HISTORY AND CONCEPTS OF SUSTAINABLE FISHERY IN TAŞAUL LAKE, ROMANIA

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Abstract. Eutrophic Taşaul Lake has been used mainly for aquaculture and fish production. The latter is strongly dependent on stocking and over-exploitation. Historical fish data show a peaking biodiversity in the 1970s, but catch records declined drastically in 1994-1995, from 180 to 50 tons, and later on to 5 tons/year, until 2000.

Fish stock in Taşaul Lake was assessed in 2005 for two out of eight species (*Carassius gibelio* [giebel carp] and *Rutilus rutilus* [roach]) from a total of 581 specimens investigated. FAO related methods were applied by using "age-structured" models based on population parameters such as length frequency diagrams and length-weight relationships. Biomass in 2005 was 23.6 tons for giebel carp and 34.2 tons for roach. Since the fishing mortality coefficient was greater than the natural mortality coefficient, fishery is claimed not to be sustainable (*i.e.*, poaching, minor restocking). The maximum sustainable yield would be, according to the model based on standard fish catch of 10 tons/year, 10.9 tons/year for giebel carp and 12.2 tons/year for roach.

Apart from reducing nutrient input of Casimcea River by fighting point sources, the conclusions and recommendations towards a more sustainable fishery management in Lake Taşaul are: (1) to perform a detailed monitoring of yearly restocking to quantify fishing input; (2) to perform a detailed monitoring of fishermen active per year, the number of gear nets used per day and the catch per unit effort (CPUE) to quantify the fishing effort; (3) to perform detailed statistics about net catches and angling, and estimate poaching, to quantify fishing output.

Key words: shallow lakes, euthrophication, fish stock assessment, population model, sustainable development

INTRODUCTION

Black Sea coastal lakes are important and threatened ecosystems. In the 1920s, Taşaul Lake (area 23.35 km^2, max. depth 4 m) near Constanţa has been transformed by technical constructions from an open coastal lagoon (salt water) to a freshwater lake (shallow, turbulent and eutrophic), classified as heavily modified water body according to the EU-WFD. In particular, a channel between Siutghiol and Taşaul Lakes, and some dams between Gargalac and Corbu Lakes were built. The channel for the outflow to the sea is a prolonged branch from Poarta Alba–Midia Channel linking Corbu Lake (North-Eastern side) and Cape Midia. Nowadays the rather complex channel system is mostly closed and Taşaul Lake is disconnected from the Black Sea, i.e., without surface outlet. Based on recent observation, Gargalac (Corbu) Lake may still discharge freshwater into Taşaul Lake by a common channel during fishing seasons, and at times water is pumped from Taşaul Lake into Corbu Lake for „refreshing" (increasung the water volume and oxygen content). There is also uncontrolled and unknown influence of groundwater flow through the rock formations and leaking dams. At the farthest point of Taşaul Lake from the sea, a fish hatchery with a surface of 67 ha was constructed near the mouth of Casimcea River, its major tributary (mean flow 0.5 m^3/s).

Due to closure and continued freshwater input and despite of considerable evaporation the salinity of Taşaul Lake (23.6 g/l in 1906) decreased from 26 g/l in 1929 to 6.7 g/l in 1938, 2.8 g/l in 1964, and 0.5 g/l in 1977 (Cure *et al*. 1977). Newest measurements in 1989, 2003 and 2005 showed that evaporation caused a slight increase of salinity to 1.3, 0.6-0.7 and 0.8-1.5 g/l, respectively. After 1929, the shift from saltwater to freshwater caused a tremendous change in the structure and abundance of fish populations.

In general, brackish biota was replaced by typical freshwater species. Commercially less valuable fish such as giebel carp and roach became abundant, while carp and pike perch drastically diminished. However, there was no regular observation until 1970. The annual difference in fish production between 1970 and 1994 (minimum 66 to/year, maximum 199 to/year with two extraordinary peaks in 1988-1989 of 378-383 to/year, Figure 1) reflected yearly changes in temperature and precipitation, *i.e.* wet and dry years affecting the water level of the lake. The fish production decreased from 180 tons/year, in 1994, to 50 tons/year, in 1995, and further down to 5 to/year in 2000 (Fig. 1).

While Taşaul Lake nowadays is an ecosystem classified as Important Bird Area by Birdlife International, it has been used mainly for fish culture and production. Fish populations, biomass and catch are dependent not only on the environmental and growth conditions but also on restocking quantities and concepts as well as exploitation pressure. Main activities in the catchment are agriculture and animal farming, both contributing diffuse sources of nutrients and contaminants. During rainy periods (mainly spring, fall) nutrient input may be significant and increased by contaminated groundwater inflow.

Our limnological survey (May 2005 - June 2007) proved the hypertrophic state of Taşaul Lake (Alexandrov 2008): High primary production (up to 2712 mg $C_{ass}/m^2.h$), phytoplankton biomass (max. fresh weight 38 mg/l) and chlorophyll a (max. 417 µg/l), and blooms of Cyanophytes making up to 67-94% of the total algal community (69 species). It is likely that the biota is bottom up controlled by nutrients (phosphate and nitrate mean concentrations of 17 and 370 µg/l, respectively) originating mainly from internal and external loading (input by Casimcea River was 3 tons TP/year and 660 tons TN/year). Contamination with heavy metals, PAHs and organochlorine pesticides is low.

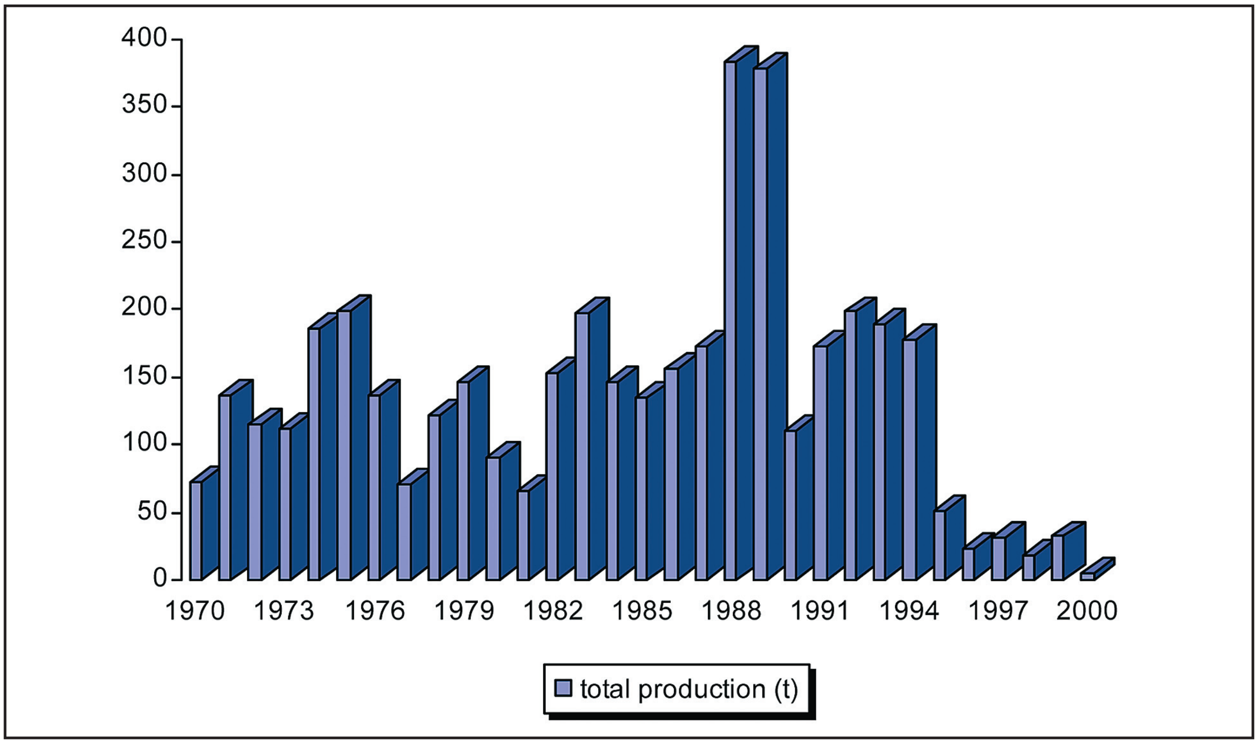

Fig. 1 Fish production (to/year) in Taşaul Lake, Romania, during 1970-2000 (PESTOM Fish Farm archive 1970-2000 and PESCOM Fish Farm archive 2000-2007, unpublished)

The aim of this paper is to present the fish population and fish yield considering the actual status of the lake (2005-2007), to compare these results with earlier fish data and to develop management strategies for a sustainable fishery practice.

METHODS

For the limnological survey of Taşaul Lake from May 2005 to June 2007 (eight sampling sites, Alexandrov & Bloesch 2008) commonly used methods were applied for chemical water and sediment analysis, biological investigations (phytoplankton, zooplankton, benthos) and species identification (NIMRD, 2006).

For the first time the YOY (young of the year) were sampled in Taşaul Lake along selected shores to check biodiversity and natural reproduction. Further fish investigations comprised the biometric analysis (species identification, age, weight, length) of the fisheries catch to assess biomass and production.

Ichthyoplankton was collected in May 2005 at eight stations by a Bongo net (0.5 mm mesh size) that was dragged along the water surface for five minutes. The samples were fixed in 4% buffered formalin. All fish larvae were counted and identified according to the keys of Koblitskaya (1981) and Bănărescu (1964). At station 1 (close to Navodari City) electro-fishing was used (DEKA 7000 W electrofisher) during day-time on a surface of about 100 m^2.

Fish stock assessment in Taşaul Lake was performed for two out of eight species (*Carassius gibelio* [giebel carp] and *Rutilus rutilus* [roach]) from a total of 581 specimens investigated. "Age-structured" models based on population parameters such as body length and length-weight relations were applied: Growth parameters were estimated using length frequency analysis with the models "ELEFAN" (Sparre *et al*. 1989) which are included in the applied fish stock assessment package (Staraş *et al*. 1996; Cernisencu *et al*. 2002).

The exploitation state of stocks was determined by the position of the current point (Pc) within the coordinate system of length (Lc = 0.5) and selectivity (fishing mortality F) in the isopleths Y/R diagram of the Beverton-Holt model (Figures 4 and 5; Ricker 1958; Sparre *et al*. 1989).

By using Virtual Population Analysis and Thomson-Bell predictable model (Pauly 1983; Jones 1984; Sparre *et al*. 1989) fishing was optimized through change of fishing mortality and recalculation of optimum biomass and Maximum Sustainable Yield (MSY).

RESULTS AND DISCUSSION

NIMRD research and documentation concerning most of the Black Sea coastal Romanian lakes and pools prove that during 1970-1985 Taşaul Lake featured the best freshwater period with a valuable and high biodiversity (NIMRD 1985; PESTOM and PESCOM Fish Farm archives, unpublished). In total, 30 fish species were recorded but the annual diversity did not exceed 10-22 species (Table 1). The most important species were: *Cyprinus carpio, Ctenopharyngodon idella*, *Hypophthamichthis molitrix,* and *Arystichthis nobilis*. Species with industrial value were: *Silurus glanis*, *Perca fluviatilis*, *Stizostedion lucioperca*, *Carassius auratus, Abramis brama*, *Alburnus alburnus*, *Scardinius erythrophthalmus*, *Leuciscus idus* and *Rutilus rutilus*. While *Scardinius erythrophthalmus, Alburnus alburnus, Blicca bjoerkna, Rutilus rutilus,* and *Perca fluviatilis* reached highest abundance, *S. erythrophthalmus, Tinca tinca, Carassius gibelio,* and *Perca fluviatilis* reached highest productivity. Small species caught were *Leuciscus delineatus, Rodeus sericeus,* and *Alburnus alburnus.* Fish larvae and juveniles of *Rutilus rutilus* and *S. erythrophthalmus* were frequent in catches.

In this period Taşaul Lake fish species indicated mesotrophic conditions with major impact on fish production. The average fish yield was only 33kg/ha, of which carp contributed more than 56% and pike perch 16%. Cure *et al*. (1977) reported a fish productivity of 40 kg/ha in 1947-1964, 80 kg/ha in 1964-1970 and 60 kg/ha in 1970-1977. These differences between small yields are considered insignificant.

A follow-up investigation by NIMRD (1989) showed that the natural productivity of Taşaul Lake is influenced by local weather conditions. In 1989, solar radiation and light intensity were about 15-20% higher than normal, thus increasing water temperature. Under such conditions the gamete production of fishes is faster and so is their maturation, *i.e*., reproduction occurs earlier in the season. The consequence is a general increase of the bio-productivity rate, which is demonstrated by the two extraordinary peaks in 1988 and 1989 (Fig. 1). The theoretical conversion of the present biomass into fish meat, with a maximum rate of consumption of 60% (12% mean value) yielded 1.122 t of planktophagous fish.

In this period population methods for various piscicultural basins were optimised in relation to their trophic and yield capacity by the Regional Special Program concerning Pisciculture and Fishing (1986-1990). Taşaul Lake then produced 475–500 tons of fish (2 and 3 years old) for consumption, out of which 65% were plankton eaters, 25% carnivores, 10% predators and Black Sea sprat and roach including fingerlings as reserve for the 1991 yield. To improve the yield of Taşaul Lake it was suggested to breed and propagate native buffalo fish (*Ictiobus bubalus, I. cyprinellus, I. niger*) as their biomass increased by more than 1000% from the first to the second year of age.

Over time, fish catch dynamics changed both in size and structure. Before 1970, the fish catch was more than 700-1000 to/year providing a high and important yield, and carp represented 70-80% (PESCOM Fish Farm Archives, unpublished). When compared with production (72-199 to/year, Figure 1), over-exploitation, poaching, habitat degradation and different hydrotechnical works, both on catchment area and around the lake are evident. Till 1989 a brackish water species *Clupeonella cultriventris* was dominant with about 47-50 to/year. After 1985 Chinese carps (*Aristichthys nobilis, Ctenopharyngodon idella, Hypophthalmichthys molitrix*) reared in hatcheries were forced by stocking and comprised most of the catch. This odd practice was given up recently, as exotic species usually compete with, and diminish, native species.

During 2001-2007 the official fisheries statistical data of Taşaul Lake show a commercial fish catch of 17.7 tons (7.6 kg/ha) in 2001 rising to 235.9 tons (101.1 kg/ha) in 2007 dominated by *Carassius gibelio* (41-66%) and chinese carp (15-38%) (Figs 2 and 3). This increase of fish yield is explained by the forced restocking quantities and according to eutrophication as restocked fish were mostly planktivorous. By these measures the downward trend since 1994 could be stopped.

The piscivorous species represent only 3.8-5.6% of the total fish catch. Gibel carp became dominant because of prolific qualities, biological resistance, a large food spectrum and by keeping the piscivorous fish at low level. Gibel carp was reported to strongly attack the breed of other species with early spawning and this predation inhibited any change of the species structure (Crăciun 1996).

In 2005 a total of 23 fish species were recorded by PESCOM Fish Farm Administration, of which 6 are commercial species and 6 species registered as protected in the Bern Convention list (Table 1). Our own control sampling yielded 10 fish species in Taşaul Lake: during a round trip survey in May 2005, 9 species were caught with bongo net fish-

Table 1 Total fish species in Taşaul Lake, Romania, recorded in 2005. (Data compiled from PESTOM/PESCOM Fish Farm archives, unpublished, and our own investigations).

Order	Family	Species	Status	English common name	Romanian common name	Food	Red list IUCN status	EU Protected status, by Law 462/2001
Cypriniformes	Cyprinidae	*Abramis brama*	native	Common bream	Plătică	zoobenthos, benthic crustaceans	-	
Cypriniformes	Cyprinidae	*Alburnus alburnus*	native	Bleak	Obleţ	plankton, invertebrates	LR/lc	
Cypriniformes	Cyprinidae	*Aristichthys nobilis*	introduced	Bighead carp	Novac	zooplankton	-	
Cypriniformes	Cyprinidae	*Aspius aspius*	native	Asp	Avat	necton, finfish, bonyfish		*
Cypriniformes	Cyprinidae	*Blicca bjoerkna*	native	White bream	Batcă	detritus, plants, zoobenthos, insects, invertebrates	LR/lc	
Cypriniformes	Cyprinidae	*Carassius gibelio*	introduced	Prussian carp	Caras-argintiu	plants, invertebrates		
Clupeiformes	Clupeidae	*Clupeonella cultriventris*	native	Black Sea sprat	Gingirica	zooplankton		
Cypriniformes	Cyprinidae	*Ctenopharyngodon idella*	introduced	Grass carp	Cosas	aquatic plants		
Cypriniformes	Cyprinidae	*Cyprinus carpio carpio*	introduced	Common carp	Crap	omnivore		
Esociformes	Esocidae	*Esox lucius*	native	Northern pike	Ştiucă	fishes		
Gasterosteiformes	Gasterosteidae	*Gasterosteus aculeatus aculeatus*	native	Three-spined stickleback	Ghidrin	plants, zooplankton, zoobenthos, necton, fishes	LR/lc	
Cypriniformes	Cyprinidae	*Hypophthalmichthys molitrix*	introduced	Silver carp	Sânger	phytoplankton		
Perciformes	Gobiidae	*Knipowitschia caucasica*	native		Guvid mic	invertebrates	LR/lc	
Cypriniformes	Cyprinidae	*Leucaspius delineatus*	native	Blica	Plevuşcă	phytoplankton zooplankton	LR/lc	*
Perciformes	Percidae	*Perca fluviatilis*	native	European perch	Biban	fishes, invertebrates	LR/lc	
Perciformes	Gobiidae	*Proterorhinus marmoratus*	native	Tubenose goby	Moaca de bradis	invertebrates	LR/lc	*
Perciformes	Gobiidae	*Neogobius melanostomus*	native	Round goby	Guvid de mare	zoobentos,	DD	
Cypriniformes	Cyprinidae	*Pseudorasbora parva*	introduced	Stone moroko	Murgoi bălţat	plants, zooplankton, zoobenthos, fishes		
Gasterosteiformes	Gasterosteidae	*Pungitius platygaster*	native	Southern ninespine stickleback	Pălămidă de baltă	invertebrates	LR/lc	*
Cypriniformes	Cyprinidae	*Rhodeus sericeus*	native	Amur bitterling	Boarcă	plants, phytoplankton	LR/lc	*
Cypriniformes	Cyprinidae	*Rutilus rutilus*	native	Roach	Babuşcă	omnivorous (insects, crustaceans, mollusks, and plants)	LR/lc	
Perciformes	Percidae	*Sander lucioperca*	native	Pike-perch	Şalău	fishes	LR/lc	
Cypriniformes	Cyprinidae	*Scardinius erythrophthalmus*	native	Rudd	Roşioară	omnivorous	LR/lc	
Siluriformes	Siluridae	*Silurus glanis*	native	Wels catfish	Somn	fishes, invertebrates	LR/lc	*

LR – Lower Risk: least concern – The IUCN Red List of Threatened Species; DD – Data deficient; * - Appendix III of the Convention on the Conservation of European Wildlife and Natural Habitats

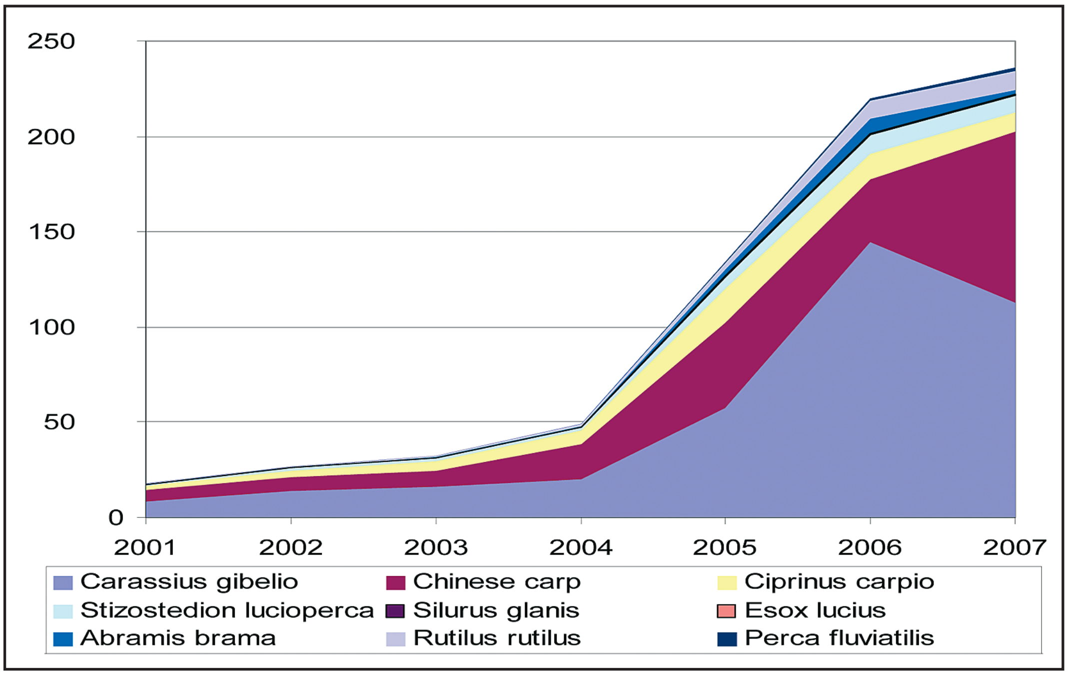

Fig. 2 Fish catch (to/year) in Taşaul Lake, Romania, during 2001-2007 (Paris Paris/PESCOM Fish Farm: Annual Production Report, unpublished data)

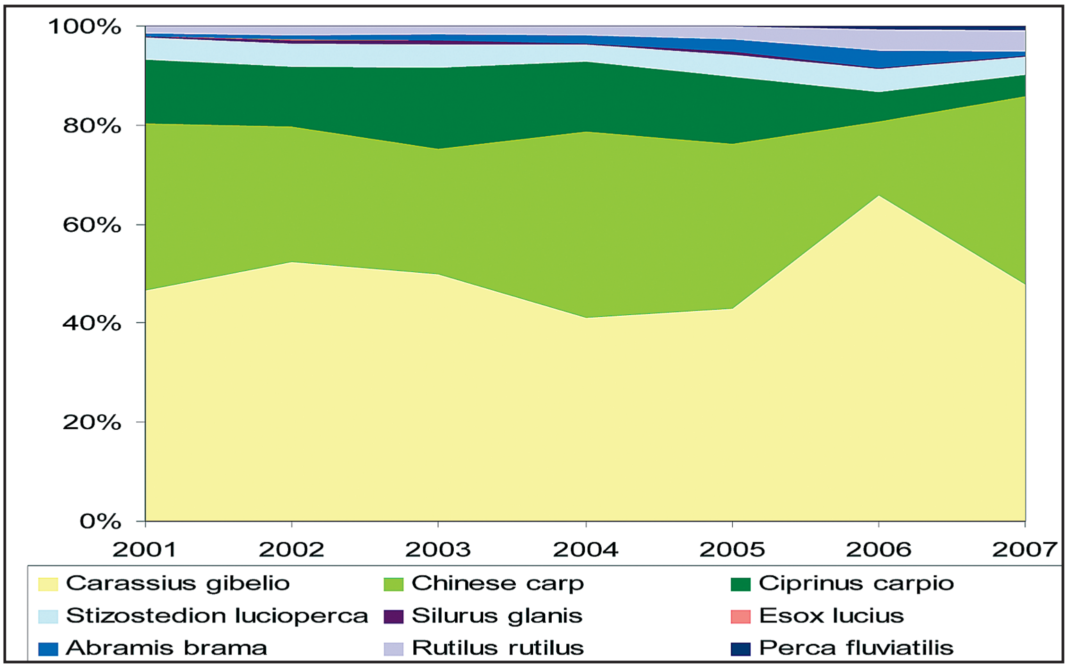

Fig. 3 Relative fish catch of 9 species caught during 2001-2007 in Taşaul Lake, Romania (Paris Paris/PESCOM Fish Farm: Annual Production Report, unpublished data)

ing (2 species are of commercial importance, the other species of high ecological value). The ichthyoplankton was dominated by *Gasterosteus aculeatus, Scardinius erythrophthalmus and Neogobius melanostomus* (Table 2). The most abundant out of 5 species collected by electro-fishing (with 1 species of commercial importance) were *Knipowitchia caucasica, Pseudorasbora parva* (representing 35.5%) and *Neogobius melanostomus* (24.8%). The total biomass amounted to 245 g/100 m^2 and was dominated by *Carassius gibelio* (39.2%), *Pseudorasbora parva* (33.5%) and *Neogobius melanostomus* (20.4%, Table 3). Most taxa (7) and individuals were found at the west shore (station 8). Some individuals were identified with difficulties due to their small size but we consider them as *Clupeonella cultriventris* because fishermen are accustomed with the reproduction of this species. In Taşaul Lake the larval stage of identified species varied from early larvae to fry stages suggesting that the sites of collection and adjacent areas are usually used for spawning.

Fish stock of Taşaul Lake was assessed by investigating 581 individuals of eight species that were obtained by capture for commercial fishing by active and passive nets. Hence, we could not fully achieve the requested optimum sample size of 1000 specimens for statistical analysis. The most abundant species as given by our and fish farm investigations, giebel carp and roach, were selected for fish stock assessment.

For all sampled species from commercial catch length-weight relationship $W = a*L^b$ was calculated (Table 4). The coefficients a and b are the variables representing the weight difference from one year to another as a result of the physiological process of growth, reflecting specific adaptations to the environment. Coefficient a represents the parameters estimated by linear regression analysis. Generally coefficient b has a value between 2-4 (Wheatherley 1972); a value b=3 describes isometric growth, characteristic of fish species; if coefficient b is larger or smaller than 3, fish growth is allometric. Coefficient b is considered as a measure of the environmental condition and is a generalized Fulton index (Pitcher 1990).

Table 2 Taşaul Lake, Romania: Fish species caught with bongo net in May 2005 (8 sampling sites).

Species/station	2	3	4	5	8	Grand Total	Lt min - max	Larval stage
Alburnus alburnus	3	1				4	7-8	young larvae
Clupeonella cultriventris		1	1			2	3-11	young larvae
Gasterosteus aculeatus	3	23	3		12	41	3-25	young larvae, fry
Knipowitchia caucasica			1	2	2	5	7-29	older fingerlins, fry
Neogobius melanostomus				9		9	4-9	young larvae
Proterorhinus marmoratus					2	2	7-8	young larvae
Pseudorasbora parva					1	1	36	fry
Pungitius platygaster					1	1	48	fry
Scardinius erythrophthalmus				9	1	10	10-14	young larvae
unidentified species		3	7	5	301	316	2-4	
Grand Total	6	28	12	25	320	391		

Table 3 Tasşaul Lake, Romania: Fish species caught by electro-fishing in May 2005 (1 sampling site).

Species	Number		Total length min. - max. (mm)	Weight		
	Total individuals /100 m^2	%		Total Weight g/100m^2	Weight min.–max. /ex. g	%
Carassius gibelio	1	0.7	175	96	96	39.2
Knipowitchia caucasica	50	35.5	25-30	10	0.1 - 0.2	4.1
Neogobius melanostomus	35	24.8	28-70	50	0.3 - 8	20.4
Proterorhinus marmoratus	5	3.5	43-53	7	1 -1.4	2.8
Pseudorasbora parva	50	35.5	35-72	82	1 - 3.5	33.5
Grand Total	141	100		245		100.0

Table 4 Taşaul Lake, Romania: Length-weight coefficients for 8 species sampled from landings in 2005.

Species	Sampled ex.	Min. Lt cm	Max. Lt cm	Average Lt cm	Average weight (g)	Wt (kg)	$W = aL^b$	
							a	b
Perca fluviatilis	58	22	26.5	24.2	232	13.5	0.02689	2.8425
Rutilus rutilus	39	21.8	31.3	26.7	260	10.2	0.29361	2.06256
Carassius gibelio	251	19.8	30	25	338	84.9	0.10402	2.48958
Cyprinus carpio	12	27.4	60.3	48.5	2292	27.5	0.01155	3.11372
Ctenopharyngodon idella	8	31.6	62.4	50.8	1663	13.3	0.15775	2.34224
Hypophthalmichthys molitrix	195	29.1	86	59	2828	551.5	0.00398	3.26507
Sander lucioperca	5	39.4	43.1	40.7	600	3	0.0475	2.54735
Aristichthys nobilis	13	22	80.3	71.9	4962	64.5	0.0199	2.88483
Total	581					768.4		

Biomass in 2005 was 23.6 tons for giebel carp and 34.2 tons for roach. Growth and exploitation parameters for giebel carp and roach showed signs of over-exploitation in 2005 enhanced by the intensive use of fishing nets (Table 5). In Taşaul Lake gillnets with a mesh-size of 50 mm as prescribed by national legislation are in use. The optimum exploitation strategy is determined by the age/length (Lc) at first capture (dependent on mesh size) and the overall level of fishing mortality. Their individuals were 3-7 years old with the dominant age class of 4-5 years. The histograms of roach (Fig. 4) and giebel carp (Fig. 5) show well balanced healthy populations indicating natural reproduction. The frequency distribution as well as the level of resources and captures in the actual exploitation regime depend on the amount of annual restocking, which is still recommended as a measure of biomanipulation. According to Table 6, an increase of fishing effort and fish catch, respectively, is needed to optimize current stocks. Since the fishing mortality coefficient was greater than the natural mortality coefficient, fishery is claimed not to be sustainable (*i.e.,* over-exploitation, unregistered poaching and minor restocking). The maximum sustainable yield would be, according to the model based on standard fish catch of 10 tons/year, 10.9 tons/year for giebel carp and 12.2 tons/year for roach.

Table 5 Tasşaul Lake, Romania: Growth and exploitation parameters for *Carassius gibelio* and *Rutilus rutilus* stocks in May 2005. $L\infty$ = asymptotic length; k = curvature parameter; t_0 = initial condition parameter, in years; M = natural mortality coefficient; Z = total mortality rate; F = fishing mortality coefficient; L_r = recruitment length; L_c = length at which 50% of the fish are retained by gear and 50% escape.

Species	$L\infty$	k	t_0	M	Z	F	Lr	Lc
Carassius gibelio	39	0.22	-0.2	0.44	1.74	1.30	18	25
Rutilus rutilus	39.5	0.175	-0.64	0.377	1.1	0.73	20	27

Table 6 Taşaul Lake, Romania: Estimation of the exploitation state and optimization measures of *Carassius gibelio* and *Rutilus rutilus* stocks in May 2005. Fc = current fishing mortality; Lc = length at which 50% of the fish is retained; Ca = Current catch; Ba = current biomass; Fo = optimum fishing mortality; Co/MSY = Maximum Sustainable Yield (t); Bo = optimum biomass; Y/Rc = current Yield per recruit; Y/Ro = optimum Yield per recruit.

Species	Mesh size mm	Fc	Lc cm	Ca t	Ba t	Fo	Y/Rc	Y/Ro g	Bo t	Co MSY
Carassius gibelio	Seine net a=50	1.3	25	57,5	135	2.53	95	101	111	62.5
Rutilus rutilus	Seine net a=50	0.73	27	3.5	12	1.87	60	67	8.3	4.2

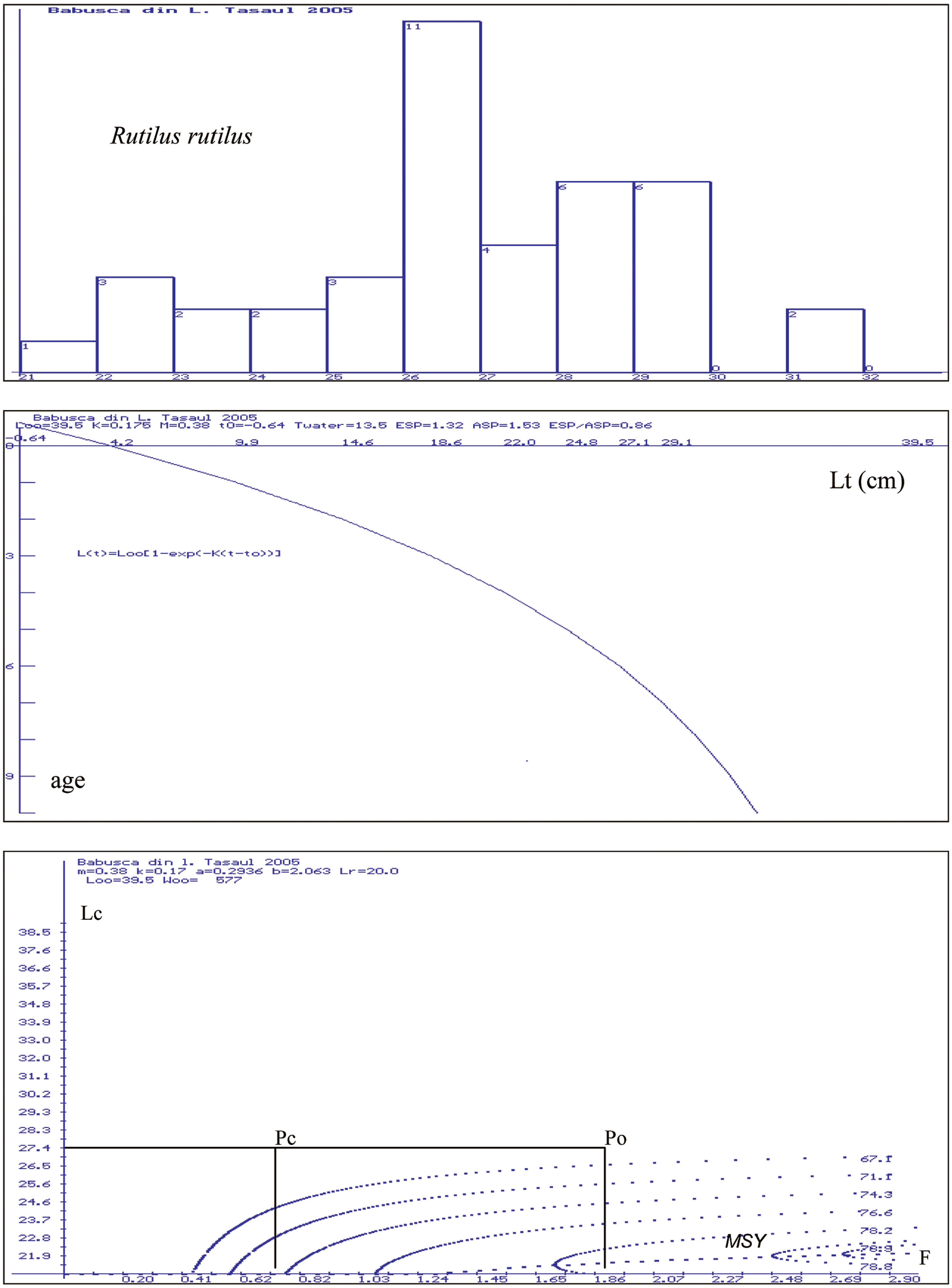

Fig. 4 Taşaul Lake, Romania: Length frequency, growth curve, exploitation coefficient and yield/recruit (Y/R) for *Rutilus rutilus* according to the Beverton-Holt model (Sparre *et al*. 1989)

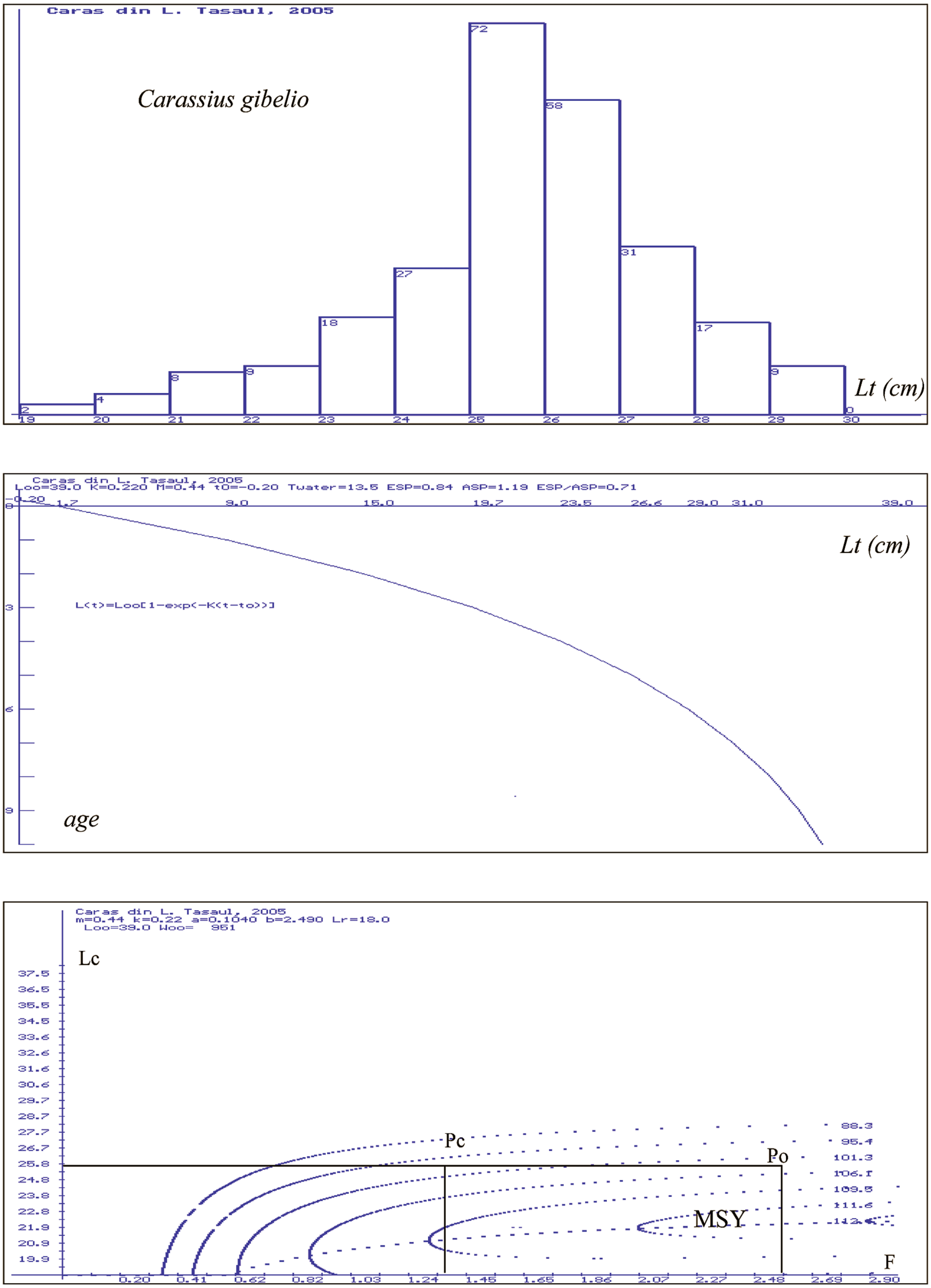

Fig. 5 Taşaul Lake, Romania: Length frequency, growth curve, exploitation coefficient and yield/recruit (Y/R) for *Carassius gibelio* according to the Beverton-Holt model (Sparre *et al*. 1989)

The administration of fish stocks based on sustainability and implementation of the correct management strategy depends decisively on the quality of the catch size data. Missing or unreal record leads to the underestimation or overestimation of some model parameters and, in consequence, biased results on the current state and exploitation of stocks. Evidently the maximum sustainable yield (MSY) is underestimated in Lake Taşaul because fishing quantity was not recorded in the last years. Fishing effort and size of the commercial catches are absolutely necessary elements in fish stock assessment. Hence, improvement of data quality and effort are the present priorities for fisheries management in all coastal lakes.

We hope that our results could support decision makers to understand and approve best solutions for the improvement not only of Taşaul Lake fisheries but also of the other Black Sea coastal lakes.

CONCLUSIONS

Recommendations towards reduction of eutrophication and a more sustainable fishery management in Lake Taşaul are: (1) to reduce nutrient input of Casimcea River by fighting point sources; (2) to continue the general monitoring, hydrology, nutrients, primary production and fish production in particular; (3) to perform a detailed monitoring of yearly restocking to quantify fishing effort/input; (4) to carry out detailed statistics about net catches and angling, and estimate poaching, to quantify fishing/output.

In particular, the following proposals are addressed:

- Research into ecological reconstruction of Taşaul Lake should be continued and strengthened to improve fish habitat quality, to restore biodiversity and fish communities in the long term;
- Monitoring of fish catch should be improved to obtain better data for fish stock management;
- Sustainable use of the commercial fish species and species conservation should be ensured by controlling input (the fishing effort) and output (the fish landed);
- Restocking carp and giebel carp may increase phytoplankton and benthos biomass which provides the main trophic resource allowing an increase of fish catch.

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