	√	x
31.	*Perca fluviatilis* (Linnaeus, 1758)	Perch	Biban	√	xx
32.	*Sander lucioperca* (Linnaeus, 1758)	Pike-perch,	Şalău	√	xxx
33.	*Sander volgensis* (Gmelin, 1789)	Volga pikeperch	Şalău vărgat	√	x
Fam. Esocidae					
34.	*Esox lucius* (Linnaeus, 1758)	Pike	Ştiuca	√	xx
Fam. Siluridae					
35.	*Silurus glanis* (Linnaeus, 1758)	Wels catfish	Somn	√	xx
Fam. Cobitidae					
36.	*Cobitis taenia* (Linnaeus, 1758)	Spined loach	Zvârluga	√	x
37.	*Misgurnus fossilis* (Linnaeus, 1758)	Weatherfish	Țipar	√	x

No.	Species (Scientific name)	Popular English name	Popular Romanian name	1949-1994 (Vasilescu, 1995)	Spring 2007
Fam. Clupeidae					
38.	*Alosa caspia nordmanni* (Antipa, 1904)	Azov shad	Rizeafca	√	x
39.	*Clupeonella delicatula* (Nordman, 1840)	Black Sea sprat	Gingirica	√	x
Fam. Gobiidae					
40.	*Benthophilus stellatus* (Sauvage, 1874)	Stellate tadpole-goby	Umflatura	√	x
41.	*Neogobius kessleri* (Günther, 1861)	Bighead goby	Guvid de balta	√	x
42.	*Proteorhinus marmoratus* (Pallas, 1814)	Tubenose goby	Guvid mic	√	x
43.	*Pomatoschistus minutus* (Pallas, 1770)	Sand goby	Guvid de nisip	√	x
Fam. Anguillidae					
44.	*Anguilla anguilla* (Linnaeus, 1758)	Eel	Anghila	√	0
Fam. Syngnathidae					
45.	*Syngnathus abaster* (Risso, 1827)	Black striped pipefish	Andrea de mare	√	x
Fam. Centrarchidae					
46.	*Lepomos gibosus* (Linnaeus, 1758)		Biban soare	√	x
Fam. Acipenseridae					
47.	*Acipenser gueldenstaedtii* (Brandt and Ratzeberg, 1833)	Russian sturgeon	Nisetru	√	0
48.	*Acipenser ruthenus* (Linnaeus, 1758)	Sterlet	Cega	√	0
49.	*Acipenser stellatus* (Pallas, 1771)	Starry sturgeon	Păstruga	√	0
50.	*Huso hsuso* (Linnaeus, 1758)	Beluga	Morun	√	0

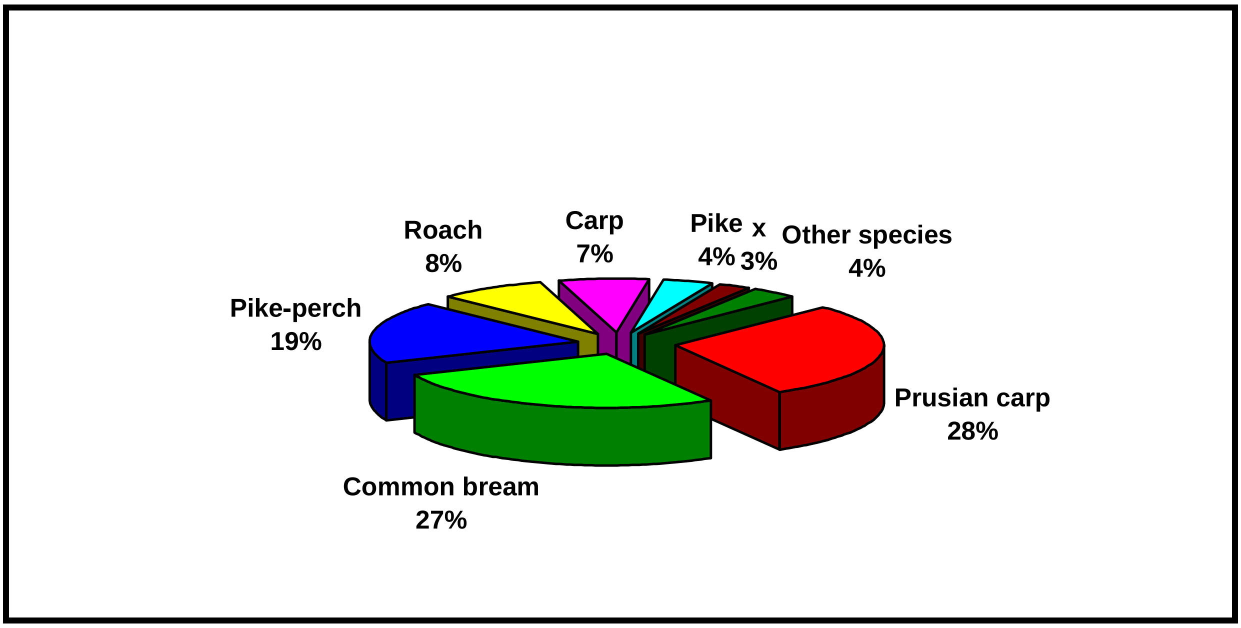

Figure 2: Species structure of ichtiofauna from Brateş Lake; x - Asian cyprinids.

CONCLUSIONS

The Brateş Lake ichtiofauna contain 46 freshwater species. It is more likely to be disappear 6 species (*Acipenser guldenstaedti*, *A. ruthenus*, *A. stellatus*, *Huso huso Anguilla anguilla* and *Carassius carassius*, species which are pontic and ponto-caspian endemics or danubian ones.

Since 1949 to 1994, 50 species have been recorded here. Since 1990, when the collapse of the socialist system caused decline in fish farms production, enterprises have been restructured and new modalities of production organizing appeared, many fish farms have been privatized, the stocking density decreased in order to make use of the natural food production of the pond and decrease (or eliminate) the artificial fish feeding. The consequence of these factors is the production decrease.

The transition from state-owned status to private entrepreneurship was not realized at the same pace in all farms. Therefore, the Brateş Lake, stay in own of States Domains Administration (ADS), unexploited from fish cultural point of view for a total period of 12 years.

Presently, it is very probably that the water surface of Brateş Lake to be assumed by concessionaires in private exploitation, for better economic, ecologic and social conditions goals. Until privatization, overexploitation (mainly fish population) has had a big influence on the present ecological status of Brateş Lake.

As result of the anthropogenic impact and climatic conditions influences, it is obvious an intensive silting process and a depreciation of water and bottom substrate quality. A big quantity of organic matters accumulated in sediments induces a quickly euthrophication with an important consequence: biodiversity decreasing. Lack of investments, during the 90', as result of the stopping of inputs, has an unfortunate effect.

In inland waters of Europe, because of obligations under the EU Water Framework and Bird and Habitats Directives, there are conflicts which could potentially arise within the fisheries and aquaculture sectors because of needs to protect biodiversity and improve the ecological status of waters. Interactions between social, economic and ecological objectives are particularly relevant considering the ongoing shift from a dominance of commercial towards recreational fisheries. This raises issues of economic rent, angling tourism, ethics of exploitation and competing objectives between biodiversity conservation and expansion of recreational fishing opportunities. There is a great need to explore these interactions further to identify appropriate solutions that balance private and public use of goods now and in the future.

The FAO Code of Conduct for Responsible Fisheries and the EU strategy for the sustainable development of European aquaculture and inland fisheries all recognize that the sector should take an approach where farming and fisheries technologies, social and economic issues, natural resource use, biodiversity conservation and governance are integrated to enhance sustainable management.

The abrupt changes in the living fisheries communities imposed the necessity of improving responsible ecosystem management. The capital investments are imperious necessary, through the capital turnover provided to be extremely slow. So, reestablished of fisheries activity is important for the social economy but not only from the interest of the production. Moreover, environmental aspects and also those of nature conservation are also to be considered.

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SUCCESSIONS OF THE ICHTHYOFAUNA IN AN EUTROPHIC SERBIAN RESERVOIR

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KEYWORDS: Serbia, Danube Basin, Gruža Reservoir, ichthyofauna, non-native species, changes.

ABSTRACT

Anthropogenic activities, primarily the intensification of eutrophication and introduction of new species, often affect crucially the qualitative and quantitative structure of the ichthyofauna of a reservoir.

This study presents basic characteristics of the ichtyofauna of the eutrophic reservoir constructed in 1984 on the Gruža River (the Danube Basin, Serbia).

The results on the icthyological investigations conducted in 2004-2005 suggested the presence of 19 species of 6 families, being dominated by representatives of the Cyprinidiae family (accounting for 80.95 % of the total number of individuals and 74.41 % of the biomass of the icthyofauna). Great changes have been observed during the two decades of the ecosystem existence.

REZUMAT: Succesiunea ihtiofaunei într-un bazin din Serbia.

Activitățile antropice, în primul rând intensificarea eutrofizării şi introducerea de noi specii, afectează adesea crucial structura calitativă şi cantitativă a ihtiofaunei unui bazin.

Acest studiu prezintă caracteristicile de bază a ihtiofaunei unui bazin eutrofizat construit în 1984 pe râul Gruža (Bazinul Dunării, Serbia).

Rezultatele investigațiilor ihtiologice realizate în 2004-2005 suggerează prezența a 19 specii din 6 familii, fiind dominate de reprezentanți ai familiei Cyprinidiae (însumând 80.95 % din totalul numărului de indivizi şi 74.41 % din biomasa ihtiofaunei). Modificări mari au fost observate de-a lungul a două decade de existență a ecosistemului.

ZUSAMMENFASSUNG: Die Ichtiophauna Succesion in einem Basin aus Serbien.

Anthropogenic Tätigkeiten, hauptsächlich die Verstärkung von eutrophication und Einführung neuer Spezies, beeinflusst oft entscheidend die qualitative und quantitative Struktur des ichthyofauna von einem Behälter. Dieses Studium überreicht grundlegende Kennzeichen des ichtyofauna vom eutrophic Behälter gebaut in 1984 auf dem Gruža Fluss (dem Donau Becken, Serbien). Die Ergebnisse auf den icthyological Untersuchungen geleitet in 2004-2005 hat die Anwesenheit von 19 Spezies von 6 Familien vorgeschlagen, beherrscht durch Vertreter die der Familie Cyprinidiae (80,95 % von der gesamten Zahl von Individuen und 74,41 % von der Biomasse des icthyofauna zu werden erklärend). Große Änderungen sind während der zwei Jahrzehnte von der Ökosystemexistenz beobachtet worden.

INTRODUCTION

Damming rivers and the construction of reservoirs or man-made lakes are unique phenomena in nature. The conversion of running water ecosystems into poorly running or standing water ecosystems induces drastic changes in exposed hydrobiont communities. Eutrophication is intensified by the inflow of nutrient salts, phosphate and nitrate, as well as by the prolongation of the lake basin retention time (Hutchinson, 1967). Most Serbians reservoirs have exhibited signs of eutrophication (Bogdanović, 2006; Karadžić and Mijović, 2007). Consequently, fish communities undergo substantial changes in these biotopes. Some species adapt rapidly and increase in abundance under the newly emerged conditions, others disappear (Lenhardt et al., 2008).

The Gruža reservoir ($43^0 54' 35''$ - $43^0 57' 51''$N, $20^0 37' 35''$ - 20^0 41’50’’E) was created in 1984 by damming of the middle course of the Gruža River, a tributary of the Zapadna Morava River (Danube Basin, Serbia) (Fig. 1). The reservoir was built to supply water to the City of Kragujevac (180,000 inhabitants). The lake has a surface area of 9.34 km^2, a length of 10 km, a maximum width of 1.5 km, a maximum depth of 31 m and water-level fluctuations of 3-5 m. The total volume of the reservoir is 64 x 10^6 m^3. The Gruža Reservoir has a drainage basin of 318 km^2.

The reservoir is characterized by a low flow rate (1 m^3/sec^{-1}) (Ostojić et al., 2005). There are no water inflows from the main river and tributaries into the reservoir during the summer months of drought years. Intensive agriculture in the riparian areas induces a high nutrient inflow causing overeutrophication and accompanying consequences, such as «blooms» of Cyanobacteriophyta. This process is facilitated by the low depth and low amount of water, as well as by minimum movement. Water quality deteriorates due to continuous faecal pollution, particularly with the *Clostridium perfrigens* species (Ćurčić and Čomić, 2002). The sediment of the shallow parts of the lake is heterogeneous, consisting of loam, clay, sand and plant detritus. The deeper parts of the lake have a silty bottom and a higher amount of detritus, being generally derived from plants. Apart from the developed macrophyte vegetation (Topuzović and Pavlović, 2004), the biota of the ecosystem include a diverse zooplankton community composed of 99 species (Ostojić 2000) and a macrozoobenthos community comprising 32 species being dominated by Oligochaeta and Chironomidae (Simić 2005). The lake is marked by an occasional oxygen deficiency in deeper parts. There have been several records of the reservoir water being loaded with nitrites, ammonia and pesticides (Ostojic et al., 2007). Despite the above limitations, the general environmental conditions in the area enable the development of a diverse fish community, making the Gruža Reservoir the major recreational fishing area in Central Serbia (Simović and Marković, 2005).

MATERIALS AND METHODS

The ichthyological research was conducted in the studied area (Fig. 1) during spring (April-May) and summer (July-August) in 2004-2005. The fish were caught using standard fishing gear - nets, 30 - 100 m long, 1 to 5 m wide, having different mesh size ranging from 10 to 75 mm. The samples were determined by standard methods (Bănărescu, 1964; Wheeler, 1978; Ladiges und Vogt, 1979; Simonović, 2006). The diversity of the fish community was used to calculate Margalef (Margalef, 1958) and Shannon-Weiner indices (Krebs, 1994).

The results obtained in this study were compared to previous ones (Simović, 1995 and 2001; Simović and Marković, 1996 and 2005; Šorić, 1996).

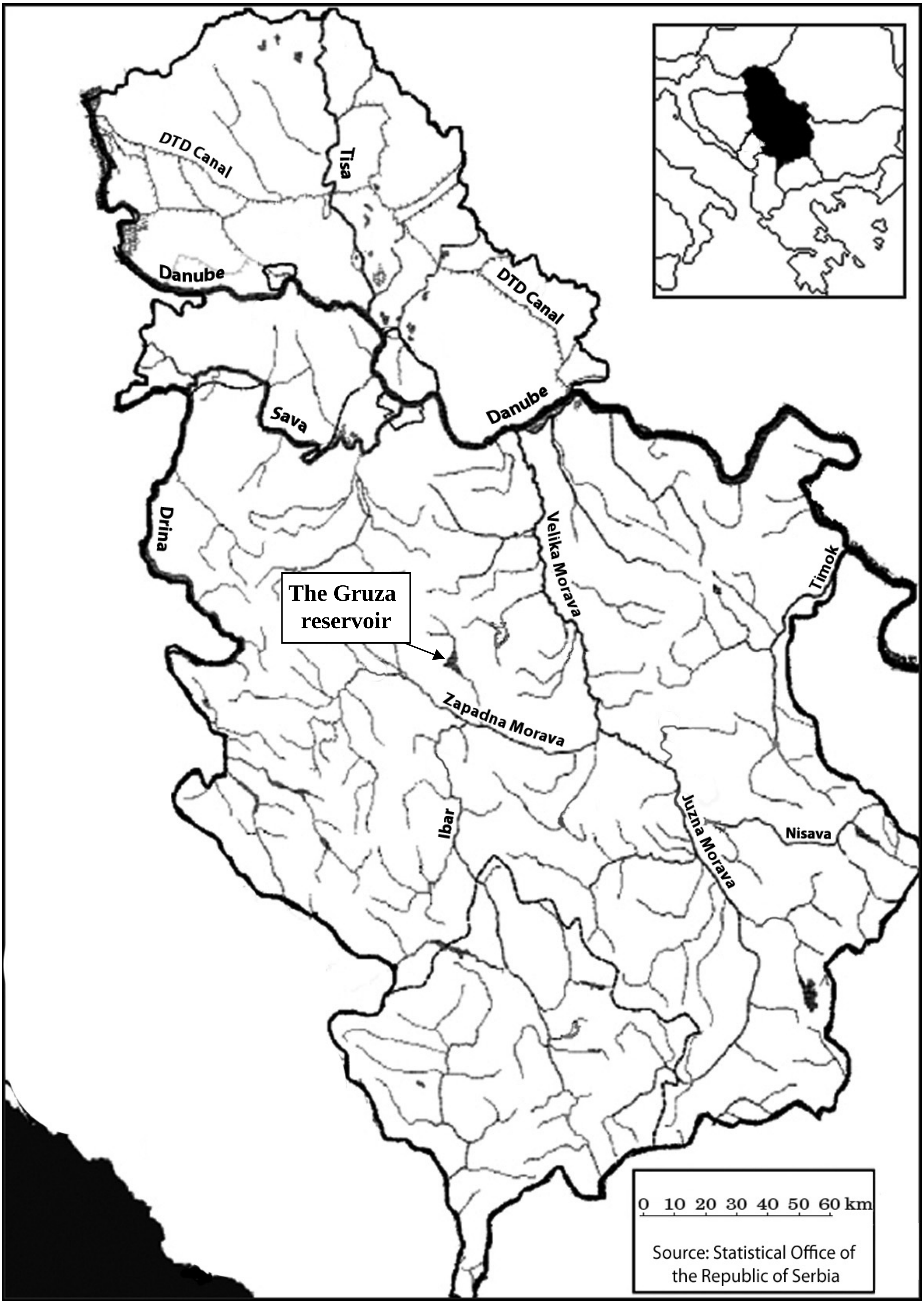

Figure 1: Studied area localization.

RESULTS

During the ichthyological investigations conducted in 2004 - 2005, a total of 1926 fish samples having a total weight of 379,160 kg were caught. The fish belonged to 19 species and 6 families (Cyprinidae, Siluridae, Esocidae, Percidae, Centrarchidae and Ictaluridae) (Tab. 1). The representatives of the family Cyprinidae predominated both in terms of the total number of individuals (80.95 %) and biomass (74.41 %) (Fig. 2). The reservoir was inhabited by 6 allochthonous species. The high occurrence of *Carassius gibelio* (28.35 % of individuals and 43.29 % of the total biomass of ichthyofauna) contributed to the significant proportion of allochthonous species in the total number (39.97 %) and biomass (45.32 %) of the icthyofauna.

Table 1: Qualitative and quantitative composition of the Gruža reservoir ichthyofauna: * non-native (allochthonous) species.

Fam.	Number	%	Biomass (g)	%
Cyprinidae				
Alburnus alburnus	357	18.54	4900	1.29
Abramis brama	185	9.61	11750	3.10
Aspius aspius	5	0.26	3950	1.04
*Carassius gibelio**	546	28.35	164120	43.29
Chondrostoma nasus	11	0.57	3200	0.84
Cyprinus carpio	77	4.00	71200	18.78
*Ctenopharyngodon idella**	1	0.05	470	0.12
Hypophthalmichtys molitrix *	2	0.10	950	0.25
Leuciscus cephalus	16	0.83	3250	0.86
*Pseudorasbora parva**	137	7.11	2800	0.74
Rhodeus sericeus	54	2.80	350	0.09
Rutilus rutilus	168	8.72	15200	4.01
Siluridae				
Silurus glanis	48	2.49	59800	15.77
Esocidae				
Esox lucius	16	0.83	17100	4.51
Percidae				
Perca fluviatilis	180	9.35	14000	3.70
Acerina cernua	13	0.67	320	0.08
Sander lucioperca	26	1.35	2300	0.61
Centrarchidae				
*Lepomis gibbosus**	47	2.44	380	0.10
Ictaluridae				
*Ictalurus nebulosus**	37	1.92	3120	0.82
Total	1926	100	379160	100

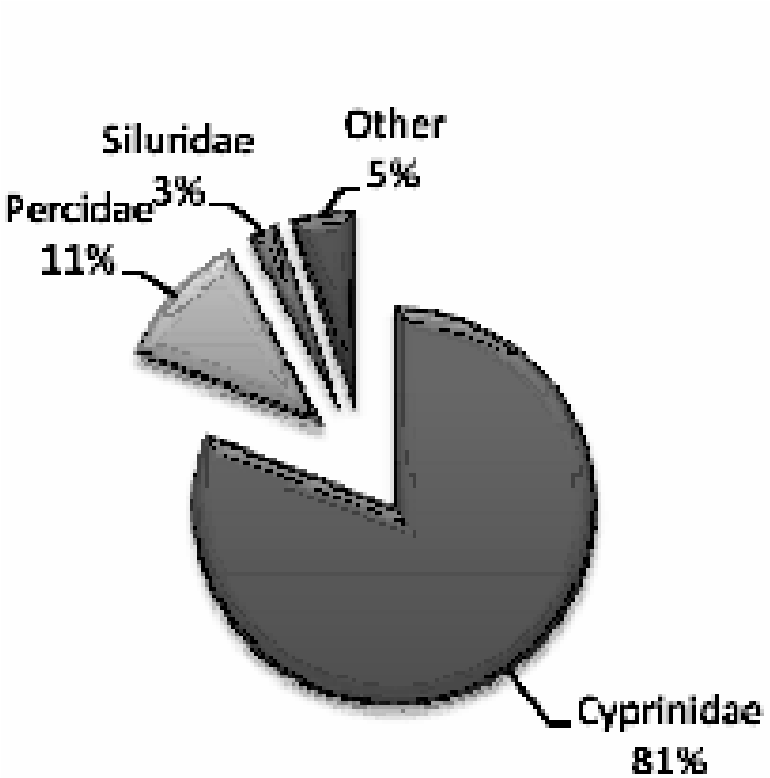

Figure 2: Proportion of fish families (number of individuals)
in the ichthyofauna of the Gruža reservoir (%).

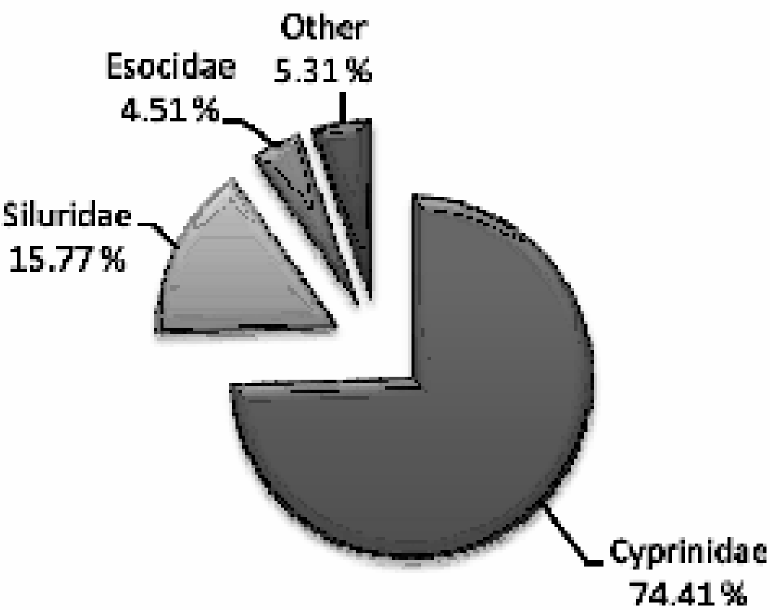

Figure 3: Proportion of fish families (biomass)
in the ichthyofauna of the Gruža reservoir (%).

DISCUSSIONS

The first ichthyological investigations of the Gruža reservoir were conducted in 1987. The reservoir was inhabited by 16 species of 6 families. The fish community in the first period of the lake existence was comprised of, among others, lothic species such as *Barbus peloponnesius*, *Alburnoides bipunctatus*, *Gobio gobio*, *Sabanejewa aurata balcanica* and *Barbatula barbatula* (Tab. 2). Among the non-native species found in the reservoir, a massive abundance of *C. gibellio* and the presence of individual specimens of *Lepomis gibbosus* were reported (Šorić, 1996).

Table 2: Qualitative composition of the Gruža reservoir ichthyofauna (1987-2005); * non-native (allochthonous) species.

Period Taxon	1987	1991	1995	1998-1999	2004-2005
Family Cyprinidae					
Alburnus alburnus (Linnaeus, 1758)	+	+	+	+	+
Alburnoides bipunctatus (Bloch, 1782)	+				
Abramis brama (Linnaeus, 1758)		+	+	+	+
Abramis sapa (Pallas, 1811)		+	+	+	
Aspius aspius (Linnaeus, 1758)		+	+	+	+
Barbus peloponnesius (Valenciennes, 1844)	+				
Carassius auratus gibelio (Bloch, 1783)*	+	+	+	+	+
Chondrostoma nasus (Linnaeus, 1758)	+	+	+	+	+
Ctenopharyngodon idella (Valenciennes, 1844)*				+	+
Cyprinus carpio (Linnaeus, 1758)	+	+	+	+	+
Gobio gobio (Linnaeus, 1758)	+				
Hypophthalmichthys molitrixis (Valenciennes, 1844)*				+	+
Leuciscus cephalus (Linnaeus, 1758)	+	+	+	+	+
Phoxinus phoxinus (Linnaeus, 1758)	+				
Pseudorasbora parva (Schlegel, 1842)*			+	+	+
Rhodeus sericeus amarus (Bloch, 1782)	+	+	+	+	+
Rutilus rutilus (Linnaeus, 1758)	+	+	+	+	+

Period / Taxon	1987	1991	1995	1998-1999	2004-2005
Family Cobitidae					
Barbatula barbatula (Linnaeus, 1758)	+				
Sabanejewa aurata balcanica (Karaman, 1922)	+				
Family Esocidae					
Esox lucius (Linnaeus, 1758)	+	+		+	+
Family Siluridae					
Silurus glanis (Linnaeus, 1758)	+	+	+	+	+
Family Percidae					
Perca fluviatilis (Linnaeus, 1758)	+	+	+	+	+
Acerina cernua (Linnaeus, 1758)			+	+	+
Sander lucioperca (Linnaeus, 1758)					+
Family Centrarchidae					
Lepomis gibbossus (Linnaeus, 1758)*					
Family Ictaluridae					
Ictalurus nebulosus (Lesueu, 1819)*					
Number of species	16	14	15	18	19

The location of the reservoir and a high nutrient inflow from surrounding agricultural land induced rapid eutrophication of the ecosystem and high bioproductivity of the ichthyofauna. However, a huge fishkill caused by the *Branchiomyces sanguinus* fungus occurred on 5 April 1988, involving particularly the carp (*Cyprinus carpio)* population. The emptied ecological niche was filled by *C. gibelio*, a predominant species in the ecosystem since the date (Simović 2001).

Later studies (1991-1995) showed evidence of recovery of the icthyofauna, but also of significant changes in the fish structure - the disappearance of a number of rheophilic species and a pronounced dominance of stagnophilic species. The predator species *Esox lucius* was not reported in the 1995 fish catches, which most likely contributed to a massive increase in «trash» fish abundance. A total of 15 species representing 5 families were reported for the ichthyofauna, being dominated by *C. gibelio* which accounted for 61.35 % and 75.30 % of the total number and biomass of the ichthyofauna, respectively (Simović, 1995). The first record of the occurrence of *Pseudorasbora parva* (Simović and Marković, 1996), an allochthonous species widely distributed in Serbian watercourses (Maletin, 1997; Cakić et al., 2004) was reported.

Studies conducted in 1998-1999 showed an increase in species diversity. The ichthyofauna comprised 18 species of 5 families, being dominated by Cyprinidae representatives (84.3 % of the total number of individuals and 74.68 % of the biomass of the ichthyofauna). The allochthonous ichthyofauna was enriched with Asian herbivores *Ctenopharyngodon idella* and *Hypophthalmichthys molitrix,* which were introduced into the reservoir to reduce the development of macrophytes and planktons. Apart from the marked dominance of *C. gibelio* (26.42 % of the total number of individuals and 36.83 % of the biomass of the ichthyofauna), an increase in *C. carpio* (4.50% of individuals and 21.09 % of biomass) abundance was another consequence of fish stocking. Interesting, the reservoir was not inhabited by tench (*Tinca tinca*), unlike a number of reservoirs in Central Serbia, irrespective of the relatively favourable conditions of the ecosystem for its survival.

Table 3: Temporal variation in the diversity of the fish assemblage of the Gruža reservoir.

Years / Diversity index	1995	1998 - 1999	2004 - 2005
Margalef	2.3537	2.2829	2.5121
Shannon-Weiner (biomass)	0.9504	1.8941	1.8004
Shannon-Weiner (total number)	1.1482	2.1824	2.2306

The results presented in this paper suggest the increased species diversity of the reservoir ichthyofauna (Tab. 3), being enhanced by the planned introduction of the predatory *Sander lucioperca* species into the ecosystem in 2002 aimed at restraining the production of «trash» species, as well as by the unplanned introduction of *Ictalurus nebulosus*. The high proportion of *C. carpio* and *Silurus glanis* in the fish productivity of the reservoir is due to fish stocking, successfull acclimatization and, also, selectivity of the fishing tools used (use of nets of larger mesh size).

Continuous nutrient inflows and a high primary production of plankton and macrophytes facilitate the development of the reservoir fish community. The minimum flow rate favours the development of stagnophilous species, which are, therefore, pronouncedly dominant, occasionally tending to proliferate in mass numbers. It is generally recognized that a large amount of fish excrement may significantly enhance eutrophication of ecosystems (Horppila and Kairesalo, 1992). The abundance of the ichthyofauna representatives and their physiologial activity, coupled with the above factors, most likely lead to more rapid ageing of this relatively young reservoir.

CONCLUSIONS

Gruža Reservoir on Gruža River (the Danube Basin, Serbia) shows characteristics of lowland reservoirs and a high degree of eutrophication favouring the development of stagnophilous species. The ichthyofauna of this ecosystem is composed of 19 species of six families, dominated by Cyprinidae. The excessive increase in the abundance of *C. gibelio* leads to a high proportion of allochthonous fish species. Anthropogenic activities have affected the ichthyofauna structure of this reservoir characterized by a low flow rate and overproductivity of herbivorous and planktofagous species.

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FIRST RECORD OF AMUR SLEEPER *PERCCOTTUS GLENII* (PERCIFORMES, ODONTOBUTIDAE) IN THE DANUBE DELTA (ROMANIA)

Aurel NĂSTASE [1]

KEYWORDS: Danube delta, *Perccottus glenii,* alien fish species.

ABSTRACT

In the autumn of 2007 an expedition in the Danube Delta was organised in order to assess the state of the ichthyofauna. During this expedition, the first five specimens of Amur sleeper (*Perccottus glenii*) were captured in the Delta region, more specifically in the Furtuna Lake (3 specimens) and in the Popina Fishery Unit (two specimens), a fishery management unit connected to the Danube.

This is the first mention of the species in the Danube Delta and the second in Romania. The presence of the exotic species in the Danube Delta was anticipated by its presence in the Danube River catchment area and Danube's tributaries catchments areas from the eastern and north-eastern part of Romania, the Moldova (Suceava River).

REZUMAT: Prima înregistrare a guvidului de Amur, *Percottus glenii*, (Perciformes, Odontobutidae) în Delta Dunării (Dobrogea, România).

În toamna lui 2007 a fost organizată o expediție în delta Dunării în vederea evaluării ihtiofaunei. În această expediție au fost capturate primele cinci exemplare de guvid de Amur (*Perccottus glenii*) din delta Dunării, mai exact în lacul Furtuna (3 exemplare) şi în Amenajarea Piscicolă Popina (două exemplare), amenajare care are legături cu Dunărea.

Aceasta reprezintă prima semnalare a speciei în delta Dunării şi a doua în România. Prezența speciei exotice în delta Dunării fusese anticipată de prezența ei în bazinul Dunării şi în bazinul unor afluenți ai Dunării din partea de nord-est şi est a României, Moldova (râul Suceava).

RÉSUMÉ: La première citation de *Perccottus glenii* (Perciformes, Odontobutidae) dans le Delta du Danube (Roumanie).

Pendant l'automne de l'année 2007, une expédition au Delta du Danube a été organisée afin d'évaluer l'état de la faune piscicole. Pendant cette expédition ont été capturés les cinq premiers spécimens de *Perccottus glenii* du Delta du Danube, plus précisément dans le lac de Furtuna (3 exemplaires) et dans l'Aménagement Piscicole de Popina (deux exemplaires), le dernier étant relié au Danube. Ceci est la première mention de l'espèce pour le Delta du Danube et la seconde de la Roumanie. La présence de cette espèce exotique dans le Delta a été anticipée par sa présence dans le bassin du Danube et dans le bassin de certains de ses affluents de la partie nord-est et est de la Roumanie (la rivière de Suceava).

INTRODUCTION

Perccottus glenii is native to Russian Far East, North-East China and northern Korean Peninsula (Berg, 1949; Nikolsky, 1956; Bogutskaya and Naseka, 2002).
This species was introduced into European part of Russia, from where was dispersed neighbohood of Russia and rapidly increasing range in Europe.

First record of species in Romania was in 2004 (Nalbant et al., 2004) in Suceava River, which anticipated the presence of species in Danube Delta.

From native area, Amur sleeper was introduced first time in 1912 (after Dmitriev, 1971; Panov, 1999; in Jurajda et al., 2006) or 1916 (after Kottelat and Freyhof, 2007) in St. Petersburg, than spread throughout the drainage of area of the Gulf of Finland. The second introduction took place in Moscow in 1948 (after Dmitriev, 1971; Panov, 1999; cited by Jurajda et al., 2006) or 1950 (after Kottelat and Freyhof, 2007), from where it spread through from the Moscow River system and into the upper Volga Basin (Spanovskaya et al., 1964; in Jurajda et al., 2006; Kottelat and Freyhof, 2007).

Also introduced and now abundant in the 1990s after Jurajda et al., 2006 in upper Dniestr drainage (Ukraine) (Korte et al., 1999 and Moshu, Guzun, 2002 cited by Jurajda et al., 2006) and locally established in Dniepr (Bogutskaya and Naseka, 2002; cited by Jurajda et al., 2006) and Don drainage (Kozlov, 1993 cited by Jurajda et al., 2006), same rivers after Kottelat and Freyhof, 2007.

Perccottus glenii has also spread through the Asian part of Russia, the Baikal area, Kazakhstan, Uzbekhistan, Turkmenistan and Eastern Europe (Litvinov and O'Gorman, 1996; Kosco et al., 2003; Reshetnikov, 2004 cited by Jurajda et al., 2006) mixed with Chinese carp in 1960 (Kottelat and Freyhof, 2007).

The expansion in the range of this fish is a result of its popularity as an aquarium fish, used as live bait and the accidental transfer together with commercial fish for stocking (Jurajda et al., 2006; Kottelat and Freyhof, 2007).

The species has been recorded in the Baltic Sea drainage (Poland - Antychowicz, 1994; Terlecki and Palka, 1999; Latvia - Plikss and Aleksejevs, 1998 cited by Jurajda et al., 2006) and also in the White Sea and the Arctic Ocean basins (Kosco et al., 2003 cited by Jurajda et al., 2006).

Spreading and abundant in northern Russia, Belarus, Ukraine, local records from Slovakia (Danube River), already abundant in Tisza drainage (Hungary), reported presence in Po drainage (Italy) not confirmed (Kottelat and Freyhof, 2007).

The first occurrence of *P. glenii* in the Danube system was in Hungary from the Tisza River basin in 1997 (Harka, 1998); in the Ukraine from the Latorica River drainage (of the Tisza River basin) in 1999 (Moshu, Guzun, 2002); in Slovakia from the basins of the Latorica River near Bodrog in 1998 Kautman, 1999; Kosco et al., 1999); in Romania from the Suceava River near Dorneşti in 2001 (Nalbant et al., 2004) and in Serbia from a fish pond in November 2001 (Sipos et al., 2004), all cited by Jurajda et al., 2006.

The first record of *P. glenii* in the main channel of the Danube River in Serbia was in the Vinci Marine (1040th river km) in February 2003 (Sipos et al., 2004).

In April 2005, 12 individuals of *P. glenii* were captured in the main channel of the Danube River in North-West Bulgaria (Jurajda et al., 2006).

Typically fresh water, in stagnant, well-vegetated waters, in lakes, ponds, quiet reaches and backwaters of rivers (Korte, 1995; Litvicov and O'Gorman, 1996 cited by Miller, 2003; Kottelat and Freyhof, 2007) and even marshes (Berg, 1949), but sometimes in brackish habitats.

Common in warmer shallow lakes and ponds with much submerged vegetation like algae and bladderwort, usually predominating in numbers over other fish, such as *Carassius gibelio*. In such lakes and slow rivers, the species is found mostly in the littoral area near highly overgrow banks, under roots and overhanging banks on usually a muddy bottom (Miller, 2003).

Limnophilic species, inhabiting freshwater canals, oxbow lakes and gravel pits with dense aquatic vegetation and mud substrate (Jurajda et al., 2006).

Spawns for the first time at 1-3 years and about 6 cm SL (Kottelat and Freyhof, 2007), but most individuals mature by two years at standard length of about 5.5 cm (Berg, 1949; Nikolsky, 1956 in Miller, 2003).

Spawning is reported from May to July, at water temperatures of 15-20 or 22°C (Miller, 2003; Kottelat and Freyhof, 2007).

Males guard eggs and larvae. Larvae are pelagic. Tolerates low oxygen concentrations and able to survive in dried out or completely frozen water bodies by digging itself into mud where it hibernates (Kottelat and Freyhof, 2007).

MATERIALS AND METHODS

In autumn of 2007 were caught five individuals of Amur sleeper, three individuals in Furtuna Lake and 2 individuals in Popina fish pond (Fig. 1).

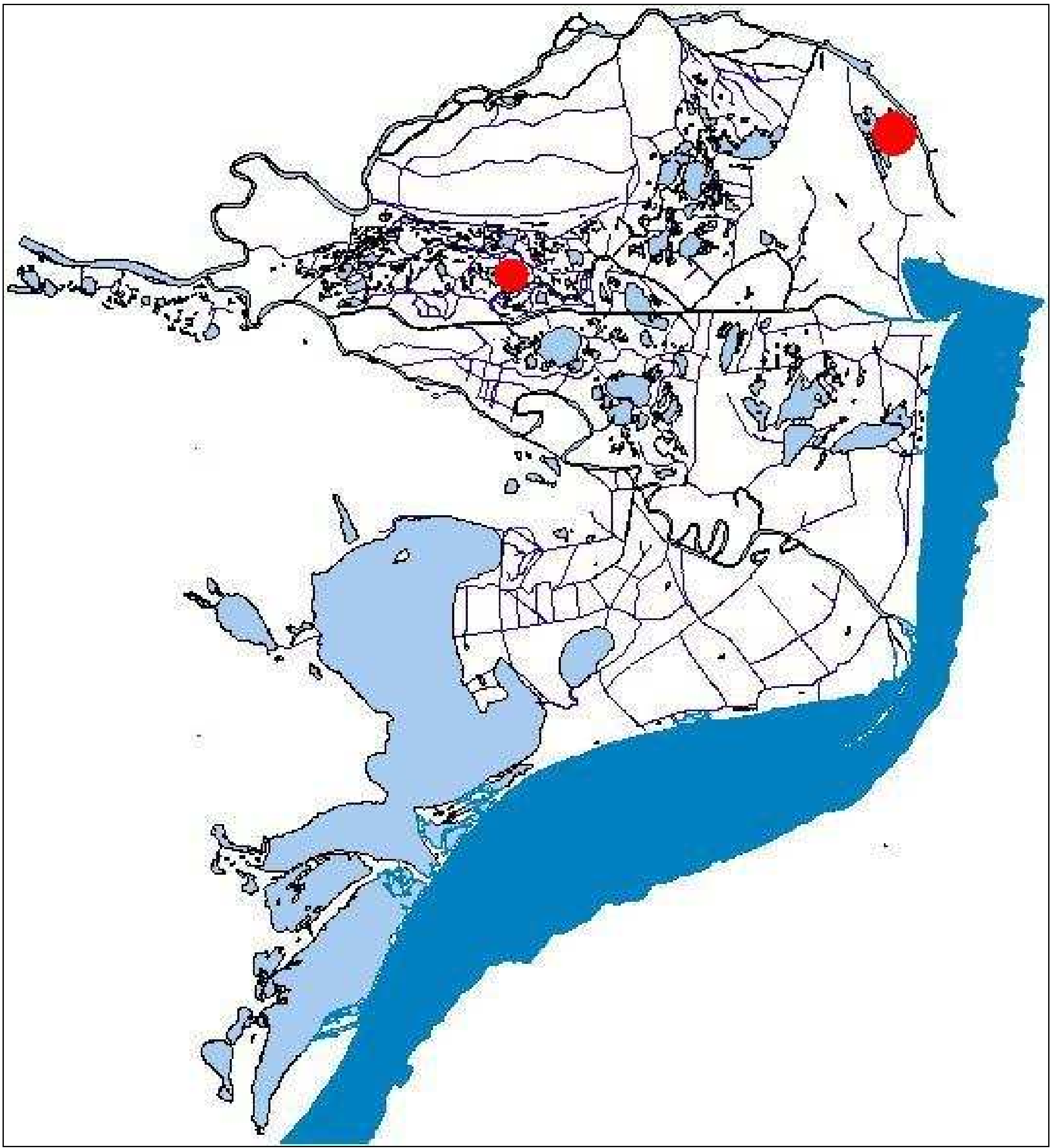

Figure 1: The sites of presence of Amur sleeper in Danube delta (the dots).

In this study we used two complementary methods of sampling: electrofishing for shoreline of waters and gillnets fishing for open water.

Four individuals of Amur sleeper was caught at electofishing, just one (Furtuna Lake) was caught at gillnets.

Those four specimens, which were caught at electrofishing, were fixed in 4 % formaldehyde and deposited in the National Institute for Research and Development Danube Delta in Tulcea, Romania.

RESULTS AND DISCUSSIONS

The Amur sleeper (foto 1) or Chinese sleeper (after Froese and Pauly, 2007) (*Perccottus glenii*) was described by Dybowsky in 1877.

Superphylum Deuterostomia

Phylum Chordata

Subphylum Vertebrata (Craniata)

Superclass Gnathostomata

Grade Teleostomi

Class Actinopterygii

Subclass Neopterygii

Division Teleostei

Subdivision Euteleostei

Superorder Acanthopterygii

Series Percomorpha

Order Perciformes

Suborder Gobioidei

Family Odontobutidae

Species: *Perccottus glenii*

Taxonomy classification was done after Nelson, 2006. From Odontobutidae family belong the freshwater sleepers. This family once a long time ago was placed in the eleotrids (Eleotridae family), now is a distinct family (Nelson, 2006).

The Amur sleeper (*Perccottus glenii*) is a freshwater fish with stocky body and a large head (Jurajda et al., 2006).

This species is the single species of the genera (monotype), also only species of the family in Europe (Kottelat and Freyhof, 2007).

Foto 1: Amur sleeper (*Perccottus glenii*)
from Danube Delta original foto.

CONCLUSIONS

Those five specimens have standard length between 6.1 cm and 14.9 cm, weight between 4 g and 21 g. All were captured near shore line of water with a lot of submersed and floating vegetations, mud substrate, increased fish diversity area (mostly small fish), little deep water.

The hydrological conditions in the drainage of Danube River are possible not suitable for *P. glenii,* but more studies are necessary, especially for Danube delta.

The pressure of predatory fish species in Danube such as perch (*Perca fluviatilis*), pike (*Esox lucius*), pike-perch (*Sander lucioperca*) and wells (*Silurus glanis*) are reported to control the abundance of *P. glenii* (Bogutskaya and Naseka, 2002 mentioned by Jurajda et al., 2006) might curb its establishment.

The Amur sleeper is a very cold-resistant and hardy species (Kirpichnikov, 1945), voracious predator on invertebrates and small fish (Miller, 2003).

Therefore, there are several studies documenting the negative impact of *P. glenii* on native fish and amphibian populations (Kautman, 1999, 2000; Reshetnikov, 2003; Kosco et al., 2003; mentioned by Jurajda et al., 2006) in the Danube.

If this species is able to form stable population it could present a threat as an invasive trophic competitor and predator, that why there are necessary further studies about the presence of this species in Danube delta.

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POLISH RESEARCHES ON THE ROMANIAN GUDGEON (ROMANOGOBIO, GOBIONINAE, CYPRINIDAE)

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KEYWORDS: gudgeons, Poland, *Romanogobio*, sand gudgeon, whitefin gudgeon.

ABSTRACT

A short review of the published works on the Romanian gudgeons (*Romanogobio*) in Poland is presented. The authors reviewed, as far as they are aware, majority of papers concerning this issue.

Not surprisingly, due to rareness of the Romanian gudgeons and lack of their economical significance in Poland, the literature is rather not rich. Further investigations are supposed and necessary.

REZUMAT: Cercetări asupra porcuşorului românesc (Romanogobio, Gobioninae, Cyprinidae).

Este prezentată o scurtă trecere în revistă a lucrărilor referitoare la porcuşorii româneşti (*Romanogobio*) în Polonia. Autorii trec în revistă, în limitele materialelor pe care le cunosc, majoritatea lucrărilor referitoare la acest subiect.

Nu este surprinzătoare sărăcia literaturii, datorită rarității porcuşorilor româneşti şi a lipsei semnificației lor economice în Polonia. Sunt necesare investigații viitoare.

ZUSAMMENFASSUNG: Untersuchungen über die rumänischen Gründling-Arten (Untergattung Romanogobio, Gobioninae, Cyprinidae).

Arbeit umfasst einen Überblick über die in Polen veröffentlichten Arbeiten zu rumänischen Gründlingen der Untergattung Romanogobio. Die Verfasser haben soweit es möglich war, die Mehrheit der Veröffentlichungen, die es zu diesem Thema gab, erfasst.

Es überrascht kaum, dass die Fachliteratur zu Romanogobio-Arten in Anbetracht ihrer Seltenheit und des mangelden wirtschaftlichen Nutzens in Polen wenig umfassend ist. Die Verfasser weisen darauf hin, dass weitere Untersuchungen und Nachforschungen sich als notwendig.

INTRODUCTION

The group *Romanogobio* (literally "the Romanian gudgeons") was originally designated by Bănărescu (1961) as one of three subgenera of the genus *Gobio* Cuvier, 1916 (subfamily Gobioninae, family Cyprinidae, order Cypriniformes). Initially it consisted of six species, i. e. type species *Romanogobio kesslerii* (Dybowski, 1862), *R. albipinnatus* (Lukasch, 1933), *R. amplexilabris*, *R. johntreadwelli*, *R. persus*, and *R. shansiensis*. Among them only the first two occur in Europe, all others in Asia (Bănărescu 1961, 1992; Bănărescu and Nalbant 1973; Nowak et al. 2008*a*). In the end of 20th century Naseka (1996) definitely recognised it as valid genus, simultaneously adding two another species, i. e. *R. ciscaucasicus* and *R. rivuloides*, which were previously (Bănărescu, 1961, 1992) joined to the genus *Rheogobio*. In 1998 Naseka and Bogutskaya described a new species of discussed genus, *R. pentatrichus*. Six years later, Naseka and Freyhof (2004) discovered one more new species, *R. parvus*, and added the stone gudgeon, considered previously as *Rheogobio uranoscopus* (Bănărescu, 1961, 1992; Naseka, 1996), to the genus *Romanogobio*. It was equal with considering that *Romanogobio* and *Rheogobio* are simultaneous synonyms, and the priority was given to the first of these two (Naseka and Freyhof, 2004; Nowak et al., 2008*a*). For the present moment the genus *Romanogobio* consists of 18 species (Nowak et al. 2008*a*).

In Poland it has been established for a long time that, beside of the common gudgeon *Gobio gobio* (Linnaeus, 1758), the only member of the subfamily Gobioninae was the so-called "long-barbel" gudgeon, considered usually to be conspecific with the stone gudgeon *Romanogobio uranoscopus* (Agassiz, 1828). However, in the 1950s and 1960s it was turned up that those "long-barbel" gudgeons belong in fact to two different species and any one of them is *R. uranoscopus*. They are the sand (or Kessler's) gudgeon *Romanogobio kesslerii* (Dybowski, 1862), and the whitefin gudgeon *Romanogobio belingi* (Slastenenko, 1934) (cf. the review in Nowak et al., 2006; 2007*a*; 2008*a*).

Additionally, in the early 1990s an alien gobionin species was found, the stone moroko *Pseudorasbora parva*. It probably has been brought together with stocking fish from Far East (via Hungary) (cf. Nowak et al. 2008*a*, *b*).

Nevertheless, regarding serious ambiguities in the taxonomy of *Romanogobio* spp. in central Europe (e. g. Mendel et al. 2005; Nowak and Koščo, unpubl. data), the issue of systematic position of the Polish populations of *R. kesslerii* and *R. belingi* is still rather not clear at all. Consecutive investigations are being currently processed (Nowak et al., unpubl. data).

MATERIALS AND METHODS

In the presented study we analyzed, as far as we are aware, most of the materials containing any information related to the gudgeons of the genus *Romanogobio* in Poland. Materials were analyzed in order of their publication. The specific names of each species were given as they appeared in the original publications. This work is a comparative review of the knowledge about Romanian gudgeons that occur in Poland.

RESULTS AND DISCUSSIONS

The first Polish work on the *Romanogobio* gudgeons, already of the great value, was that of Dybowski (1862), in which he distinguished gudgeons in Dniestr (Nistru) near Mohylew from *G. uranoscopus*, and described them as *G. kessleri* (Dybowski, 1862, 207).

Probably the first paper regarding the Romanian gudgeons within the territory of Poland was the work of Wałecki (1864), who mentioned that in Vistula and Dniestr (Nistru) River some gudgeons resembled *G. uranoscopus* which he called "long-barbel" gudgeon.

In nearly the same period Nowicki (1882) wrote that "long-barbel" gudgeon was present in San River (the Vistula River drainage) near Lesko. A few years later, he gave characteristics of these gudgeons, identified them as *G. uranoscopus* (Nowicki 1889).

Fisher (1895) repeated some remarks on *G. uranoscopus* in Vistula and Dniestr (Nistru) River after Nowicki (1882, 1889), and generally made nothing more in this point.

The next who dealt with so-called "long-barbel" gudgeon was Kowalski (1910), who gave some remarks on its identification, and mentioned its occurrence (identified as *G. uranoscopus*) in the San River system. All these information were repeated after Wałecki (1864) and Nowicki (1882, 1889).

Berg (1914) in his fundamental *Fauna of Russia* also mentioned about occurrence of *G. uranoscopus* in the San River system.

Staff (1950) cited both, Wałecki (1864) and Nowicki (1882, 1889), and repeated the statement about occurrence of "long-barbel" gudgeon, identified as *G. uranoscopus*. Irrespective, he had doubts about that identification, and following Dybowski (1862) speculated about possibility of presence of *G. kessleri* instead of *G. uranoscopus* in San River, so he gave short characteristics of both species.

Kowalska (1951), in her identification key, gave only a short characteristic of *G. uranoscopus*, together with statement that this species was recorded in San River, without any further discussion.

Rolik (1959) was the first who thoroughly investigated the hitherto question of Staff (1950). In 1956 and 1957 she collected original material from the San River system, and after thorough examinations, concluded that so-called “long-barbel” gudgeons from the San River system, those mentioned by Nowicki (1882, 1889), Staff (1950), Kowalska (1951), and probably also by Wałecki (1864), in fact belong to the species *G. kessleri*, as described by Dybowski (1862).

Balon (pers. comm. in Oliva 1960) found one specimen of *G. kessleri* that had been collected in Raba River (the Vistula River drainage) in the collection of the Department of Ichthyobiology and Fisheries of University of Agriculture in Kraków. It was the first, and for the present moment, the only record of the sand gudgeon outside of the San River system within the Vistula River drainage (cf. Błachuta 2001; Heese 2004). Then, in 1964 Balon one more time mentioned this specimen of *G. kessleri*. It must be stressed herein that consecutive investigations within the southern Vistula River drainage did not find this species in any of the tributaries of Vistula River, and so Błachuta (2001) speculated that original identification of Balon (pers. comm. in Oliva, 1960) was probably based on an erroneously catalogued material.

Nevertheless, Balon (1964) mentioned also presence of *G. kessleri* in Czarna Orawa River. Then, Balon and Holčik (1964) presented full characteristics of these sand gudgeons from Polish part of Czarna Orawa River.

Rolik (1965*a*), after gathering much wider material of sand gudgeons from the San River system, and outside of Poland (i. e. from the Dniester (Nistru) and Danube River drainage), discussed their taxonomic position in the context of other European populations of this species. She concluded that population from San River resembled the gudgeons from Dniester (Nistru) River more than typical specimens from Danube River.

In the same year the same author found one more species of the Romanian gudgeons inhabiting the Vistula River drainage. In the middle stretch of Vistula River she recorded the whitefin gudgeon *G. albipinnatus* (Rolik, 1965*b*).

Two years after, Rolik (1967*a*, *b*) described a cross-hybrid between *Gobio gobio sarmaticus* and *Gobio kessleri* from Strwiąż River (the Dniestr (Nistru) River drainage, SE Poland). However, regarding that the sand gudgeon has never been recorded in that river, and reconsidering morphometric and meristic characters given originally by Rolik (1967*a*, *b*), it seems more probable that the specimen belonged to *G. gobio* s. lato rather than to *R. kesslerii*. Nevertheless, such possibility cannot be definitely excluded without re-examination of the material.

In 1971 she gave thorough distribution of *G. kessleri* in her catalogue of the fishes that occur in the San River system (Rolik, 1971).

Rembiszewski and Rolik (1975) gave first record of *G. albipinnatus* from Narew River near Różan. They also listed all the publications known for them concerning *G.* (*Romanogobio*) *albipinnatus* and *G.* (*Romanogobio*) *kessleri*.

In 1980 Rolik mentioned in short faunistic notes about biology and distribution of *G. albipinnatus* and *G. kessleri* in Vistula River drainage.

In 1986, in the fundamental *The freshwater fishes of Poland* edited by M. Brylińska, Białokoz (1986) gave a short review of the status of both, sand- and whitefin gudgeon, within the territory of Poland. Generally nothing more was added in the reviewed edition of this book (Białokoz, 2000).

Rolik and Rembiszewski (1987) thoroughly described morphology of *G.* (*Romanogobio*) *kessleri* and *G.* (*Romanogobio*) *albipinnatus*, and one more time gave a record of this species in Narew River (the Vistula River drainage; as per Rembiszewski and Rolik 1975). Furthermore, they repeated information abuts cross-hybrid between the sand and common gudgeon (cf. Rolik, 1967*a*, *b*).

In 1992 Marszał and Penczak found some new localities of *G. albipinnatus* in the Narew River system.

In the mid- 1990s *G. albipinnatus* was found in the Odra (Oder) River drainage, and reported nearly simultaneously by Błachuta and Dębicki (1994; two specimens from a one site), and Błachuta et al. (1994; following three sites). These authors gave also basic morphometric characteristics of the specimens collected by them. In the same paper they mentioned some new localities of *G. albipinnatus* and *G. kessleri* from San River. Błachuta et al. (1994) additionally speculated about subspecific identity of the whitefin gudgeon in the Vistula and Odra (Oder) River drainage, and they concluded that most probably they should be classified as *G. albipinnatus belingi*, however they did not excluded possibility of classification as *G. albipinnatus vladykovi*, as it was somehow speculated by Marszał and Penczak (1992).

Danilkiewicz (1999) very comprehensively and thoroughly characterised distribution and morphology of *G. albipinnatus* from the Western Bug River system, supplementing his own previous observations (Danilkiewicz, 1985, 1988).

The publication of Witkowski and Błachuta (2001) was a short review of information given earlier by Białokoz (1986, 2000).

Also in 2001 Błachuta summarized the most important data about ecology, known distribution, and conservation status of *G. albipinnatus* and *G. kessleri*.

Nowak et al. (2006, 2007*a*) reviewed the current knowledge about the gudgeons, both *Gobio* and *Romanogobio*, in Poland. The authors were probably also the first who applied corrected spelling of the specific name of the sand gudgeon, *R. kesslerii* (cf. Kottelat, 1997; Bănărescu, 1999).

Later, the same authors (Nowak et al. 2007*a*, 2008*b*), in the work concerning some aspects of morphological variability of *G. gobio*, gave a short outline of the status of *Romanogobio* gudgeons in Poland.

In the same year there was published a check-list of the gudgeons that occur in European waters, and discussed a number of taxonomic issues and ambiguities in the field of the systematics of gobionins (Nowak et al. 2008*a*).

Also in 2008 Szlachciak and Ząbkiewicz discussed some morphological and osteological characters of *G. gobio* from Odra (Oder) River in the context of its possible misidentification with *G. albipinnatus*.

Beside of those direct studies on Polish populations of the Romanian gudgeons, some samples from Poland were analysed by authors from abroad (in spite of fact that some authors mentioned already above, i. e. Balon E. K., Oliva O., Holčik J., are Slovak, and Berg was Russian L. S.). These are especially works of Bănărescu (1999), Naseka et al. (1999), and Naseka (1996, 2001*a*, *b*). Also Freyhof et al. (2000) mentioned occurrence of the whitefin gudgeon in the Odra (Oder) River drainage. Short information about occurrence of *R. kesslerii* in the San River system was given also by Weisz and Kux (1966), and Baruš and Oliva (1995).

CONCLUSIONS

Literature on gudgoens of the genus *Romanogobio* in Poland is not very rich. Most of published papers are some kinds of faunistic investigations, where Romanian gudgeons are mentioned as a part of local ichthyofauna. Direct investigations were very rare (e. g. Rolik, 1959, 1965*a*, *b*; Błachuta et al., 1994; Danilkiewicz, 1999). It is probably in part due to low (if any at all) economic importance of that group of cyprinids. Other reason may be a problem of identification of *Romanogobio* spp., especially their distinguishing from the common gudgeon. Anglers, the people who are often the first source of information about occurrence of some rare (or though-to-be rare) species (cf. Błachuta and Dębicki, 1994), are in the opinion of the authors nearly unable to recognise *R. belingi* and *R. kesslerii* in the field, it is the same opinion as of Błachuta et al. (1994). Thus, education of that group is definitely needed. It is also expected because the whitefin and sand gudgeon are the species protected by Polish legislation (Ministry of Agriculture and Rural Development 2003), as well as they are species of special care in the terms of Nature 2000 network (Habitats Directive 92/43/EWG; cf. Heese 2004).

Detailed systematic position of the whitefin and sand gudgeons that occur in the territory of Poland is in great part unclear (cf. Rolik 1965*a*; Błachuta et al. 1994; Naseka et al. 1999; Nowak et al. 2006). Naseka et al. (1999) placed Polish populations of the whitefin gudgeon somewhere between the subspecies *G. albipinnatus albipinnatus* and *G. albipinnatus belingi*. Later, Naseka (2001*a*, *b*) classified them as *R. albipinnatus belingi*, the same as was suggested by Błachuta et al. (1994). Then, in 2007 Kottelat and Freyhof, regarding the current changes in the systematics of fishes (for the review cf. Nowak et al. 2008*a*), concluded that this part of Europe is inhabited by the species *Romanogobio belingi*.

After all, as it has already been stressed in previous sections, current status of knowledge is still far from a consensus, so consecutive direct investigations are being conducted (Nowak et al., unpubl. data). It is additionally important to fill these gaps in the knowledge because of conservation problems mentioned above (both, national legislation and Nature 2000 network). It is rather discussable if we could successfully protect the object in nature without thorough knowledge about what we are particularly going to protect (cf. Nowak et al. 2008*a*).

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THE PRESENT STATUS OF THE FISH SPECIES CONSIDERED OF COMMUNITY AND NATIONAL INTEREST, IN THE DANUBE DELTA BIOSPHERE RESERVE, ROMANIAN SECTOR

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KEYWORDS: fish species of community and national interest, Habitats Directive, Urgency Order No. 57, present-day status.

ABSTRACT

This paper intended to analyze the present status of fish species from area of the Danube Delta Biosphere Reserve which were included in the lists containing species of community interest (Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora - Habitats Directive) and community and national one (Urgency Order No. 57 of 20 June 2007 regarding the natural protected areas, conservation of natural habitats and of wild fauna and flora). Such, in this area a number of 24 species are listed as community interest and 9 of national one. Taking in account the actual geographical range, frequency and abundance at the European, national and local (analyzed places) level, the author believes that some unconcordances have been done in the selection of some fish species. Thus, he propose that 17 species of community interest have to put in other annexes or let only in one, while 4 species which now are well represented in its geographical range and are not threatened, have to take out from the annexes.

REZUMAT: Situația actuală a speciilor de pești din Rezervația Biosferei Delta Dunării, sectorul românesc, considerate de interes comunitar şi național.

Prezenta lucrare şi-a propus să analizeze situația actuală a speciilor de peşti din teritoriul Rezervației Biosferei Delta Dunării, considerate de interes comunitar şi național, incluse în anexele Directivei Habitate (Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora) şi Ordonanța de Urgență Nr. 57 din 20 iunie 2007 privind regimul ariilor naturale protejate, conservarea habitatelor naturale, a florei şi faunei sălbatice. Astfel, în această zonă sunt listate un număr de 24 specii de interes comunitar şi 9 specii de interes național. Analizându-se situația actuală a fiecărei specii prin prisma arealului geografic general, european, național şi local, autorul consideră că există unele neconcordanțe în privința selectării unor specii de peşti în categoriile listate. Astfel, propune ca 17 specii de interes comunitar să fie incluse în alte categorii (anexe) sau să fie lăsate într-o singură anexă, iar 4 specii bine reprezentate în arealul lor geografic şi neamenințate în prezent, să fie scoase din anexe.

ZUSAMMENFASSUNG: Gegenwärtiger Zustand der Fischarten von gemeinschaftlichem und nationalem Interesse im Biosphärenreservat Donau-Delta/Rumänien.

Die vorliegende Arbeit hat sich zum Ziel gesetzt, den gegenwärtigen Zustand der Fischarten von gemeinschaftlichem und nationalem Interesse im Biosphärenreservat Donau-Delta. Rumänien zu analysieren. Dabei handelt es sich um die Arten, die in den Anhanglisten der Flora Fauna Habitatrichtlinie (Richtlinie 92/43/EEC vom 21. Mai 1992 betreffend den Schutz natürlicher Habitaten sowie der wildlebenden Fauna und Flora) und in der Dringlichkeitsverordnung (Ordonanța de Urgență) Nr. 57 vom 20. Juni 2007 betreffend die Bestimmungen zur Funktionsweise der Naturschutzgebiete, den Schutz der natürlichen Habitate sowie der wildlebenden Flora und Fauna, erfasst sind. Unter Berücksichtigung oben genannter Bestimmungen wurden aus dem rumänischen Donau-Delta 24 Arten von gemeinschaftlicher und 9 Arten von nationaler Bedeutung aufgelistet. Auf Grund der Analyse des gegenwärtigen Zustandes jeder einzelnen Art in Bezug auf ihre allgemeine geographische Verbreitung, ihr europäisches Areal sowie ihre nationale und lokale Verbreitung, stellt der Verfasser einige nicht übereinstimmende Angaben in Zusammenhang mit der Auswahl einiger Arten in den aufgelisteten Kategorien fest. Daher schlägt er vor, 17 Arten von gemeinschaftlichem Interesse in eine andere Kategorie (Anhangliste) einzugliedern oder sie in nur einer Anhangliste zu belassen. Vier Arten, die in ihrem Verbreitungsgebiet gut vertreten und gegenwärtig nicht bedroht sind, sollten seiner Meinung nach aus den Anhanglisten gestrichen werden.

INTRODUCTION

In the context of alignment of Romania to the European Union principles concerning the habitats, flora and fauna protection, some measures have been taken in this way in the last period: the appearance of new national legislation on conservation of natural habitats and wild flora and fauna, implementation at the national level of project Natura 2000 in order to establish special protected area for habitats and species of community interest, so on. Thus, Romanian Government elaborated more documents in the course of time, as follows: Government Urgency Order Nr. 236/2000, Law Nr. 462/2001 for approval of this order, Order Nr. 1198/2005 for actualization and completion previous ones and finally, Government Urgency Order Nr. 57/2007, which seem to be more clear and entirely. Generally, the lists containing fish species of community interest are the copies of those from the Habitats Directive.

MATERIALS AND METHODS

The systematic and quantitative inventory of fish fauna from the Danube Delta Biosphere Reserve is relatively recently. It has been begun in 1990 and is on-going. A team of Danube Delta Research Institute has carried out the researches, by specific fishing methods: different kind of fishing nets, electro fishing, and so on. The obtaining data were compared with previous ones, using scientific literature both from Romania and abroad. The comparison of lists from Habitats Directive and Government Urgency Order No. 57/2007 with the present status of fish species has been done. The following terms have been taken in account for analyzed species:

-COUNCIL DIRECTIVE 92/43/EEC/ 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)

ANN. II: community interest animals and plants of whose conservation requires the designation of special conservation areas.

ANN. IV: animal and plant species of community interest of strict protection

ANN. V: animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures

-Urgency Order No. 57/ 20 June 2007 on the regimen of natural protected areas, conservation of natural habitats and of wild fauna and flora

ANN. 3: community interest animals and plants whose conservation requires the designation of special areas of conservation.

ANN. 4A: community interest animal and plant species in need of strict protection.

ANN. 4B: animal and plant species of national interest in need of strict protection

ANN. 5A: animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures

ANN. 5 B: animal and plant species of national interest whose taking in the wild and exploitation may be subject to management measures.

Species of community interest - species which in the European territory of the Member States are endangered, vulnerable, rare or endemic.

Species of national interest - the term is not clearly defined. It probably means to the species which are included in the national red lists (can be the Red Book of the vertebrates from Romania, 2005).

The scientific names of some species from the Habitats Directive lists and Urgency Order No. 57 were modified in accordance with the last taxonomically revisions.

RESULTS AND DISCUSSIONS

A number of 33 fish species of community and national interest there are in the Danube Delta Biosphere Reserve, which are included in the Habitats Directive and Urgency Order No. 57, as follows (Tab. 1; Figs. 1 and 2).

Table 1: Number of fish species of community and national interest from the Danube Delta Biosphere Reserve.

No. of species of community interest		No. of species of national interest (only in the Urgency Order NR 57, Ann. 4B, 5B)
Habitats Directive, Ann. II, IV, V.	Urgency Order 57, Ann. 3, 4A, 5A	
25	24	9

Taking in account the actual status of each fish species of the Danube Delta Biosphere Reserve, we learn the following:

1. ***Eudontomyzon mariae*** (Berg, 1931) (Ukrainian brook lamprey, Cicar)
Species of community interest.
Romanian Red Book: Critically Endangered
IUCN Red List: Data Deficient
Habitats Directive: Ann. II
Urgency Order No. 57: Ann. 3
Present-day status: present in the montain area of some rivers as Gilord, Motru, Olt, Argeş, Suceava, Moldova, from where may reach in the Danube in the time of flooding periods. In the Danube Delta Biosphere Reserve area only 2 juvenile specimens were recorded in the Danube River in last decade.

2. ***Huso huso*** (Linnaeus, 1758) (Beluga, Morun)
Species of community interest.
Romanian Red Book: Endangered
IUCN Red List: Endangered
Habitats Directive: Ann. V
Urgency Order No. 57: Ann. 5A
Present-day status: rare in the Black Sea, Danube River till Iron Gates. Its population drastically decreased in the last decades (about 50 folds in comparison with 1920-1980 period)

3. ***Acipenser guldenstaedtii*** Brandt **and Ratzeburg, 1833** (Russian sturgeon, Nisetru)
Species of community interest.
Romanian Red Book: Endangered
IUCN Red List: Endangered
Habitats Directive: **Ann. V**
Urgency Order No. 57: **Ann. 5A**
Present-day status: rare in the Black Sea, Danube River till Iron Gates. Its population drastically decreased in the last decades (more than *Huso huso*)

4. ***Acipenser stellatus*** Linnaeus, 1758 (Starry sturgeon, Păstrugă)
Species of community interest.
Romanian Red Book: Endangered
IUCN Red List: Endangered
Habitats Directive: **Ann. V**
Urgency Order No. 57: **Ann. 5A**
Present-day status: rare in the Black Sea, Danube River till Iron Gates. Its population decreased in the last decades, about 15 folds in comparison with 1920-1950 period.

5. ***Acipenser ruthenus*** Linnaeus, 1758 (Sterlet, Cegă)
Species of community interest.
Romanian Red Book: Vulnerable
IUCN Red List: Vulnerable
Habitats Directive: **Ann. V**
Urgency Order No. 57: **Ann. 5A**
Present-day status: rare in the Danube River and very rare in some tributaries as Prut and Mureş. Its population drastically decreased in the last decades.

6. ***Acipenser nudiventris*** Lovetzsky, 1828 (Ship sturgeon, Viză)
Species of community interest.
Romanian Red Book: Critically Endangered
IUCN Red List: Endangered
Habitats Directive: **Ann. V**
Urgency Order No. 57: **Ann. 5A**
Present-day status: before sporadically records in the Danube River. It no more was recorded in the last decades in Romania, but in CS (1 specimen in 2003).

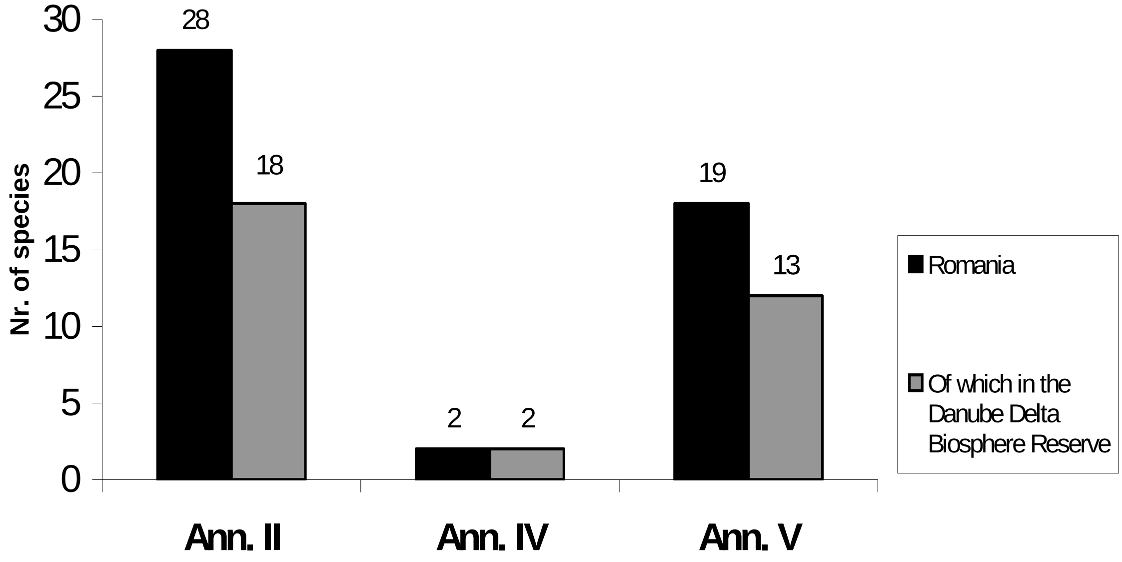
7. ***Acipenser sturio*** Linnaeus, 1758 (Common sturgeon, Şip)
Species of community interest.
Romanian Red Book: Extinct
IUCN Red List: Critically Endangered
Habitats Directive: **Ann. II and IV**
Urgency Order No. 57: **Ann. 5A**
Present-day status: before sporadically records at the mouths of Danube River and the Black Sea. It no more was recorded in the last decades in Romania.

8. ***Alosa immaculata*** Bennett, 1835 (Pontic shad, Scrumbie de Dunăre)
Species of community interest.
Pontic endemism.
Romanian Red Book: No
IUCN Red List: Data Deficient
Habitats Directive: **Ann. II and V**
Urgency Order No. 57: **Ann. 3 and 5A**
Present-day status: rather sporadically in the Black Sea, Romanian sector. In the breeding period it enters in the Danube River reaching till Iron Gates, when great quantities are harvested by industrial fishing every year. In 1960-1988 period the harvesting pontic shad was 450-2500 tons but in the last years it is 80-400 tons, in the Danube Delta Biosphere Reserve area.

9. ***Alosa tanaica*** (Grimm, 1901) (Azov shad, Rizeafcă)
Species of community interest.
Romanian Red Book: No
IUCN Red List: No
Habitats Directive: **Ann. II and V**
Urgency Order No. 57: **Ann. 3 and 5A**
Present-day status: it is rather common in the Black Sea, Razim-Sinoie, Danube River and some lakes in the Danube Delta Biosphere Reserve. However, its population has decreased in the last decade. Its harvesting quantities obtaining by industrial fishing are 74-20 tons in the last years, 4-5 folds smaller than 1960-1989 period.

10. ***Umbra krameri*** Walbaun, 1792 (Mudminnow, Ţigănuş)
Species of community interest.
Danubian endemism.
Romanian Red Book: Vulnerable
IUCN Red List: Vulnerable
Habitats Directive: **Ann. II**
Urgency Order No. 57: **Ann. 3**
Present-day status: in Romania it is present in few stagnant waters from counties Satu Mare, Bihor, Giurgiu, Ilfov and Călăraşi. In tha Danube Delta it is rather little numerous in some stagnant freshwaters. Its number drastically decreased in the last decades because of eutrophication.

11. ***Aspius aspius*** (Linnaeus, 1758) (Asp, Avat)
Species of community interest.
Romanian Red Book: No
IUCN Red List: Data Deficient
Habitats Directive: **Ann. II and V**
Urgency Order No. 57: **Ann. 3**
Present-day status: it is one of the spreadest fish species in the Danube Delta Biosphere Reserve, entire the Danube River and its large tributaries.



Ann. II

Acipenser sturio
Alosa tanaica
Alosa immaculata
Aspius aspius
Barbus meridionalis
Chalcalburnus chalcoides
Cobitis elongata
Cobitis elongatoides
Cottus gobio
Eudontomyzon danfordi
Eudontomyzon mariae
Eudontomyzon vladykovi
Romanogobio vladycovi
Romanogobio kesslerii
Gobio uranoscopus
Gymnocephalus baloni
Gymnocephalus schraetzer
Hucho hucho
Telestea souffia
Misgurnus fossilis
Pelecus cultratus
Rhodeus amarus
Romanichthys valsanicola
Rutilus virgo
Sabanejewia bulgarica
Umbra krameri
Zingel streber
Zingel zingel

Ann. IV

Acipenser sturio
Gymnocephalus baloni

Ann. V

Acipenser gueldenstaedtii
Acipenser nudiventris
Acipenser ruthenus
Acipenser stellatus
Huso huso
Alosa immaculata
Alosa tanaica
Aspius aspius
Thymallus thymallus
Coregonus lavaretus
Coregonus albula
Hucho hucho
Aspius aspius
Barbus meridionalis
Barbus barbus
Pelecus cultratus
Rutilus virgo
Gymnocephalus schraetzer
Zingel zingel

Figure 1: The species of fishes
in accordance with the Habitats Directive
(COUNCIL DIRECTIVE 92/43/EEC).

12. ***Chalcalburnus chalcoides*** (Gueldenstaedt, 1772) (Danube bleak, Oblete mare)
Species of community interest.
Romanian Red Book: Critically Endangered
IUCN Red List: Data Deficient
Habitats Directive: **Ann. II**
Urgency Order No. 57: **Ann. 3**
Present-day status: 2 fish were recorded in Romania in the last decade, in the Danube Delta Biosphere Reserve (Danube River to Cotul Pisicii). Before it was mentioned sporadically in more places of Danube River, Razim-Sinoie and Black Sea coast.

13. ***Petroleuciscus borysthenicus*** (Kessler, 1859) (Dnieper chub, Cerbuşcă)
Species of national interest.
Romanian Red Book: No
IUCN Red List: Data Deficient
Habitats Directive: **No**
Urgency Order No. 57: **Ann. 4 B**
Present-day status: frequent but not abundant in many stagnant fresh-waters in Danube Delta Biosphere Reserve. At national level, it was recorded only in Comana.

14. ***Rhodeus amarus*** (Bloch, 1782) (Bitterling, Boarță)
Species of community interest.
Romanian Red Book: No
IUCN Red List: No
Habitats Directive: **Ann. II**
Urgency Order No. 57: **Ann. 3**
Present-day status: one of the most frequent and abundant fish species in the stagnant fresh-waters of the Danube Delta Biosphere Reserve. At the national level, it is also a common species in all over the county, excepting the mountain areas.

15. ***Pelecus cultratus*** (Linnaeus, 1758) (Ziege, Sabiță)
Species of community interest.
Romanian Red Book: No
IUCN Red List: Data Deficient
Habitats Directive: **Ann. II and V**
Urgency Order No. 57: **Ann. 3**
Present-day status: Common in the Razim-Sinoie and sporadic in the Danube River (Danube Delta Biosphere Reserve). At the national level, it is abundant and frequent in the Danube River and rare enough in some large tributaries (Mureş, Someş, Prut, Siret, Criş).

16. ***Carassius carassius* (Linnaeus, 1758)** (Crucian carp, Caracudă)
Species of national interest.
Romanian Red Book: Endangered
IUCN Red List: No
Habitats Directive: **No**
Urgency Order No. 57: **Ann. 4 B**
Present-day status: sporadically presence in the few stagnant fresh-waters from Romania. In the Danube Delta Biosphere Reserve area also it lives in few channels and lakes. In the last decades its populations drastically decreased, near disappearing.

17. ***Barbus barbus*** (Linnaeus, 1758) (Barbel, Mreană)
Species of national interest.
Romanian Red Book: No
IUCN Red List: No
Habitats Directive: **Ann. V**
Urgency Order No. 57: **Ann. 5 A**
Present-day status: wide spread in majority large tributaries of Danube. In the Danube Delta Biosphere Reserve it has a sporadically presence in Danube River.

18. ***Gobio albipinnatus*** Lukasch, 1933 (White-finned gudgeon, Porcuşor de şes)
Species of community interest.
Romanian Red Book: No
IUCN Red List: Data Deficient
Habitats Directive: **Ann. II**
Urgency Order No. 57: **Ann. 3**
Present-day status: wide spread in majority large tributaries of Danube. In the Danube Delta Biosphere Reserve it frequent and abundant in Danube River.

19. ***Gobio kessleri*** Dybowsky, 1862 (Kessler's gudgeon, Porcuşor de nisip)
Species of community interest.
Romanian Red Book: Vulnerable
IUCN Red List: No
Habitats Directive: **Ann. II**
Urgency Order No. 57: **Ann. 3**
Present-day status: wide spread in majority large tributaries of Danube. In the Danube Delta Biosphere Reserve it is very rare in Danube River.

20. ***Misgurnus fossilis*** (Linnaeus, 1758) (Weatherfish, Țipar)
Species of community interest.
Romanian Red Book: No
IUCN Red List: Lower Risk / Not threatened
Habitats Directive: **Ann. II**
Urgency Order No. 57: **Ann. 3**
Present-day status: wide spread in majority stagnant fresh-waters of the hill and flat areas in Romania. In the Danube Delta Biosphere Reserve it is also frequent in many stagnant fresh-water bodies.

21. ***Cobitis elongatoides*** Bacescu and Maier, 1969 (Spine loach, Zvârlugă)
Species of community interest.
Romanian Red Book: No
IUCN Red List: No
Habitats Directive: **Ann. II**
Urgency Order No. 57: **Ann. 3**
Present-day status: wide spread in majority stagnant fresh-waters and some rivers of the hill and flat areas in Romania. In the Danube Delta Biosphere Reserve it is also frequent in most stagnant fresh-water bodies.

22. ***Sabanejewia bulgarica*** (Drensky, 1928) (Goldside loach, Dunărință) (before *Sabanejewia aurata bulgarica*)
Species of community interest.
Romanian Red Book: No
IUCN Red List: Data Deficient
Habitats Directive: **Ann. II**
Urgency Order No. 57: **Ann. 3**
Present-day status: spread in Danube River and some large tributaries as Someş, Mureş, Bega, Cerna and Argeş. In the Danube Delta Biosphere Reserve area it is a rather common presence in the Danube River.

23. ***Lota lota*** (Linnaeus, 1758) (Burbot, Mihalț)
Species of national interest.
Romanian Red Book: Vulnerable
IUCN Red List: No
Habitats Directive: **No**
Urgency Order No. 57: **Ann. 4 B**
Present-day status: rare in Danube River and some tributaries as Mureş, Bega, Timiş, Olt, Siret (Putna). Sporadically presence in the Danube Delta Biosphere Reserve (Danube).

24. ***Sander volgensis*** (Gmelin, 1788) (Volga pikeperch, Şalău vărgat)
Species of national interest.
Romanian Red Book: Critically Endangered
IUCN Red List: Data Deficient
Habitats Directive: **No**
Urgency Order No. 57: **Ann. 4 B**
Present-day status: it was identified as very rare in Danube River and Crişul Repede. In the Danube Delta Biosphere Reserve area, a few specimens were recorded in Danube River, lake Parcheş and melea Sacalin.

25. ***Gymnocephalus baloni*** Holcik and Hensel, 1974 (Balon's ruffe, Ghiborț de Dunăre)
Species of community interest.
Romanian Red Book: Vulnerable
IUCN Red List: Data Deficient
Habitats Directive: **Ann. II and IV**
Urgency Order No. 57: **Ann. 3 and 4 A**
Present-day status: in Romania it is present in the Danube River and some tributaries as Crişuri, Someş, Mureş, Ialomița, Argeş, Olt, Vedea, Timiş. It is abundant in Danube River in Danube Delta Biosphere Reserve.

26. ***Gymnocephalus schraetser*** (Linnaeus, 1758) (Sfhraetzer, Răspăr)
Species of community interest.
Danubian endemism.
Romanian Red Book: Vulnerable
IUCN Red List: Vulnerable
Habitats Directive: **Ann. II and V**
Urgency Order No. 57: **Ann. 3**
Present-day status: in Romania it is frequent in the Danube River and rare in some tributaries as Crişuri, Someş, Mureş, Prut, Siret. It is frequent and abundant in Danube River and very rare in Razim - Sinoie (Danube Delta Biosphere Reserve).

27. ***Percarina demidoffi demidoffi*** Nordmann, 1840 (Percarina)
Species of national interest
Pontic endemism
Romanian Red Book: No
IUCN Red List: Vulnerable
Habitats Directive: **No**
Urgency Order No. 57: **Ann. 4 B**
Present-day status: abundant and frequent in the Razim-Sinoie lagoon and very rare in the Black Sea, area of the Danube Delta Biosphere Reserve.

28. ***Zingel streber*** (Siebold, 1863) (Danube streber, Fusar)
Species of community interest
Endemic to the Danube Basin and Vardar
Romanian Red Book: Endangered
IUCN Red List: Vulnerable
Habitats Directive: **Ann. II**
Urgency Order No. 57: **Ann. 3**
Present-day status: rather numerous in some area of Danube River, upstream of Isaccea and sporadically in some tributaries as Mureş, Criş, Someş, Bega, Timiş and Nera. It is a very rare species in the Danube Delta Biosphere Reserve, living only in the Danube River.

29. ***Zingel zingel*** (Linnaeus, 1766) (Zingel, Pietrar)
Species of community interest
Endemic to the Danube Basin and Nistru.
Romanian Red Book: Vulnerable
IUCN Red List: Vulnerable
Habitats Directive: **Ann. II and V**
Urgency Order No. 57: **Ann. 3, 4 A and 5 A**
Present-day status: rather numerous in some area of the Danube River, upstream of Isaccea and sporadically in some tributaries as Mureş, Crişuri and Prut. It is rare in the Danube Delta Biosphere Reserve, living in this case only in the Danube River.

30. ***Mesogobius batrachocephalus*** (Pallas, 1814) (Knout goby, Hanos)
Species of national interest.
Pontic endemism
Romanian Red Book: Vulnerable
IUCN Red List: Data Deficient
Habitats Directive: **No**
Urgency Order No. 57: **Ann. 5 B**
Present-day status: present in the Black Sea, southern of Capul Midia, but not numerous. It no more was recorded in the costal area of the Danube Delta Biosphere Reserve, at least in the two last decades.

31. ***Neogobius syrman*** **(**Nordmann, 1840) (Syrman goby, Sirman)
Species of national interest.
Romanian Red Book: Endangered
IUCN Red List: Data Deficient
Habitats Directive: **No**
Urgency Order No. 57: **Ann. 4 B**
Present-day status: at the national level it is present only in the Danube Delta Biosphere Reserve, Razim-Sinoie, where it is numerous.

32. ***Neogobius eurycephalus*** (Kessler, 1874) (Ginger goby, Guvid fălcos)
Species of national interest.
Pontic endemism
Romanian Red Book: Vulnerable
IUCN Red List: No
Habitats Directive: **No**
Urgency Order No. 57: **Ann. 5 B**
Present-day status: present in the Black Sea, Constanța area, and Danube Delta Biosphere Reserve, where it is frequent and abundant in the Danube River and less numerous in the Razim-Sinoie.

33. ***Proterorhinus marmoratus*** (Pallas, 1814) (Tubenose goby, Moacă de brădiş)
Species of national interest.
Romanian Red Book: No
IUCN Red List: No
Habitats Directive: **No**
Urgency Order No. 57: **Ann. 4 B**
Present-day status: at the national level it is present in some stagnant fresh-waters from South and North. It is a common species in the Danube Delta Biosphere Reserve, about in all stagnant fresh-waters and brackish.

CONCLUSIONS

-In the author's opinion, the Habitats Directive took less in account the status of fish species from the South-Eastern part of Europe.

-Romanian Government, in order to line up to the Habitats Directive principles, elaborated more documents in the course of time, as follows: Government Urgency Order No. 236/2000, Law No. 462/2001 for approval of this order, Order No. 1198/2005 for actualization and completion previous ones and finally, Government Urgency Order No. 57/2007, which seem to be more clear and entirely. Generally, the lists containing fish species of community interest are the copies of those from the Habitats Directive.

SPECIES	HABITATS DIRECTIVE		URGENCY ORDER NR. 57	
	ANNEXES	AUTHORS'S PROPOSAL	ANNEXES	AUTHORS'S PROPOSAL
Acipenser gueldenstaedtii	V	**IV**	5A	**4A**
Acipenser nudiventris	V	**IV**	5A	**4A**
Acipenser ruthenus	V	**V**	5A	**5A**
Acipenser stellatus	V	**V**	5A	**5A**
Acipenser sturio	II, IV	**IV**	5A	**4A**
Alosa immaculata	II, V	**V**	3, 5A	**5A**
Alosa tanaica	II, V	**V**	3, 5A	**5A**
Aspius aspius	II, V	**II (only for Finnish populations). For the others, No.**	3	**No**
Barbus barbus	V	**No**	5A	**No**
Carassius carassius			4B	**4B**
Chalcalburnus chalcoides	II	**IV**	3	**4A**
Cobitis danubialis	II	**No**	3	**No**
Eudontomyzon mariae	II	**II**	3	**3**
Gobio albipinnatus	II	**IV**	3	**4A**
Gobio kesslerii	II	**IV**	3	**4A**
Gymnocephalus baloni	II, IV	**IV**	3, 4A	**4A**
Gymnocephalus schraetser	II, V	**IV**	3	**4A**
Huso huso	V	**V**	5A	**5A**
Lota lota			4B	**4B**
Mesogobius batrachocephalus			5B	**4B**
Misgurnus fossilis	II	**V**	3	**5A**
Neogobius eurycephalus			5B	**5B**
Neogobius syrman			4B	**5B**
Pelecus cultratus	II, V	**No**	3	**No**
Percarina demidoffii			4B	**4B**
Petroleuciscus borysthenicus			4B	**4B**
Proterorhinus marmoratus			4B	**No**
Rhodeus amarus	II	**No**	3	**No**
Sabanejewia bulgarica	II	**IV**	3	**4A**
Sander volgensis			4B	**4B**
Umbra krameri	II	**II**	3	**3**
Zingel streber	II	**IV**	3	**4A**
Zingel zingel	II, V	**IV**	3, 4A, 5A	**4A**

-A thing is clear: it is not possibly to institute the special areas of conservation for the species which are spread, for example, in all the Danube River water course as *Alosa immaculata (pontica), A. tanaica (caspia), Sabanejewia bulgarica (aurata), Gobio albipinnatus, G. kessleri, Gymnocephalus baloni, G. schraetser* etc.

-Taking in account the actual status of the fish species considered of community and national interest, at the European and national level, the following author's proposals are recommended (the upper table).

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NON-NATIVE ORNAMENTAL FISH IN ROMANIAN FRESHWATERS

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KEYWORDS: Romania, aquarium, non-indigenous fish, inland waters.

ABSTRACT

The entry, establishment, and spread of non-native species of fish in new environments can cause major economic damage, irreversible ecological changes, and significant public health impacts. The paper treats the most important ornamental fish that are non-native for Romanian freshwaters.

REZUMAT: Specii ornamentale non-native de peşti în apele dulci româneşti.

Pătrunderea, stabilirea şi răspândirea speciilor de peşti non-nativi în medii noi pot cauza prejudicii economice majore, modificări ecologice ireversibile şi un impact semnificativ în sectorul sănătății publice. Lucrarea tratează cele mai importante specii de peşti, non-native pentru apele dulci româneşti.

RÉSUMÉ: Especies de peces ornamentales non-nativos en las aguas dulces rumanas.

La intrusión, el establecimiento y el esparcimiento de las especies de peces non-nativos en nuevos medios pueden causar perjuicios económicos, cambios ecológicos irreversibles e impactos importantes en el sector de la salud pública. El trabajo trata las más importantes especies ornamentales non-nativas de las aguas dulces rumanas.

INTRODUCTION

Accidental or intentional introductions of non-native plants animal and microbes cause significant ecological and agricultural crop damage worldwide. Trade in both manufactured and agricultural goods is a primary vector for such introductions.

The entry, establishment, and spread of non-native species in new environments can cause major economic damage, irreversible ecological changes, and significant public health impacts. While many non-native species provide benefits in their new environment, or are considered benign, others are regarded as detrimental and therefore invasive. In many cases, the classification of non-native species is complicated by offsetting benefits from damages (Andersen et al., 2004).

In a selection from the global invasive species database, Lowe et al. (2000), catalogate the followings as the world's worst invasive alien species: crazy ant (*Anoplolepis gracilipes*), brown tree snake (*Boiga irregularis*), feral pig (*Sus scrofa*), Nile perch (*Lates niloticus*), western mosquitofish (*Gambusia affinis*), small Indian mongoose (*Herpestes javanicus auropunctatus),* rosy wolfsnail (*Euglandina rosea*), water hyacinth (*Eichhornia crassipes*), miconia (*Miconia calvescens*), avian malaria (*Plasmodium relictum*), caulerpa seaweed (*Caulerpa taxifolia*), strawberry gava (*Psidium cattleianum*).

Beside the two fish species above mentioned, there are many others with or with no importance for economy. Here are the most significant of them (Lowe et al., 2000): the brown trout (*Salmo trutta*), the common carp (*Cyprinus carpio*), the large-mouth bass (*Micropterus salmoides*), Mozambique tilapia (*Oreochromis mossambicus*), rainbow trout (*Oncorhynchus mykiss*), and walking catfish (*Clarias batrachus*).

Romania has a few aliens too, and fishes do not lack from Romanian waters. From these ones, beside species of interest for aquiculture, the ornamental or aquarium fish are mostly intentional introduced. Be they invasive or not, non-native aquarium species of freshwater fish in Romania are the subject of this brief paper.

MATERIALS AND METHODS

We made a survey of the literature, and we took in consideration all the materials available in Romania, dealing much or less with ornamental freshwater fish species.

We don't pretend we managed to consider all of the existing papers but, essentially most important data are included in this paper.

RESULTS AND DISCUSSIONS

After compilation of this information, primary data were used for completing the following table which contains the most important non-native ornamental freshwater fish in Romanian waters (Tab. 1).

Pumpkinseed sunfish is a member of Centrarchidae Family. It was introduced in Europe during the late 19th century (Roule, 1931; Vivier, 1951; Vooren, 1972) and in particular to a few small water bodies in southern England during the 1890s (Wheeler and Maitland, 1973). The native distribution of the sunfish in North America is restricted to eastern North America (in the upper drainage area of Mississippi, Great Lakes, and Atlantic Ocean, from St. Lawrence to South Carolina; Bănărescu, 1964), where sunfishes are known to have existed since the Miocene (Scott and Crossman, 1973). In Europe, introduced populations are most common in southern and south-central regions from where most previous studies originate (Künstler, 1908; Roule, 1931; Vivier, 1951; Sedlár, 1957; Balon, 1959; Bănărescu, 1964; Papadopol and Ignat, 1967; Spătaru, 1967; Tandon, 1976; Constantinescu, 1981; Copp and Cellot, 1988; Crivelli and Mestre, 1988; Guti et al., 1991; Neophytou and Gyapis, 1944).

The pumpkinseed was first imported in Europe in France (1887) and Germany (1890) as ornamental fish. From Germany its spread to east through Rhine, Oder and Danube. From Bulgaria, it was reported for the first time in 1921, in Svisciova (Cărăuşu, 1952). In Romania, its first report was made by Buşniță (1929). In short time it became common all over the floodable area of Danube, its tributaries, and some littoral lakes (Popovici, 1942). Today, the sunfish is widespread in almost all Romanian freshwaters, less in the mountain region. The aquarists contributed seriously to its spreading (Gavriloaie et al., 2005). *Lepomis gibbosus* is one of the worst invasive species of fish in our country.

Ictalurus nebulosus, or the brown bullhead (Tab. 1), is an ictalurid fish originary from North America, where it has a wide distribution (Atlantic and Gulf Slope drainages from Nova Scotia and New Brunswick in Canada to Mobile Bay in Alabama in U.S.A, and St. Lawrence-Great Lakes, Hudson Bay and Mississippi River basins from Quebec west to Saskatchewan in Canada and South to Louisiana, U.S.A).

Ictalurus nebulosus was first introduced on the "Old Continent", in Berlin (1880), as a fish of exhibitions; few years later it was also introduced in other European countries as aquarium fish (Germany, then France and Belgium, Gavriloaie and Falka, 2005).

According to Vasiliu (1959), *Ictalurus nebulosus* was introduced in Romania in 1908, in St. Ana Lake. As result of natural dispersion and translocations, the species colonized most water bodies from the western regions of Romania. In a natural way, *Ictalurus nebulosus* reached, in 1934, in Tisa River and its following tributaries: Someş, Crişuri, Mureş, Bega, then Timiş, Beregsău and Sat-Chinez pools, rivulet Pețea (nearby Oradea), Ineu, and lower Danube at Brăila. Nowadays, the brown bullhead it is considered, by many, one of the most invasive fish species in Romania (Gavriloaie and Falka 2005; Mag et al., 2005).

Table 1: The most important non-native ornamental freshwater fish in Romanian waters.

Species	Status of species in Romania	Spreading/frequency in Romania	Importance excepting aquarium	First officially reported in Romania
Pumpkinseed sunfish (*Lepomis gibbosus*)	Invasive	Frequent; all over the country (except mountain region).	Fishing	Buşniță 1929
Brown bullhead *(Ictalurus nebulosus)*	Invasive	Frequent; all over the country.	As a source of food.	Antonescu 1934
Mosquitofish (*Gambusia* sp.)	Naturalized	Southern regions of Romania; requires warm water for survival.	Mosquito control.	Bănărescu 1964 (probably reported and described much earlier)
Guppy, millionfish, (*Poecilia reticulata*)	Feral (naturalized)	Thermal waters: Băile 1 Mai (Pețea Lake), Băile Felix; requires warm water for survival.	Mosquito control; ecotoxicology; behavioral ecology; genetics research.	Mag et al., 2005
Black-molly (*Poecilia sphenops*)	Feral	Thermal waters: Băile 1 Mai (Pețea Lake), Băile Felix. Requires warm water for survival.	Algae control.	Mag et al., 2005
Swordtail (*Xiphophorus helleri*)	Feral (naturalized)	Thermal waters: Pețea Lake, Băile Felix. Requires warm water for survival.	Algae control.	Mag et al., 2005
Species	Status of species in Romania	Spreading/frequency in Romania	Importance excepting aquarium	First officially reported in Romania
Goldfish (*Carassius auratus*)	Feral (casual) or acclimatized	Introduced in ponds and lakes.	With no importance.	-
Ornamental carp (*Cyprinus carpio* var. koi)	Feral (casual) or acclimatized	Introduced in ponds and lakes.	As a source of food.	Mag et al., 2005
Paradise fish (*Macropodus opercularis*)	Feral (casual)	Thermal waters: Pețea Lake, Băile Felix. Requires warm water for survival.	Control of worms in the rice culture.	Mag et al., 2005
Gourami (*Trichogaster trichopterus*)	Feral (casual)	Thermal waters: Băile 1 Mai, Băile Felix. Requires warm water for survival.	With no importance.	-

Mosquitofish (*Gambusia* sp., Poeciliidae; Tab. 1) is a small, harmless-looking fish native to the fresh waters of the eastern and southern United States. It has become a pest in many waterways around the world following initial introductions early last century as a biological control of mosquito. In general, it is considered to be no more effective than native predators of mosquitoes. The highly predatory mosquitofish eats the eggs of economically desirable fish and preys on and endangers rare indigenous fish and invertebrate species. Mosquito fish are difficult to eliminate once established, so the best way to reduce their effects is to control their further spread. One of the main avenues of spread is continued, intentional release by mosquito-control agencies (Lowe et al., 2000).

In our country, the genre is represented by *Gambusia holbrooki* (Agassiz, 1854) which do not creates an important ecological disequilibrium. It is spread in the southern regions of the country and requires relatively warm water-temperature for survival.

In Romania, the mosquitofish were introduced for the first time in 1927 by professor Mezincescu which brought them from Hamburg. In 1929 was introduced a lot of mosquitofish brought from Bulgaria, and in 1930 a new one, from Italy. Pantelimon Lake, other lakes from Bucharest, a few littoral lakes, and some lakes or ponds from Transylvania were stoked with *Gambusia* sp. We have no other information about these populations as regards adaptative morphophysiologic variation, feeding behavior particularities or changes, and their biology of reproduction.

Gambusia holbrooki, a small fish, 2.5-3.5 cm TL males, 4-5 cm TL females, but Falka and Gavriloaie (2006) reported 7 cm females, in Carol Park - Bucharest.

The guppyfish (*Poecilia reticulata*, Poeciliidae; Tab. 1), which is a small live-bearing fish, offers a particularly interesting opportunity to study invasion success as there is a wealth of information on its biology (Houde, 1997). Moreover, through accidental or deliberate release, guppies have successfully colonized at least 32 countries in the Americas, Europe, Asia, Australasia, and Africa (Froese and Pauly 2000, FAO 2004). They are native to South America: Venezuela, Northern Brazil, Trinidad and Barbados (Rosen and Bailey, 1963; Welcomme, 1988; Bud, 2002).

From Romania, the first report in a scientific paper is that of Mag et al., (2005), where the author shortly describes the population from the natural reservation Pețea Lake (Băile 1 Mai).

In the 1960s, the well known academician Prof. Dr. Petre Bănărescu, explored this lake so as to compile material for “Fauna R.P.R.”. In that period there were not guppies in the thermal lake (Bănărescu, personal communication). Even there is a gene for low water temperature-resistance in *Poecilia reticulata*, the guppyfish remains a tropical fish. As long guppy requires warm water temperature for survival, the invasion of this species is restricted in Romania to thermal waters only.

Xiphophorus helleri, or the swordtail (Poeciliidae; Tab. 1), is a Central American species and it is philogenetic related to previous two fish species presented.

There are many color varieties of *Xiphophorus helleri* in aquarium (red-melanic swordtail, red-eyed or red-amela swordtail, black or hipermelanic swordtail, tuxedo swordtail, berliner swordtail, albino swordtail, yellow swordtail etc), but the standard variety is the green one.

Green swordtails can easily be distinguished from other poeciliids by the elongate lower caudal fin rays which form a sword on adult males. Females and immature males are green above with dark edge scales on their back and sides, and yellow below. Mature males are usually red below, with a black stripe along their sides and a yellow-orange to red colored sword. There are typically 26-27 scales in a lateral series and 12-14 dorsal rays (Page and Burr, 1991). Franck and Ribowski (1993) observed specimens to prefer shallow waters of 30-50 cm, in Veracruz, Mexico. These same authors found immature males to inhabit shallower waters approximately 20 cm in depth.

Xiphophorus helleri is tropical fish with a preference for warm springs and their effluents as well as weedy canals and ponds. Swordtails live in mixed, hierarchically structured groups. Females spend most of their time foraging, whereas males spend a good deal of time aggressively interacting among them. Franck and Ribowski (1993) observed groups of 8-10 males and 25-30 females inhabiting small stable areas with immature males tolerated by the dominant males. Dominant males held home-ranges and dominant positions over periods of many days to weeks.

Green swordtails are prolific livebearers. They may produce 80 to 150 fry per month (Axelrod et al., 1971; Riehl and Baensch, 1991). Males can be distinguished from females by the presence of extended inferior rays from the caudal fin which form a sword tail one-third to one-quarter of the length of its body, and by the presence of a gonopodium. Females have a rounder body with a larger, swelled abdomen and a spawning spot at sexual maturation (Riehl and Baensch, 1991). Franck and Ribowski (1993) observed a maximum TL of 85 mm for males and 87 mm for females in rivers and creeks around lake Catemaco, Veracruz, Mexico. Green swordtails have been reported to grow to a maximum length of 130 mm (Page and Burr; 1991).

The Romanian populations are feral, naturalized ones, they appear in thermal waters as: Pețea Lake, and Băile Felix (nearby Oradea, Bihor County); they require fairly warm waters and many aquatic plants for survival (Mag et al., 2005). The green (wild type) and the red-melanic ones established self sustaining populations in thermal waters from north-western country. Casual, the species was observed in many urban warm waters from Romania, but low values of temperature from winter do not permit the swordtails to establish self-sustaining populations in these waters.

Another species of poeciliid fish is *Poecilia sphenops* or molly. This fish originates from Central and Southern America, and individuals have a grey-oliva body color. By selection, aquarists obtained a variety that is completely black. In this case the melanism is extreme, and its vernacular name, well-known among the aquarists, is the black-molly. The black variety is the most frequent in the aquaria, but there are a lot of varieties from white (albino) to black, and a yellow variety.

Molly prefer a brackish, even salt-water, plenty of algae and lot of plants. Individuals from Pețea Lake have a relatively uniform dirty white "color" with black. There are a few black individuals too, in the population but with a reduced frequency. This population is a descendent of black-molly from aquarium, but, along the time, the melanism reduced considerably because of natural selection. There are no veiled individuals as some from aquarium ones, in Pețea Lake. The freshwater, or the lack of salt in the water, damages to molly's health. This is probably the explanation for low density of molly population from Băile 1 Mai, as there is hot and plenty of plants in the Pețea Lake. There is little if any probability of molly invasion in Romania.

Cyprinids as goldfish (*Carassius auratus*) and ornamental carp (*Cyprinus carpio* var. koi), or belontiids as gourami (*Trichogaster trichopterus*) and paradise fish (*Macropodus opercularis*) are casual and do not resist in Pețea Lake.

Belontiids are affected especially by the difference of temperature between water and air. They appear to resist at Băile Felix, where they persist because of repeated introductions and not because of their succesfully reproduction. Also, there were introduced many other species and varieties, to Băile Felix, in order to create a special, exotic, appearance.

CONCLUSIONS

In Romania, two of the worst aliens are aquarium fish: the pumpkinseed sunfish (*Lepomis gibbosus*) and the brown bullhead (*Ictalurus nebulosus*).

Beside these predators, there are some feral populations of livebearers, a few of them being naturalized in Romanian thermal freshwaters. These are: the mosquitofish, the guppy, and the swordtail. The rest of the ornamental fish species which are present, are casual in Romanian freshwaters.

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