

Salmonids of the Neretva river basin - present state and suggested sustainable selection programme to protect and strengthen salmonid populations

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Abstract The Neretva river is the largest tributary (225 km) entering the Adriatic Sea, and it covers 20% of the total water basin of Bosnia and Herzegovina. The Neretva river is home to several salmonids, and three of them are endemic: softmouth trout (*Salmothymus obtusirostris oxyrhynchus*), marble trout (*Salmon Marmoratus*) and dentex trout (*Salmo dendex*). Brown trout (*Salmo trutta m.fario*) is an autochthonous trout of the Neretva River. Fabricated constructions and activities in the river have partly destroyed the biotype of these salmonids. The unplanned restocking of the Neretva, by introducing autochthonous species (grayling, rainbow trout, brook trout) is an issue in this area.

The main objective of the proposed protection plan, discussed in this study, is to plan and develop a sustainable breeding program to ensure the conservation of each of the autochthonous trout species in the Neretva and its tributaries. The rehabilitation of vital fish stocks will be supported by training people involved in fisheries, aquaculture and ecology. All these activities will be based at the restored Center for Fisheries “Neretva” – Konjic.

Introduction

Bosnia and Herzegovina and its water resources

Bosnia and Herzegovina is the one of the youngest European countries. Formerly a constituent republic of Yugoslavia, Bosnia and Herzegovina declared its independence in March 1992. It is situated in South-eastern Europe, on the west part of the Balkan peninsula, with an area of 51.129 km². Bosnia and Herzegovina is mostly landlocked, except for 26 kilometres of coastline along the Adriatic Sea. The Bosnia region is the largest geographic region of the country and it is mostly mountainous, with moderate continental climate typified by warm summers and cold winters. At higher elevations, short, cool summers and long, severe winters with snow are common. A Mediterranean climate, with warm summers and mild winters, dominates in the Herzegovina region in the southern part of the country.

Bosnia and Herzegovina is very rich in natural resources, especially water resources, and its 10.000 km of streams puts it into the group of the richest countries of Southeast Europe in terms of hydro-potential. The fresh waters of Bosnia and Herzegovina lie within two major basins. 75% of the area covered by freshwater is found in Black Sea or Danube basin and 25% in the Adriatic Sea basin.

The major stream of the Black Sea basin is the Sava river, which runs along the northern border of Bosnia and Herzegovina, into which almost all bigger rivers flow in Bosnia and Herzegovina (Una, Sana, Vrbas, Ukrina, Bosna, Drina). The only tributary flowing directly into the Adriatic Sea is river Neretva, although, hydro-graphically a huge number of rivers flow underground to the Adriatic Sea.

In contrast to the wealth of rivers and streams, Bosnia and Herzegovina has only a few lakes. The largest one is Boracko lake in the Neretva river watershed. Reservoirs have been constructed on the rivers Drina, Neretva, Vrbas, and Trebisnjica, which are significantly larger than the natural lakes in country.

All rivers and lakes with the exception of the Bosna river and the downstream reaches represent extraordinary potential for fisheries and aquaculture owing to their high biological and chemical-physiological characteristics.

Bosnia and Herzegovina has a rich ichthyofauna. About 140 (sub)species of fish, from 14 orders and 26 families live on a permanent or occasional basis in its inland waters. Some of them are endemic species: *Salmothymus obtusirostris oxyrhynchus* (Steindachner), *Salmo dentex* (Hecke), *Leuciscus turskyi* (Heckel), *Chondrostoma knerii* (Heckel), *Phoxinellus pstrossii* (Steindachner), and some of them have a small areal distribution: *Salmo marmoratus* (Cuvier), *Leuciscus svallize* (Heckel & Kner), *Aulopyge hügelii* (Heckel). About 15 fish non-native species have established themselves in bosnian waters from Eurasian and American waters including: *Ctenopharyngodon idella* (Valenciennes), *Oncorhynchus mykiss* (Walbaum) and *Salvelinus fontinalis* (Mitchill).

The Neretva River

Naron is the Roman name for Neretva, the longest affluent river entering the Adriatic sea in the Western Balkans and with the biggest discharge. By its characteristics, Neretva is a typical mountain river with strong hydropower potential. It is formed as numerous springs converge under the Lebšnik and Zelengora mountains in south-western BiH at an altitude of 1095 m.

The total length of the river is 218 km, 200 km of which belongs to Bosnia and Herzegovina, whereas the lower reaches flow through Croatia into the Adriatic Sea. Its bigger tributaries are the mountain streams and smaller rivers of the Lađanica, Rakitnica, Ljuta, Neretvica, Rama, Drežanka, Buna, Bregava and Trebižat.

In its upper reaches the Neretva runs through the valley between the high Bosnian mountains. This part of the Neretva River basin has a predomonantly rural community and a lot of untouched natural habitat. The middle reaches of the Neretva river have been significantly modified. More than 50 years ago, the first hydroelectric dam was built in this area. The dam was 80 m high and it changed river into a 30 km long hydroelectric power plant reservoir called Jablaničko lake.. In the 1980s, three more

dams were built which formed reservoirs – Grabovica, Salakovac and Mostar. The construction of these reservoirs dramatically changed the ecosystem within the river.

Operation of the hydroelectric dams in the middle reaches of the Neretva river results in significant drops in water levels in the Neretva in the summer, altering the natural habitats of aquatic organisms. The lower course of the Neretva river flows through the karst system which slows the flows significantly.

The water of the Neretva river is of A class quality and it is the one of the coldest rivers in the world. Annual average water temperature is 8-10 °C. Dissolved oxygen concentrations range between 9 and 10 mg L⁻¹. These physical-chemical characteristics of Neretva river present an optimal environment for salmonids and associated types of fish.

Salmonids of the Neretva River

The Neretva river provides the main salmonid habitat in the Adriatic part of the West Balkans and is home to numerous salmonid species, three of which are endemic: Neretva softmouth trout, *Salmothymus obtusirostris oxyrhynchus* (Steindachner), Marble trout, *Salmo marmoratus* (Cuvier), and Dentex trout, *Salmo dentex* (Heckel). Brown trout, *Salmo trutta m.fario* (Linnaeus), and Grayling, *Thymallus thymallus* (Linnaeus), inhabit similar habitats to the endemic salmonides. Salmonids from the Neretva basin show considerable morphological, ecological and behavioural variation.

ADRIATIC TROUT, *Salmothymus obtusirostris* (Heckel) is an endemic trout to the Adriatic sea basin of the Western Balkans and the only one representative of the monophyletic genus *Salmothymus* with four subspecies: Neretva softmouth trout, *Salmothymus obtusirostris oxyrhynchus* (Steindachner), Solin salmon, *Salmothymus obtusirostris salonitana* (Karaman), Evilmouth trout, *Salmothymus obtusirostris krkensis* (Karaman), Zeta softmouth trout *Salmothymus obtusirostris zetensis* (Hadžišće).

NERETVA SOFTMOUTH TROUT (*Salmothymus obtusirostris oxyrhynchus* (Steindachner)) shows the most pronounced morphological characteristics featuring a 'softmouth', all the other subspecies are more or less brown trout-like. Neretva softmouth trout have the largest population of all subspecies and it can only be found in the Neretva river, and its tributaries Ljuta, Draženka, Buna and Trebižat. Up until the construction of the dam on the Neretva, this softmouth trout was abundant in the upper course of Neretva. Unfortunately, populations are now in decline in this area.

This trout is characterized by its striking similarity in appearance to brown trout and grayling. It has characteristically shaped head, extended skull near the eyes and the snout is considerably extended. The mouth is relatively small, fleshy and soft and the teeth are mostly covered by fleshy folds. The basic colour of this trout is the dark olive green with salmon-like round spots extending to the caudal fin. Usually, these spots are orange with black outlines but rare specimens have been found with red spots.

The Neretva softmouth trout lives only in schools in deeper and stiller parts of the river. It spawns in spring (March-April), but occasionally it spawns as late as mid may. The average length of this species is 25-40 cm and the average weight is 2 kg (Maximum weight is 4-5 kg). It feeds on zoobenthos, mostly insects, but also on other river

organisms. Because of its unique features and the many primitive salmonid characteristics on its body (short and soft jaws, small mouth, short teeth), softmouth trout are considered to be one of the oldest species of trout.

MARBLE TROUT, *Salmo marmoratus* (Cuvier). is the biggest species of salmonid in the Adriatic sea basin and the second largest European trout species. large individuals have been captured in the Neretva River, weighing up to 30 kg. It is an endemic species of the Adriatic area. Its natural range extends from the southwest Alps, along the western Balkans towards the southeast. It can be found in the rivers that flow from the Alps and into the Po river (Italy), the Soča river (Slovenia), the Neretva river (B&H), the Morača and Zeta rivers (Monte Negro) and in some Albanian rivers.

The marble trout has an elongate and cylindrical morphology. An identifying characteristic of this species is its head, which gave rise to its name „Marble trout“. The head makes up 20-25 % of its total body length. It has developed powerful jaws and teeth. Marble trout have a unique body colour. Basic colouration varies from red-grey to dark green. It has dark stripes all over its body, giving the skin a marbled effect, especially on the head. It spawns from the end of November to January on sandy or gravelly river bars. Marble trout are predatory and feed mostly on fish.

The status of DENTEX, *Salmo dentex* (Heckel) has always been questionable, mainly due to inadequate original descriptions and a paucity of sightings. According to literature sources, this trout historically lived in the Neretva. However, it has never been established if it was genetically distinct form other species or if it was hybrid between different species/subspecies. The dentex's head is small and pointed and its mouth is large with teeth that cover jaws, tongue and palate. This has lead to the name Dentex. The body of the dentex is elongated, moderately flattened and tapering to the tail. There are x-shaped black spots on both sides of the body. Fins are also covered with black spots. Along the lateral line, between black spots, there are small spots of reddish colour.

BROWN TROUT, *Salmo trutta m.fario* Linnaeus is an autochthonous trout of the Neretva river. There are two genetically well recognized autochthonous lines of Brown trout found in the river - *Mediterranean line* and *Adriatic line*. The *Danube line* and *Atlantic line* of brown trout are also present. There are a number of hybrids between these lines, which are better suited to certain conditions than those of pure autochthonous lines. As a result autochthonous lines are threatened. As well having genetic differences, the different strains of brown trout also display unique characteristics in their morphology. The *Mediterranean line* and *Adriatic line* differ from other trout because of the great number of very small, red and black dots which are uniformly distributed all over the body.

Besides this, a large number of the fish in this group have four, more or less prominent, ring like dark bands, which surround the head and body - the coverage of these bands increases around the caudal fin area. Brown trout colouration is very variable, and it can vary from a green hue to a brown hue. Body colour primarily depends on the environment in which the Brown trout lives. The body of the brown trout is elongated and well adjusted to powerful and fast flowing waters in which it lives in. Spawning takes place from the beginning of November till the end of January. In this period mature individuals migrate upstream to spawn on shallow, gravel stretches. The growth of Brown trout depends on environmental conditions. It is mainly dependant on the

quantity and quality of food items in its diet. Therefore, Brown trout, which live in mountain river streams characterised by small discharges and a limited supply of food, may only reach a maximum weight of 2 kg. In bigger streams, Brown trout can weight up to 5 - 6 kg. The brown trout feeds on a variety of organisms such as insects, larvae and even small fish.

In addition to the aforementioned salmonid species in the Neretva River and its tributaries, non- native species such as the rainbow trout and the brook trout can also be found. They are introduced into these waters by fishermen via stocking programmes aimed at improving sport for anglers. If they do not get caught, these salmonids migrate downstream towards the sea to spawn.

The state of fish population in the Neretva River

Over the last fifty years the negative human impact on freshwater ecosystems has become very pronounced in Bosnia and Herzegovina. The Neretva River and its ecosystem were strongly disturbed by dam construction during the middle of the last century. As a result, the middle reaches of Neretva River became a cyprinid zone whereas before it was primarily suitable for salmonids. Now the dominant fish species are pike-perch, carp and catfish. Changing physico-chemical water parameters and the destruction of suitable habitats has led to the complete suppression of autochthonous salmonid population. The construction of dams has also restricted longitudinal connectivity, preventing fish migration during spawning times. This has decreased numbers of salmonids to the limits of extinction in the upper course of the Neretva River.

Heavy industrialisation in the Neretva Valles region has greatly influenced the shortage of salmonid fish, and in some regions they have been completely extirpated. The ecosystems and fish in the Neretva are highly influenced through man made constructions and activities, especially during the latest war. During the war (1992-1995), in most parts of the Neretva River, fish was the only source of food. Therefore, fish were caught with nets, explosives, electricity, poison chemicals and with all available equipment for mass capture. Due to a lack of legislation, mass capture practices continued until 2000. Even today, it is hard to deal with this type of crime.

Unmonitored and incompetent restocking of the Neretva River and its tributaries presents a unique problem and a great threat to the survival autochthonous salmon.

Angling associations are carrying out fish stocking of the Neretva River without competent supervision. In such cases numerous fish species (grayling, rainbow trout, brook trout, brown trout – Atlantic and Daubing lines) are introduced to the river and in most cases they are pushing out autochthonous fish species through competitive interaction and interbreeding. Hybrids are often much more resilient to habitat changes than autochthonous species.

Global climate changes have had and continue to have a strong influence on Neretva River and its flora and fauna. Constant oscillation of water levels, a lack of water during summer, increased water temperature, etc. have led to disruption in the reproductive cycle of fish. Unsuccessful spawning and increased fry mortality due to the impacts of climate change have reduced overall recruitment.

The Neretva River and its tributaries were the subject of great scientific interest in the 1960s and 1980s. Numerous scientific and research papers connected to Neretva river and its fish population were published. During the period 1992- 2000 scientific research in this region was not advisable. After the year 2000, autochthonous salmonids from the Neretva have become the subject of numerous national and international scientific expeditions. Research based on morphological and morphometric characteristics produced an overview of the present status of the fish population in the river. Based on this overview, recommendations for measures to be introduced to protect and preserve autochthonous species (especially endemic salmonides), can be made.

The upper course of the Neretva River represents a typical salmonid reach (brown trout and grayling zone). In this part of the river salmonids are the dominant fish population (91.2% salmonids). This salmonid population is predominantly made up of brown trout (74.4%), with rainbow trout contributing 2.0% to the population. The proportion of endemic salmonides (Neretva softmouth trout and marble trout) in the population is critical, they participate just 7.4% of the total fish population.

Genetic analysis of salmonids in the upper reaches, indicated that brown trout - *Adriatic line* are dominant in this part of the Neretva River (68%). Danubian and Adriatic lines make up 16% and 11% of the population respectively. Neretva softmouth trout are the least abundant species in this sample (5%). Marble trout were not found in this investigation. Salmonid fish species contribution was only 14.6%.

Table 1. The composition of the fish population in the upper course of the Neretva river (from the source down to Jablanica lake)

Family	Species	Quantity	
		absolute (n)	relative (%)
<i>Salmonidae</i>	Brown trout (<i>Salmo trutta m.fario</i>)	261	74.4
	Marble trout (<i>Salmo marmoratus</i>)	2	0.6
	Softmouth trout (<i>Salmothymus obtusirostris oxyrhynchus</i>)	24	6.8
	Rainbow trout (<i>Oncorhynchus mykiss</i>)	7	2.0
	Grayling (<i>Thymallus thymallus</i>)	26	7.4
<i>Cyprinidae</i>	European chub (<i>Leuciscus cephalusalbus</i>)	1	0.3
	Eurasian minnow (<i>Phoxinus phoxinus</i>)	15	4.3
	Gudgeon (<i>Gobio gobio</i>)	4	1.1
<i>Cottidae</i>	Bullhead (<i>Cottus gobio</i>)	11	3.1
Total		351	100.0

Following dam construction and subsequent reservoir creation in the middle reaches of the river, cyprinid fish species became dominant in the community due to habitat changes (72.3%) (Table 2). Salmonids represent only 14.6% of the community, the remainder is made up of perch (14.6%) and other species (2.1%).

The proportion of salmonids in the community is higher in the lower reaches of the Neretva River, from Mostar reservoir downstream to the Croatian border, compared with middle course of river. In this part of the river, the salmonids make up more than half of total fish population (57.2%). Soft mouth trout represent 13.6% of the fish community. This species together with brown trout are the most dominant species in this part of the river (40.9%). In this region, marine fish (herring and mullet) are occasionally caught. Cyprinids contribute 24.9% of the community composition.

Table 2. Fish community composition in the middle reaches of the Neretva river (from the Jablanica lake to the mouth of the river Buna)

Family	Species	Quantity	
		absolute (n)	relative (%)
<i>Salmonidae</i>	Brown trout (<i>Salmo trutta m.fario</i>)	24	2.4
	Lake trout (<i>Salmo trutta m.lacustris</i>)	54	5.5
	Rainbow trout (<i>Oncorhynchus mykiss</i>)	30	3.1
<i>Cyprinidae</i>	Carp (<i>Cyprinus carpio</i>)	76	7.7
	Sval (<i>Leuciscus svallize</i>)	246	25.1
	European chub (<i>Leuciscus cephalusalbus</i>)	95	9.7
	Prussian carp (<i>Carassius gibelio</i>)	43	4.4
	<i>Alburnus arborella</i>	222	22.6
	<i>Chondrostoma knerii</i>	28	2.9
<i>Percidae</i>	Pike-perch (<i>Sander lucioperca</i>)	143	14.6
<i>Centrarchidae</i>	Pumpkinseed (<i>Lepomis gibbosus</i>)	15	1.5
<i>Anguillidae</i>	Eel (<i>Anguilla anguilla</i>)	6	0.6
Total		982	100.0

Table 3. The composition of fish populations in the lower course of the Neretva river (from the mouth of the river Buna into the Neretva down to Croatia)

Family	Species	Quantity	
		absolute(n)	relative(%)
<i>Salmonidae</i>	Brown trout (<i>Salmo trutta m.fario</i>)	102	27,3
	Marble trout (<i>Salmo marmoratus</i>)	3	0,8
	Softmouth trout (<i>Salmothymus obtusirostris oxyrhynchus</i>)	51	13,6
	Rainbow trout (<i>Oncorhynchus mykiss</i>)	47	12,6
	Grayling (<i>Thymallus thymallus</i>)	11	2,9
<i>Cyprinidae</i>	Sval (<i>Leuciscus svallize</i>)	18	4,8
	<i>Rutilus rubilio rubilio</i>	11	2,9
	European chub (<i>Leuciscus cephalusalbus</i>)	14	3,7
	Eurasian minnow (<i>Phoxinus phoxinus</i>)	28	7,5
	<i>Chondrostoma knerii</i>	22	5,9
<i>Gasterosteidae</i>	Three-spined stickleback (<i>Gasterosteus aculeatus</i>)	40	10,7
<i>Cottidae</i>	Bullhead (<i>Cottus gobio</i>)	11	2,9
<i>Anguillidae</i>	Eel (<i>Anguilla anguilla</i>)	8	2,1
<i>Clupeidae</i>	<i>Alosa falax nilotica</i>	5	1,3
<i>Mugilidae</i>	Flathead mullet (<i>Mugil cephalus</i>)	3	0,8
Total		374	100,0

Sustainable selection programme to protect and strengthen the salmonid populations

The studies reviewed in this project show the differences in fish communities along the river continuum and highlight the importance of developing ways to advance, protect and strengthen the Salmonid populations of the Neretva. The continuing decline in the these populations, especially of endemic species, could bring about their extinction the very near future. Institutional Collaboration between Academic Institutions in Agriculture, Forestry and Veterinary Medicine in Norway and Bosnia & Herzegovina, Croatia and Serbia & Montenegro 2006-2009, Norwegian University of Life Sciences and the Faculty of Agriculture and Food Sciences of the University of Sarajevo has initiated the project “Sustainable Selection Program for salmonid strains of the Neretva River”. The main objectives of the project are to:

- establish programmes for population improvement and artificial reproduction of salmonids of the Neretva river
- collection of brood stock of autochthonous and endemic salmonids from various locations of the Neretva watershed
- DNA-typing of broodstock to assess genetic variation and optimise mating scheme
- artificial reproduction and rearing of fry and fingerling of salmonids
- further broodstock selection and management, assisted by simulation programmes
- rehabilitate vital fish stocks and increase the natural populations of salmonids
- restocking of the Neretva river and its tributaries with fingerlings
- education and specialized training in Norway

To start realising the aims of the project, Konjic Municipality and Faculty of Agriculture and Food Sciences with the material and technical support of Norwegian University of Life Sciences had to establish the Center for fisheries „Boracko lake“ – Konjic. The centre is a national institution for advancing, protecting and strengthening autochthonous and endemic salmonid populations.

The role of the Centre is to:

- rear fry and fingerlings of autochthonous and endemic salmonids for restocking into the Neretva river and its tributaries
- educate pupils, students, fishermen and farmers
- carry out scientific and research works

Endemic salmonid species are given priority in the breeding program as these populations are the most at risk of extirpation/extinction (Marble trout, Neretva soft mouth trout, dentex trout and achromous brown trout).

This Center for fisheries will organize the permanent education for pupils (of primary and secondary schools), students, anglers and farmers. Beside that, students of Faculty of Agriculture and Food Sciences and other Faculty would be able to do practice work in fields of aquaculture and fisheries. The Center will organize seminars from time to time.

The Turkish International Cooperation and Development Agency was involved in the appointment and development of this important institution and a significant collaboration of domestic institutions on this project are expected.

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The contribution of Akgöl and Paradeniz Lagoons for fisheries in Göksu Delta (Turkey)

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Abstract. In this study, the role and contribution that Akgöl and Paradeniz Lagoons make to fisheries resources in the Göksu Delta was summarised. The Göksu Delta is situated on the Southern part of Turkey along the Mediterranean coast. It has two lagoons known as Paradeniz and Akgöl that have formed as a result of the accumulation of sediment carried by the Göksu River, the lagoons areas are 390 and 1200 ha respectively. Both water bodies have an influence on each others salinity: Paradeniz is a brackish water lagoon (12-39 ppt), with a seasonal salinity pattern mainly influenced by Akgöl and via the drainage channels. Akgöl is a quasi freshwater lake (1-4 ppt) in which the salinity only increases slightly towards the connection with Paradeniz. Fishing in the two lagoons is undertaken throughout the year using methods such as; trammel nets, traps, fish barrier and cast nets. Fyke nets are only used only in Akgöl. The Kurtulus cooperative, which is the organisation of the lagoons fishermen, consist of 106 members. Total productivity was around 50 t in 2007. The dominant fish species include; grey mullet, sea bass, sea bream, carp and blue crab.

Introduction

Lagoons are shallow coastal bodies of water that are separated from the ocean by a series of barrier islands which lie parallel to the shoreline. Inlets can be either natural or man made, these cut through barrier islands and facilitate the movement of tidal currents that transport water into and out of the lagoons. Due to the fact that lagoons are characteristically shallow, they are strongly influenced by precipitation and evaporation, these natural occurrences result in fluctuating water temperatures and salinity levels. Despite wide variations in the previously mentioned water parameters, lagoons can be fragile ecosystems that are susceptible to pollution effects from public waste, industrial and agricultural runoff (Hill 2007). These environments have a great deal of important ecologic aspects, providing shelter for endemic or threatened species of plants and animals, making them good economical cultural and scientific resources (Deniz 2004).

Turkey has 8333 km of coastline, with 72 lagoons as covering 36 000 ha. Of these sites, 14 are located in the Black Sea, 12 in the Marmara, 29 in the Aegean and 17 Mediterranean Sea. The main activity in these lagoons is traditional fishing which, is permitted in 43 out of the 72 lagoon systems (STM 1997). Recently, the most detailed research into Turkish Lagoons was conducted (STM 1997) with the assistance of the World Bank and Turkey's Ministry of Agriculture and Rural Affairs. Akgöl and

Paradeniz, the two lagoons surveyed in this project, are situated on the western side of the Göksu Delta in the South of Turkey. Apart from STM (1997), there has been no literature that discusses any previous specific management measures aimed at the native fishery supported by these two lagoons.

Location

The Göksu Delta (Fig. 1) is situated on the Southern part of Turkey along the Mediterranean coast. It has two lagoons known as Paradeniz and Akgöl which, have formed as a result of the accumulation of sediment carried by the Göksu River, the lagoons areas are 390 and 1200 ha respectively.

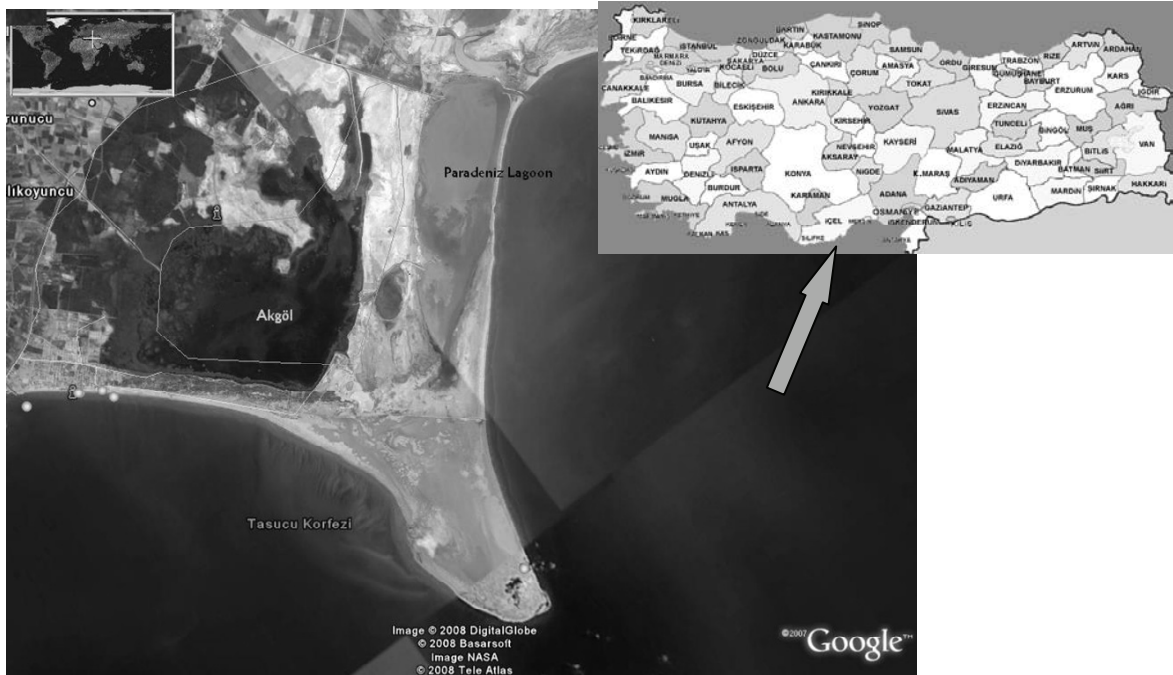


Figure 1. The map of Paradeniz and Akgöl Lagoon Complex in Göksu Delta.

General characteristics

Akgöl is roughly triangular in shape, with its longer axis extending in an E-W direction (Figure 2). The lagoon is a quasi freshwater lake (1-4 ppt) (Table 1), fed with fresh water via two SHW drainage channels that discharge along its landward side. Between 1940-1950 it was connected to the sea by a channel located along its seaward side (DKHD 1992), nowadays, it is only connected to the sea via the Paradeniz Lagoon by a narrow channel that was excavated by the State Hydraulic Works (SHW). As a result, the salinity of Akgöl slightly increases nearest to their connection.

Paradeniz is a brackish lagoon (12-39 ppt) (Table 1) with a seasonal salinity pattern that is primarily influenced by influxes of fresh water from Akgöl, via the drainage channels. Paradeniz has a long roughly triangular shape, with its longer axis extending in a NE-SW direction (STM 1997). Unlike Akgöl, the Paradeniz Lagoon has a permanent connection to the sea in the south east. It also has a manmade connection with the sea, separated by a narrow sand strip; this creates a connection in times of high south easterly winds that cause flooding.



Figure 2. Akgöl Lagoon.

Table 1. Parameters of the two lagoons.

Lagoons	Air temperature (°C)	Water temperature (°C)	Salinity (ppt)	Depth (m)
Akgöl	9.4-27.8	10-32	1-4	0.7
Paradeniz	9.4-27.8	10-29	12-39	0.8-1

Fisheries

Fishing in the two lagoons is conducted all year round, the methods that are predominantly used include; fishing barrier (Fig.3) and stationary or moving nets, other methods used are trammel nets, twine traps, fish barrier and cast nets. Fyke nets are only used in Akgöl (STM 1997). Fishing at the fish installation is mainly carried out from June to January when the barrier is closed, this accounts for 25-45% of the total catch (Crivelli & Rosecchi 1992). From March to June the fish barrier is kept open to facilitate the migration of fish. The Kurtulus cooperative, which is the organisation of the lagoons fishermen., consists of 106 members, with 4 vessels. Total productivity is around 50 t in 2007. The dominant fish species include; grey mullet, sea bass, sea bream, carp and blue crab.

Conservation Status

The Turkish Ministry of the Environment creates legislations to protect the environment and its rich natural diversity, as well as the fauna and flora that have a national importance. They declared the Göksu Delta, a Specially Protected Area (SPA) in 1990, the boundaries of this SPA include the Paradeniz and Akgöl lagoon complex. In 1994, they declared the Delta to be a Ramsar Site and in addition, in 1996 the Ministry of Culture declared the site to be a Natural Site Area.



Figure 3. The fishing barrier in the Paradeniz lagoon

Data collection

The data used for this study were obtained from the following companies and organisations; Kurtuluş cooperative, Ministry of Agriculture and Rural Affairs, General Directorate of Agricultural Production and Development, and Mersin Province Agricultural Directorate records.

Results

Mean total productivity of the lagoons has declined from about 75 t to 5t between 2003 and 2007, although there was an increase in 2007 (Figure 4). The dominant species that make up the fisheries of the lagoons are: grey mullet, sea bass, sea bream, carp and blue crab (Figure 5).

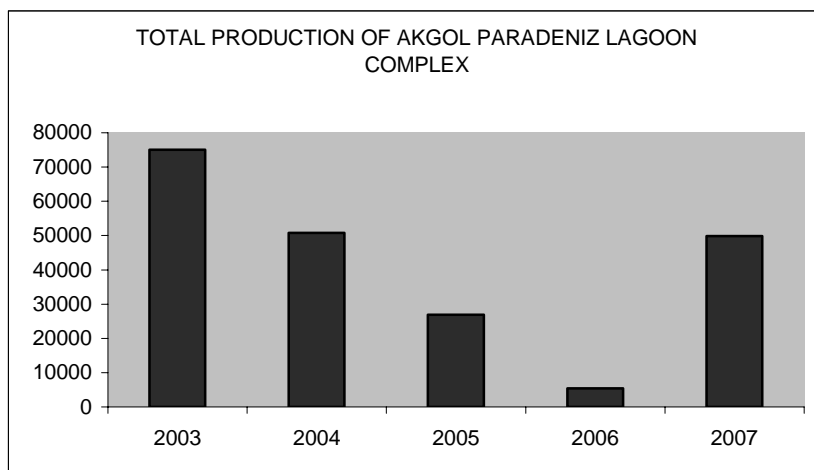


Figure 4. The total production of the two lagoons according to years.

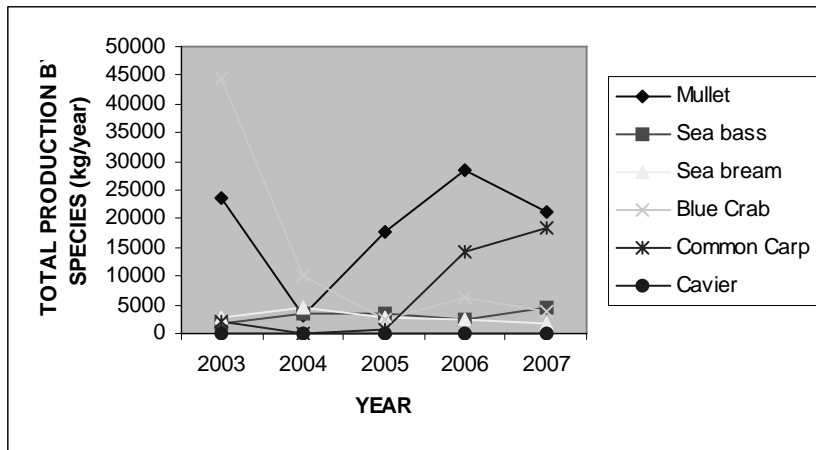


Figure 5. The total production by species of the two lagoons according to years.

Conclusions and recommendations

The Paradeniz and Akgöl lagoons receive water which has drained from the Göksu Delta and surrounding farmland on which, there is an intensive use of pesticides and manure. As a result, the water is consequently loaded with pesticides and nutrients.

The traditional fishing activities that are conducted in the lagoons should be upgraded to low-impact technologies. An introduction of extensive and semi-intensive forms of aquaculture should be applied to induce the recovery and preservation of the biological diversity. In addition, the fishing barrier should be modernized.

The Göksu Delta has a 'high conservation' status; therefore, rehabilitation studies can not be applied. For that reason, the conservation status should be overlooked for this area. The channel that is located between sea and lagoon should be deepened and widened. The effectiveness and sustainability of these lagoons in the fishery production of Göksu Delta can be increased by appropriate management actions.

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**Abstracts for unpublished papers or papers published in
Fisheries Management and Ecology**

Session on Ecological interactions

Meta-analysis of lethal and sublethal impacts of catch-and-release recreational angling on European fish species

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Catch-and-release is thought to constitute a viable way to reconcile social and ecological objectives of recreational fisheries management. However, its success depends on hooking mortality rates to be low and sublethal impacts to be negligibly as regards the fitness of individual fish post release. We conducted a meta-analysis of the published literature on the lethal and sublethal impacts of catch-and-release on European fish species. In total, 214 hooking mortality rate estimates for 17 fish species were identified in 100 published studies. The average hooking mortality rate was 15.6 ± 20.3 %. The most robust fish species belonged to the family of Cyprinidae, whereas the most sensitive ones were Percidae. Hooking mortality was significantly related to water temperature, type of bait and hook type. In addition, a suite of sublethal impacts can occur on released fish. In conclusion, catch-and-release can induce minimal impacts on fish, but this necessitates appropriate angler behaviour.

Determination of trophic situation of sarımsaklı dam lake (Kayseri, Turkey)

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Water samples were monthly collected from four different stations on Sarımsaklı Dam Lake from May 2001 to June 2002 to determine the trophic situation of lake. Additionally, physical parameters of water such as temperature, dissolved oxygen, electrical conductivity (EC), pH, and light permeability were measured in the field. Status of KOI, surface active substance, sulphur, nitrite, nitrate, total nitrogen, phosphate, total phosphate, and oxygen saturation were analyzed in Environment Ministry Reference Laboratory. Zooplankton samples were collected with a plankton net with mesh size of 55 µm horizontally and vertically, and they were fixed with 4% formaldehyde. The species were identified according to published data. The results of the light permeability, basic water quality parameters, and dominant zooplankton species indicated that the lake studied was eutrophic. Furthermore, biotic index supported to this result. The examined Lake in study area was partly polluted with different sources, because the study area is liable to human activities. If the pollution is not prevented, it may endanger the lives of living organisms here in future. Knowledge

on the trophic situation of Sarımsaklı Dam Lake is not well established, so all of the zooplankton species determined are new records.

The response of a brown trout population and the perception of the situation by anglers after ceasing trout stocking

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Since the mid 1980's, the amount of industrial discharge was stepwise reduced in a German river. To test the extent to which natural reproduction alone will preserve the local brown trout (*Salmo trutta* L.) population and the angling yield, respectively, stocking with brown trout was stopped in 2001. The development of the trout population was studied by electro-fishing between 2001-2007, angling yield (1987-2006) was derived from official statistics and local anglers were asked to complete an opinion questionnaire. Each year a natural reproduction and a stable stock of trout above 20 cm were observed. Moreover, the trout yield by anglers increased after stocking ceased and approximately 60% of the anglers were convinced that stocking is unnecessary. According to this study, a stocking stop in a river with an adjusted brown trout population will not lead to a decreasing brown trout stock, decreasing yield or unsatisfied anglers.

The possible effects of global warming on fisheries and aquaculture in Turkey

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Global warming is the increase in the average temperature of the Earth's near-surface air and oceans in recent decades and its projected continuation. The global average air temperature near the Earth's surface rose 0.74 ± 0.18 °C during the 100 year period ending in 2005. The negative effects of global warming on fisheries and aquaculture can be summarized as higher inland water temperatures, changes in sea surface temperatures, drought, sea level rise, changes in precipitation quantity and location, increase in frequency and intensity of storms. The possible effects of global warming on fisheries and aquaculture in Turkey can be seen in that changing in lake water levels and river flows, partially and totally drying out of lakes, decreasing in the amount of underground and spring water volume, increasing in the water temperature in water sources, introducing new alien species. Climate changes may affect fisheries and aquaculture directly by influencing fish stocks and hence production quantities and efficiency, or indirectly by influencing fish prices or the cost of goods and services required by fishers and fish farmers.

Traditional carp pond farming in Poland as an example of sustainable aquaculture

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Aquaculture is a very fast developing branch of food production. However, this fast development, usually focused only on one species might be very harmful for environment and cause serious damage. Sustainable development in aquaculture means such system of production which is environmentally non-degrading, technically appropriate, economically viable and socially acceptable, which conserves land, water and animal resources. A very good example for sustainable aquaculture is traditional carp production in earthen ponds. Carp ponds have very positive influence on environment as they accumulate large amount of bygones from supplying waters, creates very good habitats for thousands species of fauna and flora. Ponds are also very well accepted by inhabitants to such stage, that many people treat ponds as natural water bodies. From economical side ponds produce very good quality consumable fish and great amount of restocking material for lakes, rivers and other waters. But economic viability now is the “weak point” of traditional pond aquaculture and should be strengthened. Sustainable development is described also as such management which gives possibilities for the system to operate into the indefinite future without declining because of exhausting or overloading resources. This definition might be also considered from opposite perspective i.e. how long given system already exists in unchanged form. Due to this, carp ponds are very good example of “sustainable production system”. From total ponds area in Poland only app. 20 - 25% are ponds built after Second World War. The largest areas make ponds older than 100 years, and in this app. 15% comprise ponds older than 500 hundred years. All ponds are managed due to the Dubisch system, developed almost 150 years ago in Landek Carp Farm, near Golysz, Poland.

Impact of invasive alien species in aquaculture

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Aquaculture, the farming of aquatic organisms, although a very old tradition, has flourished in the last few decades to supplement traditional supplies from marine capture fisheries that are waning. Aquaculture is, however, becoming increasingly dependent on alien species. In Europe they account for over 70% of the aquaculture production, both in quantity and value. In this review, the role of aquaculture in the spread of alien and invasive species throughout Europe is analysed and options for mitigating the dependence on alien species and thereby minimising potential negative impacts on biodiversity are considered,. It is pointed out that there is potential for aquaculture, which is becoming an increasingly important food production process, not to follow the past path of terrestrial food crops and husbanded animals with respect to their negative influences on biodiversity.

Determination of current status on freshwater aquaculture in Mediterranean region of Turkey using socio-economic indicators

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This research study was conducted in 8 provinces (Adana, Antalya, Burdur, Hatay, Icel, Isparta, Maras and Osmaniye) located in Mediterranean region of Turkey. Data were collected from 198 fish farms by face to face survey technique. In the study, current status of fish farms was determined based on mainly socio-economic indicators. In the context of this research, survey results indicate the characteristics of fish farmers demographically, socially and economically. Firstly, fish farmers are in the middle class of age (66.5%), educated at high school or below (78.3 %). Fish farms are classified according to property ownership generally as private farm (76.8 %). On the economic standpoint, farmers do fishery in concrete pools at land (87.9%), they use their own sources for their finance (72.2 %), employ generally less than 9 people who has no professional knowledge (55.9%), has capacity vary 2-16 ton (62.6 %), prefer spring water (53.6 %) and have tendency for investment for their future. The basic aim of this study is to discuss tendencies for the future in fish farming using socio-economic data obtained from fish farmers and provide solution to the problems and make fish farming more profitable.

Effect of supplementary stockings of juvenile brown trout, *Salmo trutta* L., on yield in a Norwegian mountain reservoir

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The effect of supplementary stockings of juvenile (age 0+) hatchery-reared brown trout, *Salmo trutta* L., on annual yields was assessed in a Norwegian mountain reservoir during a 29-year-period (1979-2007). The fishery is mainly carried out with benthic gill-nets by local fishermen. During the study period, annual releases ranged from zero to 52500 fish (19.8 ha⁻¹). No stockings have been carried out since 1997. The annual yield varied from 1650 to 5653 kg, corresponding 0.62 to 2.13 kg ha⁻¹. A multiple regression showed that exploitation rate in terms of number of gill nets, and mean weights of 6+ fish (age when catchable size was reached), explaining 64% for the variability in the catches. Stocked fish seemed to contribute to a small extent to the yield or CPUE, exhibiting no positive correlation with stocking density. The lack of any significant contribution from stocked fish is probably due to a competitive bottleneck in the eroded epibenthic zone, causing high juvenile mortality. If the stockings should continue, we recommend releasing fish with body lengths of >15-20 cm.

Parasites of exotic and translocated fish species in the inland waters of Turkey

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One of the most persistent risks inherent with movements of living organisms around the world is that pathogens and parasites associated with the organisms be spread to new hosts in the receiving area. Pathogens introduction associated to fish introduction is a little studied topic in Turkey. The paper provides a review of the current state of knowledge on parasites of exotic and translocated fish species living in Turkish freshwater bodies.

Adaptation of mirror and common carp introduced to reservoirs: a contribution to the solution of the choice problem

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In addition to 664 small reservoirs, 555 large dams constructed in Turkey, another 210 large and 44 small dams are still under construction. Regarding their fishery potential, these dams creating large lakes behind, provide a significant source of income to the inhabitants living around. Introduction of fish species into these dams is under the responsibility of DSI, and mirror carp, known as a warm water fish have been introduced into most of the man-made reservoirs in Turkey, regardless the geographical location which controls the climatic conditions. During the last decade some arguments have arisen on the adaptation and spawning of mirror carp and the success of this application in Anatolia where typical cold continental weather conditions prevail. In the meantime depending on some irregular observations, common carp was introduced some reservoirs as an alternative to mirror carp. Neither governmental organizations nor universities have any long term monitoring studies on the growth and reproduction of mirror and common carp introduced into reservoirs. In this study growth, based on the data obtained through 4 years of observation, mirror and common carp populations monitored living in the same reservoir which is located in Yozgat-Central Anatolia having hard climatic conditions. Our results revealed that mirror carp has better growth and higher absolute fecundity than that of common carp.

Sustainable use of sterlet and development of sterlet aquaculture in Serbia and Hungary

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Sterlet (*Acipenser ruthenus* L.) is endangered due to over-fishing, river regulation and dam building as well as water and sediment pollution. Serbia and Hungary have

common sterlet populations in the Danube and Tisza Rivers. The highest recorded annual catch of sterlet in the past 4 decades was 79,978 kg (1988) and 37,000 kg (1990) in Serbia and Hungary, respectively. While both the sport and commercial fishery of sterlet are represented in Hungary, only commercial fisheries exist in Serbia. The aquaculture technology and rearing of sterlet is well-developed in Hungary while in Serbia, even though a market demand for this species exists, the aquaculture of sterlet has not developed till nowadays. A project aiming at the sustainable use of sterlet has been started in Serbia and Hungary to establish and to develop a common practice in the protection and utilization of the common natural resources, by which, sustainable use is promoted.

Introduced crayfish *Pacifastacus leniusculus* (Dana) utilization and effects on inland fishery

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The signal crayfish *Pacifastacus leniusculus* (Dana) was introduced from California to Sweden in 1959, and to Finland in 1967. The crayfish plague had depleted the crayfish stocks in the late 19th and early 20th century. No recovery or resistance have been detected. The signal crayfish was considered to be a homologue of the native noble crayfish *Astacus astacus* L. in Scandinavia. This new species was introduced in to a number of the Finnish freshwaters since late 1980s. The noble crayfish catch was 1.6-3.7 million specimens in 1986-2000. The signal crayfish appeared into the statistics in 2001 with 0.65 million specimens. In 2006 the catch was 1.6 million noble and 5.2 million signal crayfish. This increase of the crayfish catch is expected to continue. The rapid growth will appear in many economical and social changes in the inland fisheries, and perhaps lead to some ecological consequences as well. In the paper the catching development of the signal crayfish, especially from the point of view of methods, costs and manpower is examined and compared with the noble crayfish catching. In average, more efforts are directed to the utilization of the signal crayfish than is traditionally used in catching noble crayfish.

Fish based assessment of ecological status of Finnish lakes loaded by diffuse nutrient pollution from agriculture

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The Water Framework Directive of EU provides that pressures to surface waters due to diffuse loading of nutrients have to be taken into account in determination of their ecological status. Therefore we examined, by using a Finnish data set of fish communities in 178 lakes, the possibilities to assess the effects of agriculture-induced nutrient loads on the ecological status of lakes. The lakes were divided to reference (n=100) and affected

sites (n=78) based on an expert judgement. Fish sampling was conducted by standardized gillnet test fishing. A fish based classification tool of four parameters (EQR4) was applied in assessing the ecological status of lakes. The parameters included were mean total biomass of fish per gillnet night, number of fish individuals per gillnet night, biomass proportion of cyprinid fishes, and the presence of indicator species. The preliminary analysis resulted in a median EQR4 value of 0.78 (good status) for reference lakes and 0.56 (moderate status) for affected lakes. Thus, our classification tool gave a reasonable output for differently loaded lakes.

Responses of fluvial fish assemblages to agriculture in boreal zone

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The effect of agriculture on fish communities was studied with electrofishing data from 108 sites along 27 medium-sized rivers running in organic soils in central and northern Finland. The intensity of agriculture was quantified as the percentage of the above catchment area used for agriculture (range 0.3 – 31.0 %). Water quality data showed high correlations with the intensity of agriculture especially in suspended solids, total phosphorus and chemical oxygen demand (correlation coefficients 0.71 – 0.90). The density of several fish species, e.g. bullhead (*Cottus gobio*), alpine bullhead (*C. poecilopus*), minnow (*Phoxinus phoxinus*), and brown trout (*Salmo trutta*) responded with diminishing densities to the intensity of agriculture. On the other hand, the density of perch (*Perca fluviatilis*) and roach (*Rutilus rutilus*), for example, increased significantly along the intensity of agriculture. A fish-based index developed for the evaluation of the ecological integrity of rivers correlated negatively with the intensity of agriculture.

Wild stocks of lake-migrating brown trout near extinction in Finnish Lake District: rapid recovery actions needed

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Wild stocks of brown trout collapsed as a result of human actions in Finnish inland waters during the last century. Dams stopped migrating individuals, and low water quality and stream dredging weakened reproduction. The fall of migratory stocks was finalized by overfishing, mainly gillnet fishing on lakes. Consequently, the egg production of migratory stocks has diminished to negligible level. Remaining stocks are distinct, mixed with continuous stocking, and probably losing their genetic diversity. During last decades, various recovery actions have been carried out: stream channels have been restored, fishways have been built, and eggs and smolts have been

introduced. Gillnetting has been regulated, but slightly, and catch-and-release of wild trout is spreading in sport fishing. However, these measures seem to be inadequate, and almost no recoveries of migratory populations have been reported. The problem of by-catch in intensive gillnetting keeps populations threatened and creates dispute between stakeholders.

Does coexistence affect the growth and condition of native crucian carp *Carassius carassius* and introduced goldfish *C. auratus* in small ponds?

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Despite its long history of introductions in Europe, and its demonstrate adverse genetic impact on native crucian carp *Carassius carassius*, the Asiatic cyprinid, goldfish *Carassius auratus*, has been little studied where introduced and its ecological impacts remain unknown. To address this, we examined growth in crucian carp and goldfish in quasi-natural ponds of Epping Forest (London, England), both in sympatry and allopatry. The growth trajectories in allopatry and sympatry revealed much faster growth of goldfish in sympatry than allopatry. Crucian carp growth trajectories were similar in allopatry and sympatry but in sympatry crucian body condition values were significantly higher (*t*-test, $P < 0.001$) than in allopatry. These results may simply reflect differences among ponds in food availability, with goldfish-only ponds coincidentally having greater resources, or alternatively that co-existence incites these congeners to maximize growth potential, with associated ramifications for reproductive output. The implications for crucian carp conservation are discussed.

A new fish based index for monitoring the ecological status in rivers – A contribution to Water Framework Directive

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We collected electrofishing data from 902 rapids from the Rivers in Finland. Together with the fish data we collected information on land use, channel modification and water chemistry to understand the level of human alteration in the rivers. Discriminant function and correlation analyses were used to select fish variables that most efficiently classified the undisturbed reference sites and human impacted sites to proper classes and responded to human alteration. Five variables were selected for the index: the number of fish species, proportion of sensitive species, proportion of tolerant species, proportion of cyprinid individuals, and density of age-0+ salmonids. The value for each metrics (between 0-1) was calculated according to a point estimate for classical probability. The index value was the mean from the five metrics. An independent new data set was used

to test the index. The index is used to estimate the ecological classification of river according to EU Water Framework Directive.

Fishing activities and pollution risk on Köyceğiz-Dalyan Lagoon System

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Köyceğiz-Dalyan lagoon system, declared as a Special Protection Area in 1988, is located in south-western of Turkey. The area is composed of terrestrial structures of various qualities around Köyceğiz Subsidence Lake. It is a brackish lake which is fed by springs and several streams. The lagoon system and the beach is very important for sea turtles (*Caretta caretta*, *Trionyx triunguis*). Fishing activities are carried by DALKO (Dalyan Fisheries Cooperation) and the major commercial species are grey mullet (*Mugil cephalus*), eel (*Anguilla anguilla*), sea bass (*Dicentrarchus labrax*), gilt-head bream (*Sparus aurata*), carp (*Cyprinus carpio*) and blue crab (*Callinectes sapidus*). The amount of fish caught by DALKO decreased from 440 t to 180 t in last decades.

The lagoon is under pollution pressure of agricultural run-off and untreated urban waste. Heavy tourist-boat traffic on the canals between the lake and the sea causes heavy metal pollution, stress on fish and wave-damage to reed beds. In this study present situation of the lagoon system and fishing activities are evaluated.

Session on Governance

Global Code of Practice of Recreational Fisheries to Reconcile Social and Economic Objectives for Sustainability

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Lack of consideration and guidance about what constitutes good recreational fishing practice is hampering progress towards a coherent approach towards sustainable recreational fisheries on a global scale and is thus weakening the sector. This paper presents a recent initiative by the European Inland Fisheries Advisory Commission (EIFAC) and its Working Party on Recreational Fisheries towards development of a Global Code of Practice for Recreational Fisheries (CoP). In total 11 topical areas are addressed including intuitional and policy framework, enforcement, fish welfare, recreational fisheries practice, management and research. The resulting document complements other Code of Conducts that exists for fisheries in general, but is specifically framed for recreational fisheries. Its adoption by international, national and

local bodies is encouraged as well as dissemination of its content in an easily palatable way to anglers and other recreational fishers.

Trout stocking revisited: An interdisciplinary approach to stakeholder participation and co-management

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Following a long tradition, about 60-115 million brown trout fry equivalents of widely unknown genetic composition are stocked annually in Swiss running waters. Evaluations of survival rates are sparse and their results are mixed. In a recent survey, anglers, nevertheless, indicated they wish to keep stocking at the current or even higher level. In an interdisciplinary stakeholder participation and education program, we are now assessing the coupling of ecological and social aspects related to stocking. Mark-recapture studies of stocked 0+ trout and stock assessments are conducted in cooperation with angling clubs in different types of streams to assess stocking success. Alongside this instructed experience we conducted repeated surveys of the anglers' mental models of how fish population dynamics work and of their motivation to conduct stocking.

From strict guidelines to adaptive stocking in subarctic Lake Inari

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The regulation of the subarctic Lake Inari initiated in 1941 as the outlet River Paatsjoki was closed by a dam. Due to environmental changes the total catch collapsed from 248 t to 78 t per year in 1960's. Compensation actions initiated in mid 1970's and large stocking obligation, introduction of new fish species and restoration of fishing possibilities created the bases for increasing fishery. Total catch peaked in 1989 at 560 t and professional fishery peaked at 400 t thus following by a collapse in mid 1990's due to the fluctuation of vendace (*Coregonus albula*) stocks. Recreational and subsistence fishing recovered since early 1980's and are nowadays responsible for 75 % of the total catch. Initially the Lake Inari and its tributaries were managed separately and this gave only little possibilities to adjust the stockings to changing food, environment, fish stock and fishing conditions. Due to the increase of vendace stock it became important food storage for the predators. As the vendace stock collapsed, brown trout (*Salmo trutta* m. *lacustris*) and arctic charr (*Salvelinus alpinus*) catches collapsed and the predators became strongly infested by parasites making them unattractive for fishers. In 1996 the adaptive stocking policy was adopted and in 2001 also court orders for management practices were changed making it possible to adjust the stockings. Nowadays catches of

the predatory salmonids are larger than before the regulation. Governmental financial aid for fisheries has varied in different decades thus creating a solid infrastructure for the fishing activity of different stakeholders.

Inland Fisheries of Turkey

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Turkey fish production in 2006 was 661,991 t. Of this figure , 44,082 t come from inland capture fisheries and 56,694 t come from inland aquaculture production. Turkey has 200 natural lakes with 906.118 ha area, 206 dam lakes with 342,377 ha area, 953 small dam lakes with 15,500 ha and 33 rivers, 177,714 km long and many streams. Main species of inland capture fisheries are common carp, sand smelt, Tarek, crayfish, pike, catfish, mullet. Fisheries management is under taken by the Ministry of agriculture and Rural Affairs, its provincial offices and Research institutes. All inland water resources are hired to the private sector and fishermen cooperatives. Hiring is based on stock assessment. Inland fisheries are regulated and managed with a notification prepared by the Ministry of Agriculture and Rural Affairs that posses some restrictions and responsibilities to the people involved in fisheries for both commercial and Sport fishing. The restrictions are on fishing time, fish size, fishing area and fishing methods and equipment. Research on ecology, stock assessment and selective fishing equipment must be improved. Management plans must be prepared for each water source with a participatory approach.

Turkish fisheries management towards sustainable exploitation of resources

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Being surrounded both by the Mediterranean and Black Sea, Turkey is a leading fisheries country in its region. Turkish fishery presents a typical artisanal and off-shore fishery with multi-gear and multi-species characteristics, employing about 100 thousand fishermen. 10 species, being comprised mostly of small pelagics, account for approximately 90 % of the total marine catches. Fishing activities are regulated through distinct fishing circulars, under two categories, i.e. “commercial fishing” and “recreational fishing”. Total fishery production in 2005 from marine capture fisheries, aquaculture, inland fisheries and the others (shellfish etc) were 334,248mt, 118,277 t, 46,115 t and 46,133 t respectively, totalling a production of 544,773 t. This contributed 0.6% in the global production. Turkish aquaculture has grown markedly over the last years, having 5th place in Europe. In parallel with Turkey’s accession process to the EU, Turkish fisheries have been subject to a comprehensive review procedures in terms of harmonisation of the fisheries with responsible and active participation from relevant stakeholders. In this connection, newly developed pilot applications have been introduced to create a framework for sustainable exploitation of fisheries resources. Examples are development of a vessel monitoring system, Fisheries Information

System, construction of port offices, regulations on market standards, drafting of preliminary Fisheries Management Plans and a sector strategy. Draft amendments have been made to the existing Fisheries Law 1380, in order to form and strengthen legal basis in terms of enforcement and sanctions for newly introduced applications.

Conservation and sustainable fishery management of brown trout in Irish lakes: is roach a real threat?

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Ireland's freshwater fish fauna was historically dominated by salmonids. Among the native species the wild brown trout (*Salmo trutta* L.) became very attractive to anglers and sport angling makes a significant contribution to the local tourism industry. Thus, brown trout represents an economically important resource with high socioeconomic value. However, brown trout populations are potentially threatened by the introductions of non indigenous fish species. One introduced species roach (*Rutilus rutilus* L.) has been regarded for a long time as a threat to salmonid species because of potential competition for food and space due to their high population density. The present study of the ecological interactions of brown trout and roach in non-polluted Irish lakes using Stable Isotope Analysis (SIA) and gut content analysis (GCA) reveals that in clean waters the two species do not compete for food sources. These results are important for salmonid conservation as well as sustainable management of both coarse and game angling.

Economic, social and ecological value of whitefishes on the European North of Russia

A. NOVOSELOV

Northern branch of PINRO (SevPINRO)

Seven species of whitefishes inhabit European North of Russia. There are Arctic whitefish (*Coregonus pidschian*), peled (*Coregonus peled*), Arctic omul (*Coregonus autumnalis*), chir (*Coregonus nasus*), Baltic cisco (*Coregonus albula*), Siberian cisco (*Coregonus sardinella*) and nelma (*Stenodus nelma*). These fishes are traditional objects of commercial fishery in the Barents sea, White sea and Kara sea watersheds. Whitefishes are important for recreational fishery. For example, Arctic whitefish is main subject for winter recreational fishery in the delta of the Severnaya Dvina river. In the ecological aspect whitefishes are unique group which can use as biological indicator for human impact on water ecosystems. Under technogenic influence whitefishes stocks need guard and extended reproduction. For the European North of Russia was designed

program for management of whitefishes stocks. Important part of this program is aquaculture of whitefishes in the large river systems and lakes with using fish hatchery.

Fishing tourism, biodiversity protection and regional politics – case of the River Tornionjoki, Finland

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Salmon fishery involves a broad range of interest groups and is thus a challenge for fisheries governance. Our paper focuses on the undammed River Tornionjoki between Finland and Sweden, the most important wild salmon (*Salmo salar* L.) river in the Northern Baltic Sea. The marine salmon fisheries have been restricted in order to protect the declining wild salmon stocks and, on the other hand, to secure catches for fishing tourism in the river. The interest groups of the river fisheries have been totally absent from the salmon committees. Consequently they have taken various measures for influencing salmon politics. This social movement has achieved its aims only partly, because of counter reactions by the coastal commercial fishers and their associations. We suggest creating a forum for dialogue between stakeholders in order to reduce the tensions between the commercial fishery and tourism industry.

Fishery management in the large lake systems located in the special protected areas of the European north of Russia

I. STUDENOV

SevPINRO (Northern branch of PINRO)

Many special protected areas of nature on the European North of Russia include large and medium lake systems. There are large lake Lekshmozero (54.4 km²) and system including 3 large lakes (Kenozero, Dolgoe and Svinoe with total area 68.6 km²) situate in the National park "Kenozersky" (Arkhangelsk region). Nosovsko-Luzskaya lake system (about 60 km²), including 12 different lakes, locates in the National park "Vodlozersky" (Arkhangelsk region and Republic Karelia). In the landscape reservoir "Kozhozersky" (Arkhangelsk region) place large lake Kozhozero. In the natural reservoir "Nenetsky" (Nenetsky autonomous okrug) locate large lake Golodnaya Guba (186 km²). Commercial fishery on all these lakes was earlier, then on various reasons it's stopped. At the present time use of fish resources in the lakes of specifically protected territory is recover. Sport, amateur and scientific fishing are main three directions of modern use of water bioresources in the special protected areas. Identical estimation of total allowable catch (TAC) is the main problem for fishing management which directed on the sustainable use of fish resources.

Implementing 'Regional Fisheries Management' In the Mekong Basin

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The Technical Advisory Body on Fisheries Management in the Mekong Basin (TAB) was established in June 2000. It has four areas of concerns: 1) shared stocks and habitats; 2) external factors impacting on local and national fisheries; 3) shared interests in technical and institutional innovations in fisheries management and development; and 4) global principles of governance. Yet, fisheries management is clearly under the authority of each riparian country. How, then, will 'regional management' be possible? The TAB has two entry points: Uptake of regional concerns in national management and policy-making; and regional networking of national initiatives, where desired outcomes and methodologies applied are agreed and results exchanged by all. As a result, maintenance of critical habitats for regional fisheries, conservation of threatened species, and user involvement in management decision-making, that is, 'regional fisheries governance', are now being discussed at all levels and scales of governments and civil society in the Lower Mekong Basin.

Functional vs scenic restoration - challenges to improve fish and fisheries in urban waters

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Urban waters are subjected to multiple uses and thus, typically characterized by higher pollution, nutrient and temperature loads, as well as degraded habitat structures. Fisheries management is commonly restricted to stocking, whilst the European Water Framework Directive (WFD) aims at establishing naturally recruiting diverse fish assemblages. What are the most efficient management ways to meet the WFD requirements?

Two restoration measures, one in urban Berlin and one in the rural vicinity, have been compared according to their fish ecological efficiency. This study aimed to assess the feasibility of successful environmental improvements for fish in urban waters. If the underlying basic bottlenecks have been identified, artificial structures could provide functionally similar fish habitats replacing the natural equivalent in urban river stretches. It was hypothesized, that especially the most heavily degraded waters provide opportunities to improve fish diversity and fisheries very efficiently by artificially improving habitat structures at comparably low efforts.

Session on socio-economic interactions

Examining changes in participation in recreational fisheries in England and Wales.

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Inland fisheries in England & Wales have a high economic and social value. Managing participation to maximise fishery performance is key to maintaining this status. Atlantic salmon (*Salmo salar*) and sea trout (*S. trutta*) support important net and recreational fisheries and represent a valuable resource, particularly for rural economies. The value

of these migratory salmonid fisheries is estimated to be £128 (€165) million. Similarly, coarse fish (non-salmonid, principally cyprinids) provide catch and release angling; a pastime which puts £971 (€1250) million spend into the economy. The total declared rod catch of salmon and sea trout over the last five years (2002-06) has averaged 18,953 and 30,117 fish respectively in England and Wales. The central tenet to increasing participation in recreational salmonid fisheries is that an increase in stock size will result in more anglers accessing the fishery. This principle was examined for salmon on two rivers; the Usk (Wales) and Lune (England) where exploitation restrictions resulted in an increase in the number of salmon available to anglers. On the River Lune the number of salmon available to anglers post-intervention increased significantly by 79% ($P < 0.05$). There was no significant increase in catch ($P > 0.05$) while the number of anglers decreased significantly by 20% ($P < 0.05$), compared to the situation prior to the intervention. On the River Usk the closure of the net fishery resulted in potentially an additional ~1120 salmon available to anglers. Following closure of the net fishery the rod catch increased by 17%, while the number of anglers decreased by 11%, in both cases the change was not significant ($P > 0.05$). For coarse fisheries, based on catch & release, increased participation is dependent less upon stock manipulation and more upon facilitating the activity. In recent years, urban fishery development programmes have provided improved access to local fishing opportunity. Also, new anglers have been targeted with such campaigns as Get Hooked on Fishing and the Scout Angler Badge. This paper discusses the above, both in relation to availability of angling opportunities and in a wider context.

Reconciling ecological and social objectives in managing European eel (*Anguilla anguilla*) stocks – the angler’s perspective

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In response to the current decline in the European eel (*Anguilla anguilla*) stocks, the European Union (EU) has recently implemented an eel recovery action plan. Accordingly, each member state is expected to provide a management plan on eel until 2008. One challenge to developing management plans for declining fish resources is accounting for stakeholder preferences, particularly anglers and fishers, to reconcile ecological and social management objectives. To tackle this problem with respect to the declining European eel stocks, a maximum difference conjoint task focusing on management strategies for eel was administered to a random sample of anglers ($N = 640$) in northern Germany. The task’s unique nested structure allowed the estimation of 3 separate preference models: (1) eel angling regulations, (2) multi-sector management, and (3) acceptability of the overall package. Angler preferences conformed to

psychological reactance theory in that regulations restricting other sectors were strongly preferred over those that targeted anglers. Overall, greatest preference was expressed to reduce the commercial fishery effort. Despite the strong opposition towards personal restrictions, anglers supported the overall management portfolio as long as an eel recovery success was assured. In conclusion, managers must expect opposition restricting recreational fishing if the success of such measures is uncertain or management measures are designed that affect anglers exclusively.

Socio-economic character and importance of fisheries on Danube between Serbia and Croatia

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Study of socio-economic aspects of use of fish resources on Danube River between Serbia and Croatia was performed by questionnaire (40 commercial and 309 sport fishermen). Analyses was done by the program SPSS (Statistical Package for Social Sciences) and Statistica 6.0 StatSoft. This work present comparative result on both side of Danube River and contains basic data about fishery sector in Serbia. It presents specific issues related to freshwater fisheries, management, policy, protection, exploitation of fishery resources, legislation, statistics, problems, solutions for future strengthening of the national fishery sector. Socio-economic circumstances leads to intensive fishout and jeopardize fish fund as well as ecological factors. Awareness of economical, social, ecological problems is apparent. Lack of systematic regulation and organization in fishing is the major problem. Attitudes, values, experience and behaviour of fishermen make good base for planning of sustainable development in fishing.

Profitability and productivity analysis of fishery enterprises in Lake Durusu (Terkos)

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In this research, profitability and productivity of 22 inland fishery enterprises were investigated. In this study, Cobb-Douglas production function was applied to input-output data which obtained from these fishery enterprises for 2006-2007. Partial productivity analysis of boat, horse power, labour force, labour day of inland fishery enterprises was made. On the other hand, profitability indexes of same fishery enterprises were calculated.

Reconciling the conservation objectives for an endangered endemic freshwater fish with those for tourist development on the island of Rhodes (Greece)

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Only 11 populations of the endangered fish species, gizani [*Ladigesocypris ghigii* (Gianferrari, 1927)] exist on Rhodes' island. These populations inhabit different natural stream systems (except one that lives in a small water-supply reservoir), but all are threatened during summer when the streams are partially drying up or are reduced to isolated pools. This is mainly because natural conditions (poor rainfall and increased summer temperature) combined with surface- and groundwater ion have contributed to a decline of the island's water resources. It is estimated that about 20% of the island's fresh water is used for agriculture, while the rest goes to domestic consumption, mainly to meet the demands of the flourishing tourism industry. Tourism on Rhodes developed rapidly during the 1990s, reaching 10.8 million overnight stays in 1999 declining to 8.6 millions in 2003. However, tourism now mainly occurs between June and September and to meet the increased demand for water during this period, a large dam (60 million m³) is being built (completion projected for 2008) in the biggest stream of the island that supports the most viable gizani population. This drive to support tourism, which is the main source of income for the local residents, is having a detrimental impact on conservation objectives for the endangered gizani populations. This paper reviews the steps being taken to manage the island's water resources sustainably, increasing the public's awareness and ownership of the problems with conservation of gizani and to integrate the conservation policy into the development policy of tourism.

The inland fisheries of Central Asia:

Why Production and Consumption Declined - and Suggested Strategies for Rehabilitating the Sector.

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The dismantling of the Soviet Union and the corresponding independence of the Central Asian states in the early 1990s had severe economic consequences for the Central Asian Region. The transition from command to free-market economies was (and sometimes still is) accompanied by dramatic contractions in production in virtually all primary resource sectors. However, arguably the most catastrophic and ongoing declines in output were to be found in the fisheries sector. This paper shows how a combination of ecological (most notably the introduction of alien invasive species and pollution), economic (increasing ion of water for irrigation and power generating purposes), social (increased impoverishment following the removal of employment guarantees) and governance (collapse of local management structures) affected fisheries production and

consumption in the Central Asian transition economies. In the light of these findings, we provide some general observations as how this decline might be arrested or reversed.

The review on Turkey inlands in terms of interaction between social, economic and ecological objectives of fisheries and aquaculture

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Turkey has a rich country in terms of inland resources comparing with many countries. Generally, all of freshwater ecosystems are suitable for capture fisheries and some of them are convenient for the aquaculture. Each of the catch and aquaculture quantity from the inland waters is nearly % 9-10 of the total annual fishery production in some years. It is expected the great contribution to capture fisheries and aquaculture from inland fisheries due to their capacity and rich potentials. Turkey inland resources have quite range varieties in terms of water quality, trophic status, altitude, climate ecosystem diversity, species diversity etc. Inland resources inventory of Turkey is consisted of 26 basins. There are more than 200 natural lakes, 555 dam lakes and 33 long rivers. Within these lakes, 48 lakes have surface area larger than 500 ha. South Marmara, Lake District, East Anatolia, GAP Region and Lagoon Lakes are represented the main fishing grounds. Turkey inland fish fauna is consisted of 236 species and subspecies which belong to 26 families. Cyprinidae is represents by 116 species (% 49) within Turkey fish fauna. In terms of fish fauna protection status; 102 of them are under the IUCN Red List categories. Recently, eutrophication and water pollution are raising problem for inland waters in Turkey. The social, economic, ecological interactions in terms of fisheries and aquaculture are reviewed within the Turkey inland waters in this presentation.

Posters

Estimation of the phosphorus loads caused by cage-cultured rainbow trout (*Oncorhynchus mykiss* Walbaum, 1792) farms in Kesikköprü Reservoir, Turkey

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Aquaculture in freshwater and marine environments is a rapidly developing sector in Turkey, and trout is the major fish species used for cage culture in freshwater systems. According to official records indicate that there were 72 cage farms in reservoirs, with an annual capacity of 4,777 t in 2004. Five rainbow trout cage farms with capacities varying between 15 and 50 t, exist in Kesikköprü Reservoir, one of the inland water areas in Turkey where cage culturing has been performed. This study intended to estimate the phosphorus loads released to Kesikköprü Reservoir from five different

rainbow trout (*Oncorhynchus mykiss* Walbaum, 1792) cage farms, which are using pelleted and extruded feed, from April to July 2006.

Phosphorus loads from cage farms during the on-growing season using pellet and extruded feed was estimated according to Ackefors and Enell (1990). Moreover, we compared the phosphorus loads results from cage-cultured and external inputs in the Kesikköprü Reservoir.

Some biological characteristics of *Chalcalburnus mossulensis* Heckel, 1843 from Atatürk Dam Lake (Turkey)

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Being the most important part of the South Anatolian Project, Atatürk Dam Lake with 48 700 hm³ water deposits and 817 km² surface area, is representing very high potential for fishery. Besides of this potential, there are several species coming from naturally Euphrates River. There are about 28 species belonging to 8 families in this basin. The most important species are *Silurus triostegus*, *Acanthobrama marmid*, *Aspius vorax*, *Barbus rajanorum mystaceus*, *Barbus xanthopterus*, *Capoeta capoeta umbla*, *Capoeta trutta*, *Carasobarbus luteus*, *Chalcalburnus mossulensis*, *Chondrostoma regium*, *Cyprinus carpio*, *Leuciscus cephalus orientalis*, *Leuciscus lepidus*, *Tor grypus* and *Liza abu*. In this study some of the biological characteristics of *Chalcalburnus mossulensis* Heckel, 1843 were investigated. Totally 641 specimens were captured monthly by means of gillnets between March 2004 and February 2005. The aim of this study was to determine some biological characteristics such as sex composition, growth in length and weight, length-weight relationships, relationships between total, fork and standard lengths, condition factor, spawning time, and time of sexual maturity of *C. mossulensis* in the dam lake under consideration.

The accumulation of heavy metals (Cd, Pb, Hg, Cr) and its state in phytoplanktonic algae and zooplanktonic organisms in Abant Lake -Turkey

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As Phytoplanktonic dominant algae determined *Choroococcus*, *Microcystis*, *Oscillatoria*, *Spirulina*, *Anabaena*, *Plectonema*, *Euglena*, *Trachelomonas*, *Dinobryon*, *Botryococcus*, *Oocystis*, *Scenedesmus*, *Stigeoclonium*, *Cosmarium*, *Spirogyra*, *Zygnema*, *Oedogonium*, *Cyclotella*, *Melosira*, *Amphora*, *Asterionella*, *Cocconeis*, *Cymbella*, *Diatoma*, *Fragilaria*, *Gomphonema*, *Gyrosigma*, *Navicula*, *Nitzschia*, *Pinnularia* and *Synedra* in Abant Lake. As zooplanktonic dominant organisms determined *Filinia longiseta*, *Synchaeta pectinata*, *Synchaeta littoralis*, *Daphnia*

longispina, *Diaphanosoma brachyurum* and *Acanthodiptomus denticornis* in Abant Lake. They widely adapted taxon on the state of an aquatic environment. Abant Lake is two shallow lakes that are under environmental protection status. Accumulation of heavy metals (Cd, Pb, Hg, Cr) in the water and plankton of Abant Lake was studied seasonally, during from April 2000 to December 2002. Higher concentration of all heavy metals was recorded in plankton. Hg was found in lowest and Pb in the highest correlation, however, the concentration of each metal varied seasonally. In addition, the seasonal changes in phytoplankton and zooplankton populations and species abundance were also determinate. Some physical–chemical parameters of water and their correlation with heavy metals were also examined.

The Effects of saponin on enzyme activities, hsi and growth rate of rainbow trout (*Oncorhynchus mykiss*)

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Saponin is the active matter of *Verbascum* plant which used in fisheries in East Anatolia of Turkey, utilizing with the anesthetic specifications of plants. In this study the effects of saponin on the enzyme activities (GR and G6PD), hepatic-somatic index and growth rate of rainbow trout were researched. Fish were fed with the two doses of saponin (150 mg kg⁻¹ and 300 mg kg⁻¹) added feeds for 45 days. At the result of the experiment; decrease obtained in all parameters, GR and G6PD enzyme activities, HSI and live weight gaining of rainbow trout according to the doses.

The quality properties and management of trout farms effluents

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The objective of this study is to draw attention, in the scope of the Turkey's accelerating EU integration activities, to the quality properties of the effluent of trout farm in aquaculture production and environmental interaction and to inform about the methods concerning their management .In this context, depending on the capacities of enterprises, necessary arrangements related to the distance between them should be made and limitations to effluent and its load should be set and put into practice. Constructed wetlands should be constituted, in the places where terrain enables. Feed management concerning the development and use of extrude high-energy feeds should be carried out. The use of antibiotic and chemicals of enterprises should be limited and inspected. The obligation for purification of the effluent of enterprises by transferring through sedimentation ponds, before disposing it into receiver environment should be brought and sedimentation process should be applied to purify phosphorus from waste water.

Research on age determination and some population characteristics of chub (*Leuciscus cephalus* L.) in the Çamlidere Dam Lake (Ankara, Turkey)

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In this study, reliable bony structure for age determination and some population characteristics of 101 chub (*Leuciscus cephalus* L., 1758) from the Çamlidere Dam Lake were investigated between June and August 2006. Different bony structures such as scale, vertebra and otolith were removed from all specimens for age determination and interpreted by three times, independently. Sex composition of population was 71.3% female and 28.7% male. The fork length and weight of specimens ranged 18.5-35.3 cm and 124.40-667.57 g, respectively. Length-weight relationships were estimated as $W=0.0131FL^{3.0434}$ for females, $W=0.0142FL^{3.0186}$ for males and $W=0.0138FL^{3.0276}$ for all individuals. Condition factors of females, males and females+males were calculated as 1.54, 1.51 and 1.52, respectively. Differences between condition factors of females and males were not statistically significant ($P>0.05$).

The effect of trout aquaculture facilities on water quality of Kanlıçay stream (Çameli/Denizli)

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In this study, physicochemical and microbiological parameters of Kanlıçay Stream were investigated to determine the effects of trout aquaculture facilities on water quality. Along this stream, there are 93 trout aquaculture facilities, many of which do not have any clearing pool systems. Five stations were selected on the Kanlıçay Stream according to densities of aquaculture activity. Water quality parameters in each station were measured monthly from January to December 2007. Minimum and maximum values of measured physico-chemical parameters in Kanlıçay Stream were determined in the following ranges (respectively): flow rate, 65-9548 l/sec.; turbidity, 0.15-101.00 NTU; conductivity, 208.00-538.00 μ mhos/cm; pH 7.55-9.30; temperature, 6.20-18.90 °C; dissolved oxygen, 5.84-10.50 mg/l; chloride, 3.00-22.00 mg/l; organic matter, 1.58-46.86 mg/l; bicarbonate, 73.20-305.00 mg/l; carbonate, 0.00-7.20 mg/l; hardness, 15.00-44.00 °F; calcium, 28.05-95.14 mg/L; total nitrogen, 0.03-3.00 mg/l; ammonia, 0.001-0.69 mg/l; nitrate, 0.94-3.28 mg/L; nitrite, 0.002-0.018 mg/l; ammonium, 0.05-1.53 mg/L; sulphate, 3.00-44.00 mg/l; phosphate, 0.02-1.26 mg/l; acid binding ability, 2.00-6.40 ml acid, oxygen saturation, 56.70-92.00 %; total hardness, 11.00-309.00 mg/l; biochemical oxygen demand, 2.00-14.00 mg/l; chemical oxygen demand, 15.80-38.50 mg/l; chlorine, 0.01-0.87 mg/l; magnesium, 11.20-70.50 mg/l; sodium, 49.00-82.00 mg/l and potassium, 2.00-2.20 mg/l. In generally, it was found that the water quality in the upstream stations was appropriate for trout aquaculture and water was not polluted. On the other hand, in the downstream stations, organic pollution was observed on account of dens trout aquaculture activity as determined by analyses of water quality

parameters, and the level of pollution was higher than the limits proposed by EC Directive for the protection of fish.

Histopathology of the tissue of a tubificid worm (*Limnodrilus hoffmeisteri*) exposed to cadmium

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Although, cadmium is not an essential element for any organism, oligochaetes especially Tubificid worms accumulate large concentrations of cadmium like other freshwater specimens. In addition, some species such as belonging to *Limnodrilus* genera use indicator organisms. The aim of this study is to examine histopathological alterations induced experimentally with cadmium in tubificids worm (*Limnodrilus hoffmeisteri*) exposed for different times and concentrations were compared to controls. Live specimens were collected at 3 sampling sites from Porsuk River. Samples exposed to the contaminant for short periods 6, 12, 24, 48 and 72 h at two different concentrations 0.25 and 0.5 mg/L. Samples were embedded in paraffin blocks and were cut at 5 µm on a microtome. All sections were stained using Hematoxylin & Eosin. Our results showed that no differences (6, 12, 24, 48 h) compared with controls. However after 72 h exposure results showed differences.

Conservation sturgeon culture in the Azov and Black Seas basin: achievements, constraints and prospects.

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Federal Centre for Genetics and Selection in Aquaculture

Stock enhancement is the main source of *Acipenser gueldenstaeddi* and *A. stellatus* recruitment in the Sea of Azov and Black Sea (30 million juveniles have been released). The hatchery production strategy aimed solely to produce and release the largest possible number of juveniles, utilizing only the most mature brood fish of the spring spawning run. The spawning run was dramatically shortened from several months to just 15 days, and includes only females with advanced gonadal maturity. Conservation of the Azov and Black Seas sturgeon species and their unique spawning ecotypes is currently supported by the Federal Living Gene Bank, which maintains over 12,000 adults of seven critically endangered species. This paper summarizes the results of comparative analysis of biological characteristics such as growth, age of the first sexual maturation, relative fecundity, and morphological and physiological indices in wild and cultured specimens of different species and intraspecific groups of sturgeons. It is shown that there is a need for developing better hatchery technologies to maintain diversity of the stocks, through breeding protocols that maximize the genetic diversity of offspring based on evaluation of parentage and relatedness in farmed stocks by microsatellite loci.

CSan River „Catch and Release” fly fishery as a new form of rivers exploitation in Central and Eastern Europe.

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Angling is very popular form of recreation in Poland. The number of anglers is estimated as 2 million, app. 5.3% of total population. In this approximately 600 000 are members of Polish Angling Association. Until the late 1990s, they usually visited “natural” waters like rivers or lakes, obtained fish were taken for consumption, and even not far ago were important part for household budget. This situation has been changed after political and economical changes, and for last decade more and more anglers in Poland is searching for good quality commercial fisheries. However, as “put and take” fisheries are very common in Poland now, number the of “catch and release” fisheries is very limited. This refers specially rivers. In 2004 Regional Unit of Polish Angling Association in Krosno, Southern Poland, opened first “catch & release” fly fishery on San River. The fishery is famous because of grayling and some brown trout as well. From present perspective this “enterprise” could be evaluated as very good. Four persons were employed as “guards and guides” directly at the fishery. The fishery also creates local demand for tourist accommodation and fishing tackle. Carefully protected area of the fishery is now a reservoir of good quality grayling and brown trout spawners, and generates profits from restocking material production. What is also very important natural reproduction of mentioned species takes place, and increasing number of grayling in San River, down to the fishery, is observed year by year.

However, the example of San River fly fishery, successfully established in 2004, proofs general statement that this kind of natural waters exploitation is very good solution only when certain level of economic development of the society is attained.

Effect of dietary supplementation commercial probiotic (Protexin™) on growth and survival of narrow-clawed crayfish(*Astacus leptodactylus* Esch.)

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The aim of the study was to determined the impact of commercial probiotic (Protexin™) on growth and survival of narrow-clawed crayfish. The two month rearing period was carried out in 600 L tanks(water level 30 cm). The tanks were stocked with crayfish with an average body length of 8.19±0.6 cm and weight of 14.37±2.97 g. The crayfish were stocked in tanks as 15 individuals and the artesian water heated from 12°C to 20±1 °C) was delivered to tanks. The experiment was constituted two groups. Control group were fed with trout feed (49 % protein, % 19 lipid) and the other group were fed with same trout feed added Protexin™ (0.1%) during 60 days. There was no significant effect of Protexin™ usage on growth (P>0.05). Survival rates in control and the other group were determined 40 % and 46.6 %, respectively.

Determination of cadmium levels in lake water, sediment, meiobenthos (Chironomidae) and three fish species from Lake Uluabat (a Ramsar site in Turkey)

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Metals of natural and anthropogenic origin in surface water of aquatic systems can exist in dissolved form or associated with suspended particulate materials. The accumulation of elevated metal concentrations in sediment of aquatic environments can result in biological impact. Lake Uluabat (also known as Lake Apolyont) is one of the most Important Bird Area (IBA) not only in Turkey but also in Palearctic region, have eutrophic freshwater lake on the South side of the Sea of Marmara. Concentration of cadmium was measured in abiotic [lake water (n=80), sediment (n=80)] and biotic component [meiobenthos (Chironomidae larvae, n=80) and some tissues (gill, liver and muscle) of three fish species *Esox lucius* (n=25, age=3-5), *Carassius gibelio* (n=30, age=3-5) and *Scardinius erythrophthalmus* (n=32, age=3-4)] of food chain between August 2004 and July 2005 from 12 sites within the Lake Uluabat. In addition, results for levels in samples were compared with Turkish and international water quality guidelines, as well as literature values were reported. The cadmium concentration in the lake water, sediment and Chironomidae larvae were found as in the range of trace-0.025 mg L⁻¹, trace-14 mg kg⁻¹, 0.22-13.69 mg kg⁻¹ respectively. The metal concentrations found in the tissues of the three fish species varied considerably. The accumulation order of lead in fish samples for liver was found to be *Scardinius erythrophthalmus* > *Carassius gibelio* > *Esox lucius*; for muscle *Scardinius erythrophthalmus* > *Esox lucius* > *Carassius gibelio*; for gill *Esox lucius* > *Carassius gibelio* > *Scardinius erythrophthalmus*. Cadmium from various pollutant sources were observed to accumulate in the lake. The results emphasize the need for monitoring in order to improve the water quality management in this lake.

A study on demographic structure of trout farmer workers in Fethiye region at Muğla

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The total fisheries production is approximately 130 million tones year⁻¹ in the world. World aquatic production in 2006 is about 52 million tonnes (excluding aquatic plants). Production of aquaculture Turkey reached 128.943 tonnes in 2006. The share of aquaculture in total fisheries production has reached to 24,2 % in 2006 compared to 6% in 1996. There are 77 trout farms, where 57 are at Fethiye, in Mugla. These farms of total aquaculture capacity are 8255 tones/year. Fethiye region is leader for the trout farming, whatever quality of aquaculture for trout or number of the trout farms. In the Fethiye region, trout aquaculture was begun at the 1982. In this study, surveys wee

carried out on trout farms, workers and their employers. As a result of these data to be detected of the workers, works trout farms in Fethiye region, of demographic structure.

Effects of microalgae added diets on fatty acid composition of European Sea Bass (*Dicentrarchus labrax* L., 1758) juveniles

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There are few studies on nutritional value of microalgae in marine fish diets. The effects of PUFAs (Polyunsaturated Fatty Acids) enriched microalgae included diet on fatty acid composition of European Sea Bass (*Dicentrarchus labrax* L., 1758) juveniles was investigated in this study. One thousand juveniles of which initial mean weight was 4.28±0.05 g. were fed during 60 days. Fish were fed with one control and one experimental diet included 10% microalgae powder (Algae Rich). Mainly, 16:0, 16:1, 18:0, 18:1n-9, 18:2n-6, 20:5n-3 (eicosapentaenoic acid, EPA), 22:6n-3 (docosahexaenoic acid, DHA) fatty acids of feeds and fish fillets were examined. DHA/EPA ratios in fish fillets observed both for the control groups and the experimental groups were found as 1.83 and 1.81 respectively. These results indicate that microalgae added diet supported n-3 and n-6 fatty acids levels of sea bass juveniles. EPA and DHA levels in the feeds were found adequate for sea bass juveniles.

Inland Aquaculture in Turkey

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Turkey's inland resources are varied in terms of water quality, trophic status, altitude, climate, ecosystem diversity and species diversity. Turkey provides high potential for fisheries and aquaculture with 8333 km cost line, and more than 200 natural lakes of these, 48 lakes have a surface area larger than 500 ha and total 33 rivers with their 177 000 km length. Finally, total available water surface area reach to 25 million ha. Total fishery production was 662.103 t in 2006. This is comprised of 489.079 t from marine fisheries (73% of the total), 128,943 t from aquaculture (20% of total), 56,694 t inland fisheries (9% of the total). At the beginning, inland aquaculture sector focused on carp production. In the last decades trout production became more popular instead of carp because of the low consumption and high production of carp from wild sources. Total inland fish farms are 1.187 number with 57 170 t production capacity per year. 171 farms operate in cage culture, 995 numbers of them are land based culture

Replacement of commercial fish meal with sand smelt meal (*Atherina boyerii* Risso,) in fish diets

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During the past decades, rapid increment has occurred in feed manufacture industries due to improvements in aquaculture knowledge and production technologies. The use of fish meal in different areas as well as aquaculture has increased demands of this feed ingredient. Recently a sharp decrease has observed in the capture of fish used as fish meal source. Due to these problems, the mentioned demands could not be compensated and a seeking for alternative protein sources commenced. Therefore, experimentations on the use of plant protein sources were realized but the complete replacement of animal protein sources with vegetal ones found to be inconvenient for at least some cultivated fish species. On the other hand, sand smelt (*Atherina boyerii* RISSO, 1810), a species abundant in fresh and marine Turkish waters seems to have a good potential to be used as ingredient in commercial feed because of its continuous supply, low price and preference for human consumption. As a result, the use of this fish meal as an alternative protein source in stead of commercial fish meal is evaluated in this study.

Effects of three Carassius (Cyprinidae) species [*C. auratus* (L.), *C. carassius* (L.) and *C. gibelio* (Bloch)] in the inland waters of Turkey.

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Information concerning the distribution, life history and biology of the three carassius species, along with its uses by humans and impacts to aquatic ecosystems was compiled. These species can impact, directly or indirectly aquatic macrophytes, water quality and aquatic fauna. This information is used to understand invasion problems of Carassius genus in Turkey.

Recirculation aquaculture systems using for the brown trout egg incubation

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The aim of this study is to compare of the brown trout egg incubation performance differentiation, between recirculation aquaculture system (RAS) and open system. Recently, because of the increasing demand to spring water resources and need to freshwater of RAS systems is very low, using of RAS in aquaculture is highlight in the worldwide. Incubation of trout eggs in the RAS will be able to a model for mainly rainbow trout and brown trout in the Eastern Black Sea Region of Turkey, which has low spring water, whereas it has high potential for inland and sea cage trout farming. Since the escape of individuals from RAS is completely prevented, there is not negative effect on wild population. The success of the incubation was compared between the open system used spring water and closed system used UV, physical and biologic filters.

Study about nitrogen and phosphorous release into an Italian river coming from an intensive Italian farm: comparisons between laboratory and field research

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The aim of the research was the evaluation of the quantity of nutrients (nitrogen and phosphorous) released from an intensive trout farm in a small river of the Italian central Appennine. Fish production, feed administered and water quality were monitored from the farm. In laboratory, the farming conditions were reproduced with help of some metabolic devices. At the end of experiment the feed consumption, the nitrogen and phosphorous retained and released were compared in the two different conditions. Other parameters (initial and final fish mean weight, unitary and total biomass, specific growth rate and food conversion rate) were monitored. All the data were evaluated in order to determine the impact of the nutrients on this inland water body.

Plasmatic and tissular parameters as indicator of welfare status of rainbow trout (*Oncorhynchus mykiss*) reared in intensive and extensive condition

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The work aimed to determine the welfare status of rainbow trout, weighing 50±15 g, intensively reared in two concrete raceways at different stocking density until the commercial size so to reach final load of 40 kg/m³ and 20 kg/m³, respectively. Throughout the fattening phase, plasmatic parameters and hepatic glycogen content were determined at seasonal intervals and compared with those of rainbow trout at the same age and mean weight, reared in extensive condition in an artificial reservoir. The results of the present work show that the final load reached at the end of the trial provided significant differences of the monitored parameters between rainbow trout reared in raceways and those held in the reservoir.

Concentrations of some heavy metals in water, sediment and tissues of two fish species (*Cyprinus carpio* and *Carassius carassius*) from the Geyik Dam Lake (Southwestern-Anatolia), Turkey

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The concentrations of heavy metals (Cd, Co, Cu, Fe, Mn, Ni, Pb, and Zn) were measured in the water, sediment and tissues (muscle, gill and liver) of two fish species

(*Cyprinus carpio* and *Carassius carassius*) from the Geyik Dam Lake, Turkey. Results for levels in water compared with national and international water quality guidelines, as well as literature values were reported for streams and rivers. Comparisons were made of metal concentrations in water and sediment with those in the muscle, gills and liver of *Cyprinus carpio* and *Carassius carassius* caught from the Geyik dam Lake.

Non-governmental fisheries organizations in Turkey

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There have been a couple of fishery organizations such as fishery cooperatives, unions and associations in Turkey.

There are currently 522 fisheries cooperatives, 13 cooperatives unions (East Black Sea, Sinop, Samsun, İstanbul, Marmara, Balıkesir, Çanakkale, İzmir, Muğla, Antalya, Adana, Mersin, Hatay Regional Unions) and one central cooperative union representing the catching sector and aquaculture sector has 11 fisheries aquaculture producer unions.

Furthermore, there are one Fishery Federation and 5 societies and associations representing any kind of fishery and aquaculture sector. These are; Fisheries Advertisement Society, Aquaculture Association, Muğla Aquaculture Union Association, Aquaculture and Fisheries Association and Bluefin Tuna Culture and Export Association.

Mortality ratio and stock analysis of vimba (*Vimba vimba tenella* (Nordmann)) population in Karacaoren I Dam Lake (Burdur-Turkey)

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In this study, 808 vimba (*Vimba vimba tenella* (Nordmann, 1840)) individuals captured during October 1996- April 1998 from Karacaören I Dam Lake and mortality ratio and stock size were estimated. Age distribution of *V. v. tenella* varied from 0- VII and 73.51 % of the investigated samples was belong to I- II age group. The fork length was ranged between 11.7- 27.8 cm. The growth parameters of vimba population were found as $L_{\infty} = 43.39$ cm, $K = 0.0863$ and $t_0 = -4.7615$. The mortality rates of vimba, according to constant parameter system were calculated as; $Z = 0.71 \text{ y}^{-1}$, $M = 0.27 \text{ y}^{-1}$ and $F = 0.44 \text{ y}^{-1}$. The survival rate of the vimba is determined as 49.16 %, exploitation rate as 62 %. Mean number and mean biomass of fish, bigger than 18 cm length, in population have been estimated as 762328 and 95044 kg respectively. With the simulations of fishing mortality rates belong to each length group, it was determined that maximum sustainable yield (MSY) could be obtained with increase 40 % increase of the present effort.

Distribution, population estimation and economical importance of medicinal leech, *Hirudo medicinalis* (L. 1758, Hirudinidae) in Eastern Anatolia, Turkey

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The medicinal leech (*Hirudo medicinalis*) is used intensively in the medical industry and is listed in Appendix II of the 1987 *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) because of recent decreases in populations due to environmental pollution, and its common trade between countries. In this study, the distribution, population size and economic importance of medical leech in the Eastern Anatolia Region of Turkey was assessed. Samples were collected using a modified unit square design, used for the first time in this study. Medicinal leeches were found in 22 out of the 87 wet field sites studied. The total surface area of wet field sites surveyed was 599642.5 ha, but sites at which leeches were found comprised only 8784.77 ha (i.e. 1.46% of the total wet field area). We estimate that 10.58% (63414.6 ha) of the total wet area surveyed would provide suitable habitat for leech introductions.

Changing socio-cultural basis for governance interactions: Images of good recreational fishing practices in Finland

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Transitions in fisher groups, fishing practices and management reflect general changes in the society. During the last decades people's images of good practices in fishing have changed in many countries. In Finland two million recreational fishers operate in various environments from the Baltic coast to lakes and rivers. Fishing has changed from subsistence-based towards more leisure-oriented activities. The use of rod fishing gear has increased, but gill nets and wire traps are still weighty methods. Lately the protection of biodiversity has become an important motivation in management, but the traditional idea of keeping fish stocks abundant for harvesting purposes has kept its position as a vital paradigm. Also the contradictory animal welfare issues are increasingly emphasized. Catch-and-release has gained some popularity during the 1990s, but still more than one half of all Finnish recreational fishers consider it to be pointless torture of an animal. Although the thrill of catching a fish has become more important than retaining the fish for consumption, keeping the caught fish for consumption is not underrated. The starting point of this presentation is that debates about "good" and ethical recreational fishing practices – whether related to catch-and-release, gill net or other fishing - reveal and foster changes in fishing culture and governance. The analysis bases on a collection of reports, newspaper articles and other material.

Pond fish farming in the district of Savran in South-Western Region

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There are several types of pond currently used in aquaculture as using the natural topography of the land. Savran River is in south-western part of Anatolia, where an intensive aquaculture methods in pond are made. The pond is made by means of the construction of the fish farm facility in which the underground and river water are used. The measured values determined for salinity are 0,610% (underground) and 0,115% (river water). In this area, pond aquaculture is carried out by means of purpose-built earthen ponds, generally with water supply and drainage infrastructure incorporated, in order to grow fish such as sea bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*). Also, synthetic pond liners are being used to provide better control on mud-bottom ponds. Brackish water ponds are used for commercial aquaculture production and are the most common in this area. After one and a half year, the 0.1-10 g weight of fingerlings of sea bream and sea bass have grown out in the farming and reached a final market size of 350-410 g and 530-680 g respectively. From this pond, approximately 10 t/ha/year of fish was harvested. In a farm in this region, fish, turbot (*Scophthalmus maximus*) and sturgeon (*Acipenser güldenstaedti*), are also raised in concrete construction, which has been thrown into this construction a year ago, but not harvested yet. The methods of aquaculture in pond have shown that the growth rates of sea bream and sea bass in Savran are higher than the cage aquaculture in the sea. The sophisticated fish farming procedures as related to aquaculture in ponds demand a more manageable and controlled environment. We observed that some advantages of pond culture can be listed as (a) relatively cost effective, particularly if gravity fed and drained, (b) provide some control over growing conditions (*e.g.* nutrient inputs), (c) minimises loss of stock through escapement or predation compared to more extensive operations. Some disadvantages of pond culture can be listed as (a) high land requirement and construction costs (b) little control over ambient environmental conditions (*e.g.* temperature), (c) stock management may be difficult.

Body composition and fatty acid profiles of rainbow trout (*Oncorhynchus mykiss* W., 1792) and Russian Sturgeon (*Acipenser guldensteadtii*) fed different experimental feeds

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Fish oil is the main lipid for energy and essential fatty acid source in commercial aquaculture feeds. Whole body composition and amount of fatty acids of rainbow trout and Russian sturgeon fed the feeds included fish oil; soybean oil and sunflower oil were studied. Rainbow trout juveniles having approximate initial weight of 5.78 ± 0.09 g were fed by experimental feeds included different kinds of oil during 60 days. The fish was fed by a commercial trout feed added different kind of oils with a ratio of 10% and containing approximately 43.5% crude protein, 14.0% crude lipid. Russian sturgeon

juveniles having an approximate initial weight of 27.23 ± 0.98 g were fed experimental feeds containing different kinds of oil for 63 days and the effects of the feeds on fatty acid composition of the fish were studied. The experimental feeds contained 43.79% crude protein and 13.98% crude lipid. At the end of the feeding trials with rainbow trout, whole body fat contents were found 6.1% in the fish oil group, 5.3% in the sunflower group and 5.9% in the soybean oil group. There is no big difference among the groups regarding to lipid accumulation in the liver. At the end of the feeding trials with Russian sturgeon, whole body fat was found 4.65% in the fish oil group, 5.19% in the sunflower oil group and 4.73% in the soybean oil group. Growth performance parameters (HSI, VSI, FCR and SGR) varied significantly among the groups ($P < 0.05$). The fatty acid composition analyses showed that total n-3 and n-6 in the whole body fatty acids and the liver fatty acid contents of fish fed feeds contain different kinds of oil were significantly different ($P < 0.05$). Naturally, in the groups fed vegetable oil, the ratio of total n-6 fatty acids was higher than that in the fish oil group and in the group fed fish oil, the n-3 fatty acid ratio was higher than that in the vegetable oil groups for two species. These results suggest that rainbow trout and sturgeon require both n-3 and n-6 fatty acids and accumulation of these fatty acids in the flesh and liver was affected by fatty acids in the feeds. Therefore, it is possible to use a certain amount of soybean oil or sunflower oil instead of fish oil in rainbow trout and sturgeon diets.

Certain population characteristics and reproductive biology of freshwater mussel *Unio terminalis delicatus* (Lea, 1863) in Gölbaşı Lake (Hatay), Turkey

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In this study, some growth and reproductive characteristics of *Unio terminalis delicatus* were investigated in Gölbaşı Lake (Hatay). *U. terminalis delicatus* were collected in Gölbaşı Lake and some growth and reproductive parameters were determined. Mean length, width, height and weight were 7.82 ± 0.52 cm, 3.98 ± 0.26 cm, 2.88 ± 0.24 cm and 42.28 g, respectively for the individuals obtained from the lake. Gonadal development of *U. terminalis delicatus* occurred between December and February and glochidia were released in January and February. Length at first maturity was 6.10 cm for male and 6.00 cm. for females. The mean wet meat rate for male and female individuals was 29.16 % and 29.33 %.

Growth performance and biochemical composition of the freshwater mussel *Unio terminalis delicatus* (Lea, 1863) in the Gölbaşı Lake, Turkey

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The effects of four stocking rates (20, 40, 60, 80 / m²) on growth performance of the unio terminalis delicatus were investigated. At the end of 6 month growing period, highest growth was obtained at 40 individuals/m², while best condition factor was acquired at 20 individuals/ m² with the spats having on initial size of 0.73±0.03 g. Specific growth rate for length and weight were highest in June and July. The results indicated that the water could be classified as clean when the levels of nitrite (NO₂), nitrate (NO₃), ammonia (NH₃), phosphate (PO₄) and chemical oxygen demand (COD) were taken into account and that organic matter level was appropriate. Calcium (Ca) level was lower in the area where mussels were mostly located. The results of proximate composition of *U. terminalis delicatus* are determined in this study. The ratio of crude protein, humidity, crude ash, and lipid were 7.99, 86.14, 3.44 % and 1.51%, respectively.

The influence of environmental information richness during early ontogenesis on bream's (*Abramis brama*; Cyprinidae) behavior formation

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The feeding behavior of bream (*Abramis brama*) yearlings kept before the experiment (four months post hatch) under different conditions has been studied. Three variants of conditions, varied in their levels of informational richness, were modeled for keeping young fish prior to the experiments: 1—minimal richness, mimicking conditions of standard commercial hatchery containers; 2—the conditions enriched by a water current; 3—the conditions enriched by modeled impact of predation and feeding by live food. In the following experiments, the conditions were similar for all three groups. It was revealed that the fish grown under the conditions of Variant 1 had a lower learning ability, higher extent of schooling behavior, and lower efficiencies of feeding and defensive behaviors. Similar traits were described in literature as being typical for the fish grown at standard fish farms. The Variant 2 fish had the shortest adaptation period and most efficient feeding behavior but were lacking the skills of defensive behavior. The fish from the 3rd variant had a medium duration of adaptation period and efficient feeding behavior and possessed well-developed skills of defensive behavior. The results have shown that the level of environmental information richness during fish early life stages plays a crucial role in further development of the most important adaptive forms of behavior. Maintaining the young fish in containers with water current facilitates swimming performance and development of feeding behavior. However, such fish, in fact, lack the skills of defensive behavior.

Economical And social value of the White Sea offshore fishery for the Arkhangelsk Region (Russia)

I. STUDENOV & E. NIKITENKO

SevPINRO (Northern branch of PINRO)

There are 11 fishing collective farms located on the southern and eastern coast of the White sea in the borders of the Arkhangelsk region. Total population of these villages is

about 5000 people. The biggest fishing collective farms are "Sever" (Dolgoshelye village), "Osvobozhdenie" (Koyda and Mayda villages), "Lenin" (Tamitsa and Kyanda villages) and "Soyana" (Soyana village). The main activities of these farms are coastal fishing, sealing, sea weeds gathering, farming and forest industry. The main subjects of coastal fishery are salmon, humpback salmon, herring, navaga, smelt and flatfish. The main method of fishing is fishing with using of fish traps. Total annual catch of Atlantic salmon in this area during last decade is about 20-30 metric t what is about 60% from total Atlantic salmon catch in the Arkhangelsk region. Regional quotas for humpback salmon, herring, navaga, smelt and flatfish are caught here in full size. Shared weight of coastal fishery is 15-30% in fishing collective farms economic. Shared weight of sealing was before about 50% and now is in average 20-30% due to high fees for using of bioresources. Sealing is conducted irregularly depending on subsidies availability. Sea weeds gathering from storm outbreaks are conducted by inhabitants of the southern coast of the White Sea. This activity is not significant in the fishing collective farms economic. According to presented materials the main activity of fishing collective farms is coastal fishery. About 50% of coastal village population is directly connected to fishing and fish processing.

Effects of supplemental lysine and methionine in Broiler diets on weight gain of juvenile carp (*Cyprinus carpio*)

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A 75-day growth study was carried out to determine the effects of some feeding stimulants on juvenile carp (*Cyprinus carpio*). Lysine (L) and methionine (M) were added to a normal broiler feed as feeding stimulants in different ratios (0.5L- 2M %, 1L-3M %, 1.5L- 4M %, and none as Control). The commercial broiler feed contained 20% crude protein. The experiment, which included 120 juvenile individuals at total, was conducted in triplicate. The fish were initially weighed one by one (6.92 ± 0.11 g), and then put into 12 cages (50x50x50 cm) of two fiberglass tanks (210x110x60 cm) and fed three times a day (at 08:00, 13:00 and 18:00 h) with the diets weighing 3% of the mean body weight. The individuals were weighed every 15 days and the amounts of the feed were rearranged according to these weighing results. Oxygen, pH and temperature were measured daily. Live weight gain (%), specific growth rate (SGR), feed conversion ratio (FCR) and feed intake (FI) were calculated at end of the experiment. Better SGR and FCR were observed with 0.5L- 2M % inclusion level ($P < 0.05$).

A study on human effect on the brown trout, *Salmo trutta*, populations in three streams of Upper Coruh River, Turkey

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Objective of this investigation was a primarily study to determine the effect of human activities on brown trout (*Salmo trutta*) in three streams of upper Coruh River, Turkey. Instantaneous annual rate of total mortality (Z), age-length frequency, and Proportional Stock Density (PSD) were used to estimate the effect of human activities. Instantaneous annual rate of total mortality (Z) of brown trout from Anuri, Kan, and Cenker streams were 0.95, 0.96 and 0.74, respectively. The age of fish ranged 0-6 age for Anuri stream and 0-7 for Cenker and Kan streams and dominant age classes were ages 1 (49.5%) for Anuri, 1 (33.2%) for Cenker and 2 (35.8%) for Kan. The longest lengths for Anuri, Kan, and Cenker streams were as 29.9 cm, 26.1 cm and 34.4 cm, and dominant length classes were 9 cm (14%), 8 cm (18.1%), and 13 cm (9.3%), respectively. Values of Proportional Stock Density (PSD) for Anuri, Kan, and Cenker streams were as 6.4, 6.1 and 11.0, respectively. It may be suggested that differences among the streams occurred because of fishing pressure on populations.

A model county for European sea bass (*Dicentrarchus labrax*) and gilthead sea bream (*Sparus aurata*) culturing in the earth-pond: Milas-Muğla

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Earth-pond or land-based aquaculture is a under controlling fish culture in the land-base except for fish culture in the dam lake, dam, river and the sea. The accomplishment of land-based aquaculture is dependent on bio-ecological demand of the species, structure of ground and characteristics of the water. In 2006 the Turkey production from aquaculture reached about 128.943 t. In this production carp has included 668 t, trout 57.659 t, bream 28.463 t, bass 38.408 t, mussel 1.545 t and others 2.200 t. The Muğla is a locomotive country of Turkey aquaculture which has suitable conditions for aquaculture. In the point of view for land-based aquaculture, the Milas has very intensive production in the fish culture. There are about 92 culture farms and their capacity of about 2.341 t. In this study aquaculture farms has been visited and questionnaires that directed to the culturists prepared with meet the culturists.

Some hemolymph characteristics of narrow clawed crayfish (*Astacus leptodactylus* Esch.) after exposure to sublethal nitrite concentrations

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Nitrite, an intermediate product of bacterial nitrification and denitrification processes, can build up in the aquatic environment particularly those receiving effluents from

sewage plants and fertilizers. Elevated ambient nitrite concentrations is a potential health problem for crayfish, since it can alter deeply the defence and often stressful. Hemolymph nitrite, total haemocyte counts (THCs) and hemolymph glucose were examined in narrow clawed crayfish (*Astacus leptodactylus*) (30.02±0.69 g) after 24 h exposure to three different sublethal nitrite concentrations (9, 14, 25 mg/L NO₂-N). The same parameters were also determined after exposed to different sublethal nitrite concentrations (8, 13, 24, 30 mg/L NO₂-N) with additional environmental chloride. Hemolymph nitrite levels were elevated significantly parallel with water nitrite in both test groups. However, in the nitrite plus chloride-exposed tests, the accumulation of nitrite in hemolymph was relatively low compared to the nitrite-only tests. While THCs decreased following nitrite exposure, in the nitrite with chloride exposed tests THCs increased in high nitrite levels. Hemolymph glucose levels increased after nitrite exposure, independent of environmental nitrite concentrations.

The symposium on Interactions between Social, Economic and Ecological Objectives of Inland Commercial and Recreational Fisheries and Aquaculture, was organized in conjunction with the Twenty-Fifth Session of the European Inland Fisheries Advisory Commission (EIFAC) in Antalya, Turkey, from 21 to 24 May 2008.

The symposium objectives were:

- 1) To review the wide range of socio-economic and ecological interactions between fisheries and aquaculture and the roles of various stakeholders with respect to these interactions.
- 2) To identify where future research should focus and propose measures to decrease interactions that compromise sustainable development and management, and promote interactions that contribute to sustainability.
- 3) To provide information to policy and decision makers to contribute to the general awareness of trends in socio-economic and ecological interactions within and between the sector and other rural sectors.
- 4) To facilitate dialogue between scientists, researchers, fisherfolk, aquaculturists and policy and decision makers on the motives, interactions and interests of stakeholders.
- 5) To advise EIFAC on appropriate management and development measures and tools for inland fisheries and aquaculture in Europe.

This Occasional Paper, in conjunction with a special issue of Fisheries Management and Ecology, represents the proceedings of the symposium. The Report of the symposium was published in 2008 as EIFAC FAO Fisheries and Aquaculture Report No. 871. The symposium made considerable progress towards understanding the interactions between ecological/environmental and socio-economic/governance objectives for fisheries and aquaculture. There was a broad recognition that inland fisheries and aquaculture need to shift from a sectoral view where they are treated in isolation to an integrated, multi-disciplinary systems view.



Ministry of Agriculture
and Rural Affairs of Turkey

