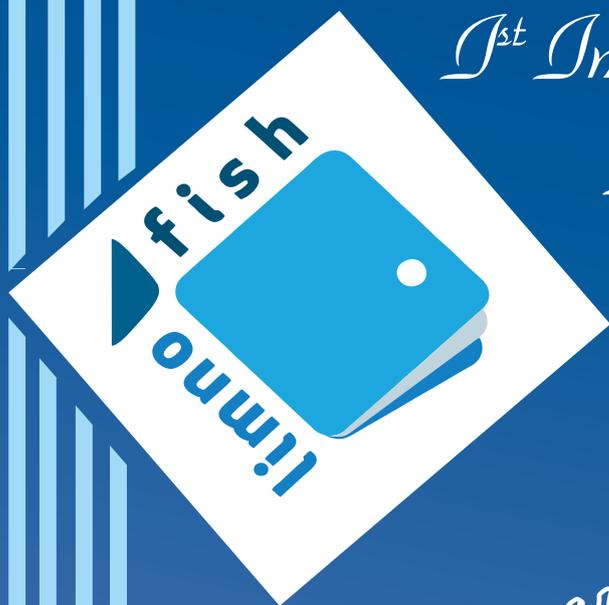


*1st International Symposium on
Limnology and Freshwater
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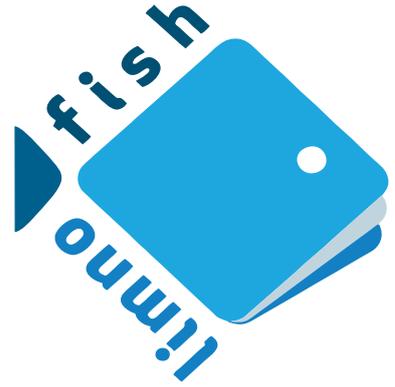


SYMPOSIUM ABSTRACT BOOK

LIMNOFISH-2017

*4-6 October 2017
Egirdir-Turkey*

**1ST INTERNATIONAL SYMPOSIUM ON
LIMNOLOGY AND FRESHWATER
FISHERIES**



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SYMPOSIUM ABSTRACT BOOK

All manner responsibility of legal and spelling errors are incumbent on authors interested in the abstract, that published in abstract book of *1st International Symposium on Limnology and Freshwater Fisheries*.



Welcome

The value of water is understood much better if we consider that 1% of the world's total water volume is 1.4 billion km³ can be used. We use this resource in many areas from food production to industrial manufacturing. Global climate change, a steep decline in resources, rapid population growth and increasing pollution threaten our future. Although the amount of water seems to be abundant in our geography, Turkey is not a rich country in terms of water. This situation forces us to take urgent measures.

Water and water products from which people have gotten their basic nutrients throughout history, have gained more importance in recent years. We see that the world's aquaculture production has reached 170 million tons and fisheries are the fastest growing sector of aquaculture in animal production. In this increase, the importance of aquaculture is significant because the maximum capacity in fishing resources has been reached and stocks are decreasing steadily. We already know the inherent risks of inland waters that are already limited. For this reason, it is imperative that the limnology work is continued to minimize these risks.

Our institute has been established to serve in the field of Limnology and has been working hard since 1986 and has undertaken a role as a locomotive in this regard. LimnoFish (Journal of Limnology and Freshwater Fisheries Research), a product of our work in this field, started to be published in 2015. Limnofish, which acquired its place in this area in a short period of time, is scanned by many indexes including TÜBİTAK Tr Index.

Our goal in this symposium, which has the same name with our journal is to help the development of new scientific technologies for the protection of freshwaters and to prepare the environment for the configuration of these works. The "1st International Limnology and Freshwater Fishery Symposium" will be held in Eğirdir on 04-06 October 2017 will ensure that all Limnologists have an international platform to share their ideas. I believe that this organization, which we are doing for the first time, will grow rapidly in the following years and will take its internationally deserved place. We are honored to welcome you and our esteemed guests to this symposium in Eğirdir, which we consider to be the pearl of Anatolia.

Şakir ÇINAR

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1ST INTERNATIONAL SYMPOSIUM ON LIMNOLOGY
AND FRESHWATER FISHERIES

INVITED SPEAKERS

LIMNOFISH-2017



Hydroacoustic monitoring in freshwater ecosystems: potential and limitations

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Echo sounding or hydro acoustics is the application of sound in water. It is a non-invasive method that can be used for detecting, measuring, monitoring and investigating both aquatic populations and the depth and topography of the bottom structure in the environment. The method is based on sending high frequency sound waves into the water column, and registration of the reflected echoes from the insonified objects with different density than water. In fisheries, it is traditionally used for abundance estimations and size distributions of open water populations. It is also used for mapping ecosystems components like plankton, fish, mammals, vegetation, gas bubbles and pollution. Using many frequencies simultaneously can discriminate between species and even identify species. The methodology, precision and resolution of echo sounding has developed rapidly over the past couple of decades and the applications for under water research is increasing at the same rate.

This presentation will focus on the principles of the method and the application of hydroacoustics in freshwater environments with practical examples of usage for various purposes and illustrations of newly developed equipment using multi-frequency transducers. Further advances in ecosystem monitoring technology are autonomous remote sensor platforms like drifting or stationary buoys or landers fixed on the bottom or in the water column. Long term remote monitoring is needed for the full understanding of ecosystem dynamics, species interactions and finally ecosystem health.

Keywords: Hydroacoustic survey, fisheries management, freshwater

The importance of monitoring fish in lakes and the use of the resulting data in models

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Fish play an important role in lake ecosystems. Not only are they good indicators of lake ecological state, although stocking as well as introduction of invasive species may hamper their use as indicators. They also to a large extent drive the ecosystem functioning through top-down control and by affecting nutrient cycling/availability. Moreover the strength of these interactions and their effects are changing with the ongoing climate warming. For all these basic reasons it is important to include fish in the monitoring programs of lakes. In the talk I will provide examples of fish as indicators, their role for the lake ecosystem function and how lake fish assemblages change with climate warming, and the resulting cascading effects in the lake ecosystems. I will also show how we use such information in dynamic ecosystem modelling and predictions.

Keywords: Lake monitoring, data modeling, ecological state

Crayfish situation in Turkey and Europe - history, present and future perspectives and threats

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There is an obvious decline of indigenous crayfish species (ICS) populations throughout Europe in the last decades. The main reason behind is apparently proliferation of non-indigenous crayfish species (NICS) throughout Europe. They are usually of North American origin and often carry a causative agent of crayfish plague (*Aphanomyces astaci*), to which ICS are highly susceptible. NICS presence have resulted in the alteration or destruction of invaded habitats as well as biota, influencing both directly and indirectly the native counterparts. The future of ICS occurring in Central and Western Europe – the noble crayfish *Astacus astacus*, the stone crayfish *Austropotamobius torrentium* and the white-clawed crayfish *Austropotamobius pallipes* – remains uncertain. Although these crayfish species are protected by a series of both European and national laws, and several species protection programmes have been initiated (including re-stocking activities) in various countries, decline of ICS populations still continues. According to the EU Regulation 1143/2014 on Invasive Alien Species, there is a new Commission Implementing Regulation 2016/1141 adopting a list of invasive alien species of Union concern which contain about fifty organisms from which five are crayfish (http://ec.europa.eu/environment/nature/invasivealien/list/index_en.htm). Besides mentioned invasive NICS, the human impacts on crayfish can be partly reduced by active approach in cases when crayfish or their habitats are directly threatened. Crayfish must be secured in some cases such as civil engineering or water management works, as well as revitalizations of ponds or running waters.

Many populations of the narrow-clawed crayfish *Astacus leptodactylus* in Turkey, declined drastically in the mid-1980s due to introduction of crayfish plague. However, unlike many other localities in Europe, there has been some recovery in the *A. leptodactylus* populations inhabiting e.g. Lake Eğirdir even though crayfish plague have persisted since then. Crayfish sampled recently from the lake tested positive by both conventional and real-time PCR using species-specific primers targeting the rDNA internal transcribed spacer region, and product sequence analysis confirmed the identification of *A. astaci*. This complies with other recent reports of coexistence of native European crayfish with this pathogen, and further research is now needed to identify the key mechanisms involved.

We also re-evaluated the host range of *A. astaci* by screening for the presence of *A. astaci* in freshwater crab *Potamon potamios* cohabiting with the narrow-clawed crayfish. Tissues from 13 of 30 individuals of *P. potamios* yielded qPCR results indicating *A. astaci* presence. Analyses of polymorphic microsatellite loci demonstrated that *A. astaci* strains in the crabs and in cohabiting crayfish belonged to the same genotype group, suggesting crayfish as the source for crab infection. The potential for *A. astaci* transmission in the opposite direction, from crabs to crayfish, and potential impact of this pathogen on populations of freshwater crabs require further investigations, because of possible consequences for crayfish and freshwater crab conservation and aquaculture.

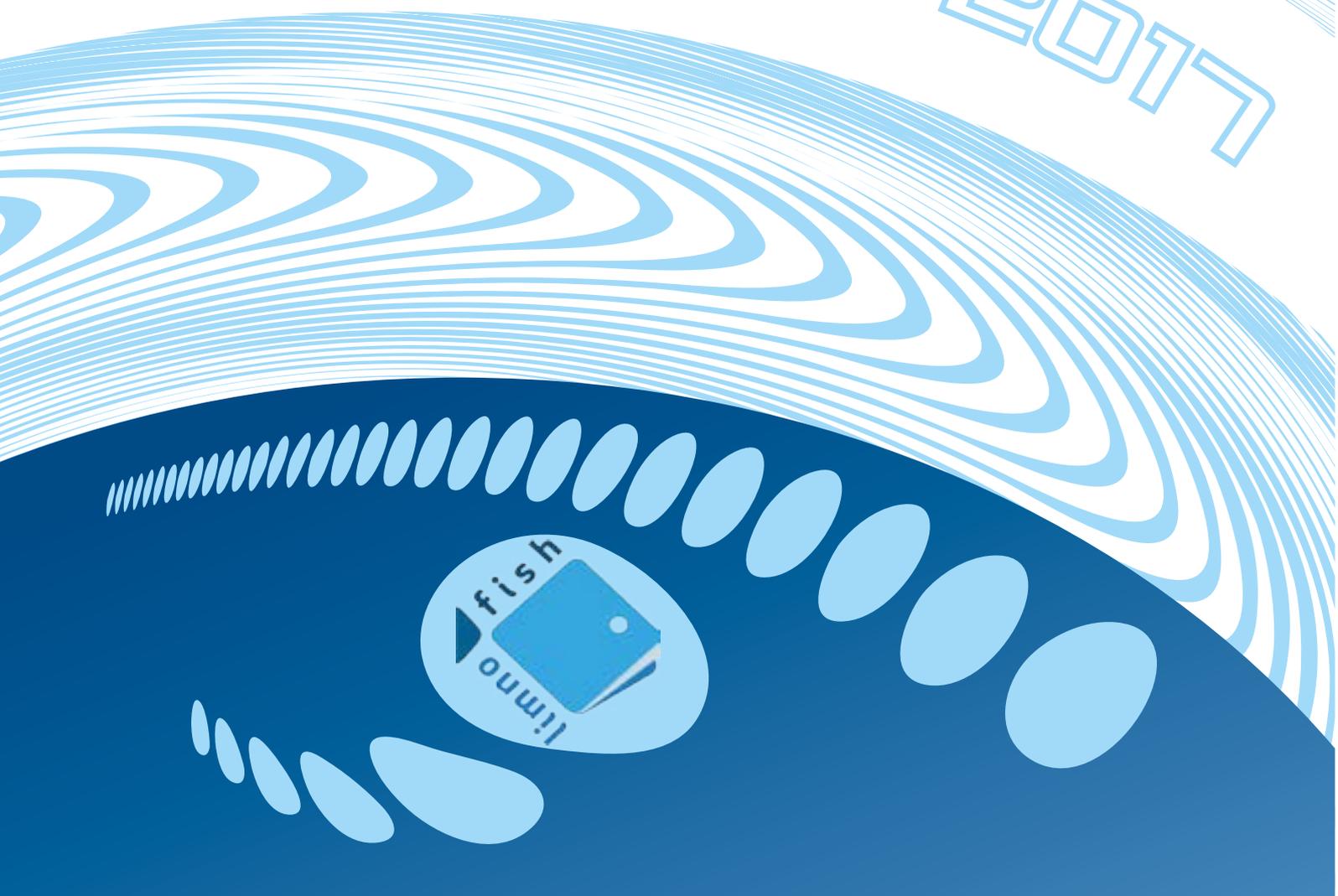
To conclude, according to the strong recommendation of European astacologists, a strong attention must be paid to stop spreading, import and culture of NICS in Turkey. The negative ecological and economic impacts include a risk of losing the native species as well as irreversible changes of freshwater ecosystems. It should be pointed out that the economic value of *A. leptodactylus* is higher compared to Australian and American crayfish species. Eradication of NICS once established in the wild is costly and practically almost infeasible.

Keywords: Crayfish, *Aphanomyces astaci*, crayfish plague,

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AND FRESHWATER FISHERIES

ORAL PRESENTATION

LIMNOFISH-2017



Species Composition of the Mollusc in Değirmendere Stream (Tunceli-Turkey) in Relation to Water Quality

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Objective: In this study, it is aimed to find out the relations of the mollusk species in the Değirmendere Stream (Tunceli-Turkey) with the water parameters.

Methods. Molluscs samples collected during each season to include 5 stations between August 2015 and September 2016. Sampling was quantitative using Surber net (225 cm²). Molluscs were separated from sediment using a system of sieves of different mesh sizes (20 mm, 2mm, 1mm and 0.5mm). Molluscs were preserved in 75% ethanol. samples were identified at the lowest possible level under a stereomicroscope. Chemical analysis of water samples for the four seasons of each station were obtained from the surface. Water samples for chemical analysis were collected from surface each station. Three major water variables (Water temperature (°C), dissolved oxygen (DO/mg/L) and pH) were measured with multi parameter instrument. The levels of NO₂-N (µg/l) and NO₃-N (µg/l) were measured in the laboratory according to standart method. The samples were acidified with (0.2 v/v) ultrapure nitric acid to pH< 2 and stored approximately at ±4 C. Na, K and Ca elements in the water samples were measured with Flame Atomic Absorption Spectrometry. The following parameters: Mn, Ni, Cu, Cd, Cr, As and Pb were analyzed in the water with Graphite Furnace Atomic Absorption Spectrometry The following detection limits were calculated: 0.05 for Ni and Pb, 0,1 for Mn, 0,01 for Cu, 0,01 for Cd, 0,02 for Cr, 0,2 for As.

Geographical data (coordinates) were recorded with geographical positioning unit. After the coordinates are marked on the google map. Species-environmental relationship was examined by using canonical correspondence analysis (CCA) where environmental variables with nine species found in 4 seasons were used. Species diversity (*H'*) was calculated according to Shannon-Weaver. The similarities for species composition were determined using Bray-Curtis index.

Results and Discussion: A total of 8 taxa were found between August 2015 and September 2016. 2 species belong to Prosobranchia [(*Bithynia pseudemmerica* (Bp) Schütt, 1964, *Bithynia tentaculata* (Bt) (Linnaeus 1758)], 4 species belong to Pulmonata [(*Galba truncatula* (Gt) (O.F. Müller, 1774), *Radix labiata* (Rl) (Draparnaud, 1805), *Physella acuta* (Pa) Draparnaud 1805, *Planorbis planorbis* (Pp) (Linnæus, 1758)] and 2 species belong to bivalvia [(*Pisidium casertanum* (Poli, 1791), *Pisidium liljborgi* (Clessin, 1886)]. Station and the average according to the seasons DO levels were between 8.3 mg/l and 10.7 mg/l. pH levels were between 6.3-7.5, water temperature levels were between 5.5-11.9 °C, salinity levels were between 0-0.01, levels were between NO₃--N, 0 and < 0.02 µg/l, levels were between NO₂-- N - 0 and < 0.01 µg/l. Calcium ion was between 214.2-751.01 mg/l. Water temperature, pH, Ca and dissolved oxygen were the four most influential variables and had significant effects on mollusc occurrence (p<0.05).

According to criterion values of “YSKY 2016” Cu, Cd, Pb, As, Mn, Cr, Na and Zn concentrations were low in all stations. The Cu concentrations in the water samples were between 0.001 and 0.003 mg/l (0.2 mg/l is in

first class in Turkish Standart), Cd between 0 and 0.001 mg/l (0.001mg/l is in first class in Turkish Standard), Ni between 0.001 and 0 mg/l (0.01 mg/l is in first class in Turkish Standart), Mn between 0.004 and 0.072 mg/l (1 mg/l is in class I in Turkish Standard). As, Pb and Cr between 0 and 0.001 mg/l (0.001 mg/l is in class I in Turkish Standart). Na between 0.01 and 0.03 mg/l (0.001 mg/l is in class I in Turkish Standart). K between 0 and 0.001 mg/l (0.001 mg/l is in class I in Turkish Standard)

According to the Shannon-Wiener index, the species diversity in Değirmendere Stream was found to be 0.666 at average. The highest level of diversity was found at station 1 (0.933) and its lowest was found at station 3 (0.54). Analyses of Bray-Curtis Cluster showed four main clustering groups. Until the present study, almost nothing was known about the ecological requirements of this species. There is only a few study about mollusk and their ecology in Turkey. We found that the species has a positive relationship with water temperature, pH, dissolved oxygen and Ca ion. Further detailed studies on each of these individual parameters are needed.

Keywords: Mollusk, Değirmendere Stream, CCA, water quality, Tunceli

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Malondialdehyde Levels in *Gammarus pulex* Exposed to Landfill Leachate Treated by Using Electrocoagulation Process

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Objective: In this study, it is aimed to investigate antioxidant response of *Gammarus pulex* exposed to landfill leachate (LL) treated by using electrocoagulation.

Methods: Malondialdehyde (MDA) levels in *G. pulex* exposed to untreated, treated, and diluted rates (1/10) and (1/20) in both LL during 24 and 96 h were tested. The concentration of MDA of the tissue homogenates was determined by the method of Placer et al (1966) and expressed as nmol/g tissue. Physicochemical parameters (electrical conductivity, pH, phosphate, turbidity, NH₃, Cl⁻ and colour) were conducted before and after treatment. Leachate is treated by using electrocoagulation process.

Results and Discussion: The all physicochemical parameters of LL decreased after treatment process. The MDA levels were increased when compared to control for 24 h ($p < 0.05$) but increased for 96 h ($p > 0.05$). After treatment by using electrocoagulation process glutathione levels were decreased again for 24 h and 96 h. In conclusion, present study demonstrated the abilities of LL to induce oxidative stress. Findings of the study suggest that MDA is useful in understanding the biochemical mechanisms of *Gammarus pulex* exposed to landfill leachate treated by using electrocoagulation process. as early warning indicators.

Keywords: *Gammarus pulex*, MDA, Landfill leachate, electrocoagulation process

Determination of the Effect of Temperature Changing on Cadmium Toxicity in Freshwater Amphipod *Gammarus pulex* (L., 1758)

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Objective: In this study, it is aimed to investigate antioxidant response of *Gammarus pulex* exposed to different temperature (10, 14 and 18 °C) and sublethals cadmium concentrations.

Methods: *G. pulex* were collected with dipnets from Munzur River (39.156820 N, 39.499640 E). They were transferred to the laboratory and kept in aerated 1 L aquaria in a climate controlled room at 18 °C and a 12:12 light:dark cycle. Individuals in similar intermoult stage with a size between 8 and 10mm in length, measured using a binocular, were selected for the study. Each aquarium consisted of 3 replicates with 10 individuals that were fed willow leaves. Experimental conditions for the acute test (96-h) were used acute static tests. *G. pulex* were not fed during the experiments. *G. pulex* were checked daily and dead individuals were counted and removed. The absence of response to gentle mechanical stimulus was the criterion for death.

Results and Discussion: In this study, the oxidative stress effects of cadmium (Cd) toxicity depend on water temperature was investigated on *Gammarus pulex*. The lethal concentration (LC₅₀) values for *G. pulex* which were exposed to various Cd concentrations for 96 hours were determined at different temperatures as 10, 14 and 18 °C. LC₅₀ values from probit analysis was found to be; $51.79 \pm 1.2 \mu\text{gL}^{-1}$ for 10 °C, $47.67 \pm 0.6 \mu\text{gL}^{-1}$ for 14 °C and $33.93 \pm 0.6 \mu\text{gL}^{-1}$ for 18 °C. LC₅₀ values were decreasing with increasing the temperature. The oxidant levels and average values of antioxidation activities with increasing temperature shows that MDA levels and CAT enzyme activities increase with raising temperature, but GPx enzyme activities decrease. It can be said that MDA levels, CAT and GPx enzyme activities increase with concentration. The results of this study show that oxidative stress due to Cd on *G. pulex* was increasing with temperature.

Keywords: Aquatic toxicology, *Gammarus pulex*, oxidative stress, antioxidant.

A Revised Study on Limnology of Cip Dam Lake (Elazığ, Turkey)**Bülent Sen¹, Mehmet Tahir Alp², Feray Sönmez¹, Mehmet Ali Turan Koçer³, Memet Varol⁴, Ergün Aslan¹**¹*Fırat University, Fisheries Faculty, Basic Aquatic Sciences Department, Elazığ, Turkey*²*Mersin University, Fisheries Faculty, Basic Aquatic Sciences Department, Mersin Turkey*³*Mediterranean Fisheries Research Production and Training Institute, Antalya, Turkey*⁴*İnönü University, Fisheries Faculty, Basic Aquatic Sciences Department, Malatya, Turkey*

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Objective: Cip Dam Lake is one of the important dam lakes in Elazığ Province mainly used for irrigation, fisheries and recreational purposes. The dam was constructed in 1965 in the form of rock weight and earthfill. The dam lake has 7×10^6 m³ of water capacity and its maximum reservoir area is 1.3 km². The present paper aims to revise and analyze the results of the previous limnological studies carried out on Cip Dam lake.

Methods: Water and algal samples were collected from both littoral and open water parts of the reservoir. Plankton net was used for plankton collection whilst cylindrical glass tube and Ekman dredge were employed to collect benthic algae and animal organisms respectively. The methods proposed by Edmondson (1959) and Welch (1948) were used for collection, preservation and dissection of cladocerans and copepods. Qualitative and quantitative analysis were performed through research and inverted microscopes. Results were subjected to various indices.

Results and Discussion: There are many studies performed on different limnological properties of the reservoir. Cladocera and Copepoda (Crustacea) were reported to be the main members of zooplankton of Cip Dam Lake (Akıl & Şen, 1995). Saler studied (1995) rotifera fauna of the lake focussing on their seasonal distribution. The author reported 15 species belonging to 12 genera that showed their best growth in spring and summer. A total of 17 chironomid species belonging to sub families Tanypodinae, Chironominae and Orthocladinae were recorded in the lake. The larvae showed their best growth in summer whereas the lowest numbers were encountered in winter (Akıl et al., 1996). *Cyprinus carpio*, *Ctenopharyngodon idella* and *Capoeta umbla* were determined as major fish species in the lake (DSİ, 1976). A study related to phytoplankton of Cip Dam revealed good growth of different algal groups in the association (Alp & Şen, 2014). However diatoms were the most conspicuous with their number of species and dense populations in the phytoplankton. A study performed in fish ponds which is filled by water coming from Cip Lake also yielded good growth of algae in ponds (Sen & Sonmez, 2006). There are also algalogical studies (Yavuz & Çetin, 2000; Çetin & Yavuz, 2001; Yıldırım & Çetin, 2009) carried out on Cip Stream that is the main inflow of the reservoir. Only the study belong to benthic algae in the reservoir seem to belong to Şen & Çetin (1988) who studied the seasonal variations of benthic algae on three different types of sediment. Most recently Alpaslan et al. (2015) and Karakaya & Saler (2016) studied water quality of the reservoir and reported interesting findings. The results of all these limnological studies were analyzed and discussed by means of relative indices.

Keywords: Limnology, Cip Dam Lake, Elazığ, Turkey.

Does Fish Transportation Instead of Fish Passages Protect the Biological Diversity Or is It A Biological Exile For Fish?

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Objective: In Turkey, many small scale hydroelectric power plants (HPP) have been built and all rivers have been obstructed for fish migrations. Some of the government institutions, researcher and private companies have recently an agenda named “*fish transportation system (FTS)*” instead of fish passages. The aim of this study is to examine and discuss **FTS** with the applications and international literature support.

Methods: In order to examine **FTS**, the draft of the Fishery Law No: 1380, **FTS** applications of the private companies and literature have been investigated. **FTS** carried out by some HPPs in Ceyhan, Seyhan and Çoruh river basins have been applied and discussed based on bio-ecology and migration characteristics of the fish. In addition, the fish passages and fish ways systems for fish migrations have been reviewed based on international literatures and it has been discussed whether **FTS** can be used instead of fish passage.

Results and Discussion: Results and Discussion: In the draft of Fishery Law no 1380 (article 4/6), it is stated that fish passage will not be effective in the dams and regulators higher than 30 m and therefore **FTS** may be used instead of fish passage. At the Kavşakbendi HPP in Seyhan River, the fish were transported to the upstream between 12 and 22 June 2017 and they were transported downstream between 23 June and 7 July 2017. At the Köprü HPP in Seyhan River, fish transportation carried out to the upstream between 8 and 19 July 2017, while they were transported to downstream between 20 and 31 July 2017. At the Menge HPP in Seyhan River, the fish were transported upstream in between 1 and 11 August 2017 and they were transported downside in between 12 and 23 August 2017. At the Sarıgül Dam in Ceyhan River, upstream fish transportation took place in between 12 and 30 June 2017 while just after one day later, downstream fish transportation took place between 1 and 18 July. At the Kandil Dam of Ceyhan River, upstream fish transportation took place between 20 July and 5 August 2017 while downstream fish transportation took place between 7 and 23 August 2017. The same applications were carried out at the Arkun HPP in Çoruh River Basin and upstream fish transportation took place between 3 and 19 July 2017 and just after one day later downstream fish transportation took place between 20 July and 5 August.

Various types of fish passages, fish ways, and fish elevators are used all over the world to provide fish migration. These constructions were applied even for dams higher than 80-100 m. Furthermore, it will be possible to provide fish migrations by constructing fish elevators. We have not known migratory fish species in Turkish rivers. We have also not information about habitat characteristics, distribution areas, spawning areas, migration period, stock densities, fish sizes etc of the migratory species. Therefore, without this knowledge, **FTS** will not help to protect biological diversity, but it will also damage fish populations and it will be a biological exile for fish. In addition, it must be discussed which ethical procedures have been applied for **FTS**.

Keywords: Fish passage, Hydropower, Dam, Fish transportation system (**FTS**).

Dioxin and Dioxin-Like Compounds in Five Fish Species Living in Keban Dam Lake

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Objective: In this study, it is aimed to determine the toxic equivalent (TEQ) levels of dioxins and dioxin-like compounds in the five fish species (*Mastacembelus mastacembelus*, *Squalius cephalus*, *Cyprinus carpio*, *Onchorhynchus mykiss* and *Capoeta umbla*) living in the Keban Dan Lake, Elazığ, Turkey.

Methods: Fifteen fish for each species were sampled from Keban Dam Lake in the same fishing season. Total length (TL) and body weight (W) of them were measured and their otoliths were removed for age determination. A sufficient amount of muscle samples for the determination of levels of dioxins and dioxin-like compounds was taken and stored at -20°C in the dark. The extraction was done according to modified method 8290 and 1613 of United States Environment Protection Agency (USEPA) 9. A 20 g homogenized sample mixed with anhydrous sodium sulphate was spiked with ¹³C12-labeled standards (100 µl of 4 ng/ml), allowed to dry and then extracted for 16 h using methylene chloride: hexane (1:1) in a Soxhlet extractor. The solvent was evaporated and the lipid content was determined gravimetrically. The lipid residue was dissolved in toluene and the mixture was placed onto an acidic silica column. This column was washed twice with toluene and refluxed with toluene for 30 min. Finally, the eluate was evaporated to dryness and re-dissolved in toluene containing injection standards. Dioxins were analysed by PTV-LV-GC/MS, GC (Schimadzu QP 2010 plus) coupled with a Plus Mass Spectrometer operating the EI mode 70 eV and with a resolution of 10.000. The capillary column was a TRB5 MS capillary column (60 m x 0.32 mm I.D., 0.25 µm film thickness, Teknokroma S. Coop. C. Ltd, Barcelona, Spain) connected to a BEST PTV injector and PTV-LV 2.75×2TRC for PCDD/Fs and PCBs verification. The oven temperature was maintained at 100°C for 6 min, ramped at 52°C min⁻¹ to 200°C; ramped at 2.9°C min⁻¹ to 250°C for 6 min; ramped at 2.9°C min⁻¹ to 260°C and finally ramped at 10°C min⁻¹ to 300°C for 5 min. During the analysis, the injection volumes were increased from 1 µl to 4 µl with the PTV-LV inlet. At the result, analytical sensitivity is greatly enhanced for analysis of samples. The TEQ values of PCDD/Fs and PCBs were calculated using the toxic equivalent factor (TEFs) according to WHO2005.

Results and Discussion: Fat content (%) was the highest in *M. mastacembelus* followed by *S. cephalus*, *C. carpio*, *O. mykiss* and *C. umbla* respectively. The toxic equivalent (TEQ) levels of dioxin and dioxin-like compounds in fish species were higher in fat than in wet weight. Total TEQ levels (pg/g-wet weight) were the highest in *M. mastacembelus* (3.052), followed by *S. cephalus* (1.249), *C. carpio* (1.184), *O. mykiss* (0.948) and *C. umbla* (0.582). Total TEQ levels in the wet weight of fish species increased with the increasing of age, total length and weight. The maximum levels set forth for the sum of dioxin and dioxin-like compounds is 10 pg WHO-TEQ/g wet weight for eels and 6.5 pg WHO-TEQ/g wet weight for fresh water fish. Finally, none of the fish species examined in the present study exceeded permissible limits established for fish by European Commission Regulation. The dietary consumption of these species does not represent a risk for human health in term of dioxin and dioxin-like compounds.

Keywords: Dioxin, Fish, Keban Dam Lake, Turkey

Study on Effect of Different Growth Media on Biomass Production of *Pseudopediastrum boryanum* (Turpin) E. Hegewald Isolates

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Objective: Microalgae *Pseudopediastrum boryanum* (Turpin) E. Hegewald was chosen as a subject for this research due to its potential uses of wastewater treatment and biodiesel production. In this study, it is aimed to the characteristics of biomass production in different growth media on *P. boryanum* in growing conditions was presented.

Methods: Our previous study, the samples collected from different freshwater reservoir were brought to incubation at room temperature after inoculation at pre-enrichment nutrition media. *P. boryanum* was identified at species base with microscopic examination after incubation. From the mixed species in the pre-enrichment medium, *P. boryanum* was isolated using the dilution technique. In this study, semi-continuous culture system was utilized in reproduction of the cultures. Allen and BG 11 media were used for experiments. The isolated *P. boryanum* strain was inoculated with 270 ml of medium + 30 ml of suspension culture. The pH of nutrient media was adjusted as 6.5-7. The implementation of 16:8 light/dark photoperiod were applied on cultures and they were cultivated under at 22-25°C room temperature. Optical density was recorded by using UV-Visible spectrophotometer at 670 nm, and cell count examination was performed using haemocytometer (Neubauer). Dry weight and chlorophyll a concentration of stain was also determined.

Results and Discussion: The genus *P. boryanum* (Chlorophyceae) is colonies form green algae occurs commonly in natural freshwater environments. Recently, it has become a kind of working on different subjects by scientists. In this research, we investigated the growth and biomass production of *P. boryanum* using semi-continuous cultures employing two growth media (Allen and BG 11 media). The highest cell density was obtained in Allen, while the lowest in BG 11 medium. Chlorophyll a and dry weight were highest in Allen media. The results suggested that Allen medium is better choice with the other growth media, while at the same time resulted in better growth performance and biomass production.

Keywords: *Pseudopediastrum boryanum*, cell density, semi-continuous culture, growth parameters

Assessing Trophic Level of the Nif Stream (İzmir) Using Macro-Invertebrate Composition and Distribution

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Objective: The study was conducted in Nif Stream (İzmir) and the aims of the study are (a) to determine the macro-invertebrate composition of the stream, (b) to determine environmental features of the stream, (c) to investigate the relations between the determined species and the environmental variables and (d) to assess the trophic level of the stream which was under the pressure of industry, agriculture and settlement.

Methods: Samplings of macrobenthic invertebrates were performed seasonally at eight stations between October 2013 and September 2014. Macrobenthic samples were collected by kicking benthic material with a 500 µm mesh sized kick-net. The samples were fixed in 4% formalin solution in field and then sieved under the tap water in laboratory. All the macro-invertebrate samples were firstly sorted in groups and then identified to genera-species level where possible. They were studied both qualitatively and quantitatively. These quantitative samples have been analyzed. Six environmental variables, namely temperature (Temp., C°), dissolved oxygen (DO, mg/l), oxygen saturation (%), pH, Electrical Conductivity (EC, µs/cm) and salinity (S, mg/l) were measured in situ by using a WTW pH-meter (model 330), a WTW oxygen-meter (model 330) and a YSI 30 model SCT-meter. Other variables (PO_4^{3-} -P, HCO_3^- , NO_2 -N, NO_3 -N, NH_4 -N, Total N, Hardness, Ca^{2+} , Mg^{2+} , SO_4^{2-} , PO_4^{2-} , Alkalinity) were measured in the laboratory after following the standard methods of the American Public Health Association (APHA). Canonical ordination techniques (CCA) were used to explain the variation in taxa along the gradients (axes 1 and 2 of an ordination diagram) using the environmental variables. Multivariate analyses were carried out with the CANOCO 4.5 package. All statistical analyses were conducted using the Multi-Variate Statistical Package (MVSP) program version 3.1 and Statgraphics Plus 5.1 program.

Results and Discussion: At the end of the study, 6540 specimens were investigated and totally 59 species determined. Chironomidae and Oligochaeta were the higher groups in terms of species richness with 25 and 17 species, respectively. Multivariate analyses indicate that pH, Ca^{2+} and NO_3 -N were the most effective variables on the distribution of the determined macro-invertebrate species in Nif Stream. Along the measured physico-chemical characteristics and the ecological requirements of the determined species, it is obvious that the stream is under high pressure of human activities and there was a heavy pollution especially in the middle and lower parts of the stream.

Keywords: Nif Stream, macro-invertebrates, assessment, water quality, Turkey.

The Algal Flora of Thermal Springs in Kırşehir (Turkey)**Tülay Özer¹, İlkey Açıkgoz Erkaya²**¹*Ahi Evran University, Faculty of Science and Arts, Department of Biology, Kırşehir*²*Ahi Evran University, Faculty of Architecture and Engineering, Department of Environmental Engineering, Kırşehir*

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Objective: In this study, determination and distribution of the algal flora of thermal springs in Kırşehir were investigated in relation to some measurable environmental variables.

Methods: Between October 2016 and June 2017, the algal samplings from 7 thermal springs in Kırşehir were taken at least once in each season. The sampling stations are belonging to Terme, Karakurt, Savcılı (Büyüko-ba), Mucur (Avcı Spring), Akpınar, Bulamaçlı and Mahmutlu geothermal areas. Temperature, conductivity and salinity values of thermal waters were measured in situ by YSI 30 brand multiparameter, pH was measured by Thermo Orion 210 Model pH-meter. Samples collected during the study were fixed using 4% formaldehyde and species were identified using a research microscope with Nikon brand. Related reference sources were used in the identification.

Results and Discussion: The measured values of water throughout the study exhibited different characteristics at all stations. Except for Karakurt and Avcı thermal springs, parallel increasings observed in the values of the temperature, conductivity and salinity of the water springs. When all stations were taken into consideration, measured variations; temperature from 20 °C to 73.2 °C; conductivity, from 564 to 3600 $\mu\text{S cm}^{-1}$; salinity from 0.3 to 6.3 ppt and pH from 5.2 to 8.4 were changed. Temperature and salinity variables showed that they were rather a restricting factor over the algae development. Mahmutlu and Karakurt stations have the highest measured temperature values for extreme conditions in terms of the algae development. Especially, *Synechococcus* sp. and *Anabaena* spp. species of the photosynthetic procaryotic algae were observed as abundant and wide-spread. In the Avcı thermal spring where the salinity value was the highest, only *Oscillatoria tenuis* C.Agardh ex Gomont and *Oscillatoria* sp. was recorded. Akpınar, the algal diversity is the highest, conductivity, temperature, salinity and pH values were recorded as optimum (Optimum values are 945 $\mu\text{S cm}^{-1}$, 31.5 °C, 0.3 ppt ve 7.9, respectively). *Botryococcus braunii* Kützing, *Cosmarium* sp., *Merismopedia* sp. and *Achnanthes* sp. species were observed only in this station. In all stations, Cyanobacteria (especially *Oscillatoria* species) were observed to have been more thermotolerant than eukaryotic algae.

Keywords: Kırşehir, thermal spring, algal flora

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The Algae Flora of Hereke Stream (Kocaeli -Turkey)

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Objective: Microalgae are very important for the nutritional chain for lotic ecosystems. It is also included in the group that should be examined in order to determine biodiversity in aquatic ecosystems. For this purpose, this research has been carried out in the Hereke Stream.

Methods: In order to study the algal flora of Hereke Stream, four stations were selected depending on the length of the stream. The study was carried out seasonally between January 2015 and November 2015. Algal specimens were examined and diagnosed in the microscope using relevant diagnostic books in the laboratory. In addition, some physicochemical analyzes of the water have been carried out in accordance with international standard methods.

Results and Discussion: In the algological study conducted at Hereke Stream; A total of 25 taxa were identified, 20 of which belong to Bacillariophyta, 3 belong to Chlorophyta, and 2 belong to Cyanophyta. According to the results of our study, 80 % of the total algal flora of was represented by members of Bacillariophyta . At the same time, water temperature (8.10 – 17.1 °C), dissolved oxygen (8.2-9.4 mg L⁻¹), pH (6.95-8.10), and conductivity 382 - 447 µS / cm were determined. It is thought that the flow rate of the stream is effective in the presence of a few algal taxa. The same result has been observed in the rivers and streams in Turkey.

Key Words: Algae, Flora, Stream, Hereke, Turkey

A Preliminary Study on the Determination of Epilithic Diatoms of Hortuk and, Kan and Moryayla and amlıkaya Streams (oruh Basin/Turkey)

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Objective In the algological study conducted at Hortuk Stream and, Moryayla Stream and, Kan Stream and amlıkaya Stream.

Methods: Winter and spring samples were taken from these springs. The study was carried out January 2008 and April 2008. Algal specimens were examined and diagnosed in the microscope using relevant diagnostic books in the laboratory. In addition, some physicochemical analyzes of the water have been carried out in accordance with international standard methods.

Results and Discussion: In the study, at Hortuk Stream 22 taxa, at amlıkaya Stream 6 taxa, at Kan Stream 14 taxa and at Moryayla Stream 20 taxa were determined. *Odontidium hymela* (Roth) Kütz. , and *Hannaea arcus* (Ehr.) R. M. Patrick were the most abundant species in epilithic composition. It has been determined that the streams have oligotrophic character terms of epilithic algal composition.

Key Words: Environment, epilithic, stream, diatom,

Evaluating changes in Fish Fauna and Ecological Quality of Namnam Stream (Köyceğiz-Muğla) over a 15-year-time-period

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Objective: This study was carried out to evaluate the change in fish fauna and ecological water quality of Namnam River in a period between 2002 and 2017.

Methods: To determine the change in fish fauna and ecological quality of Namnam Stream, the data belong to 2002 and 2017 were compared. The fish samples were caught mainly by electro-shocker in the area of research. The cast-nets and fishing lines were also used when required. The samples were collected from the chosen stations. The fish samples were fixed by the 4 % formaldehyde solution in the field and were carried to the Muğla Sıtkı Koçman University Hydrobiology Laboratory. Some of water quality parameters were analysed in the field by portative multimeter and others were analysed in laboratory medium. For this purpose, the water samples, which were taken to polyethylene bottles in the fieldwork, were carried to the laboratory with cold chain. Electrical conductivity, temperature, dissolved O₂ content, pH, BOD₅, NH₄-N, NO₂-N, NO₃-N, PO₄-P were analysed for physical and chemical evaluation.

Results and Discussion: As a result, because of the presence of invasive and marine originated species, a change in the fish fauna of Nannam Stream was observed. In addition, systematic revisions and contributions on the fish fauna in Köyceğiz Lake Basin was another reason of this change. The changes in ecological water quality was mainly because of the trout farm, agricultural activities, influences on hydrological structure of stream and antropogenic activities. Especially the ecological quality in lower basin, which is in relation to Köyceğiz Lake, should be monitored in the view of pollution.

Keywords: Namnam Stream, Fish Fauna, Ecological Quality, Muğla

Biological, Physical and Chemical Evaluation of Water Quality of Namnam Stream (Köyceğiz-Muğla)

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Objective: This study was carried out to determine the water quality of Namnam Stream with physical, chemical and biological methods between November 2012 and September 2013.

Methods: To determine the water quality features of Namnam Stream five sampling points were chosen and six field works were done. By the field works, water quality parameters of each sampling points were investigated and benthic macro invertebrate and fish samples were collected. Some of water quality parameters were analysed in the field by portative multimeter while others were analysed in Hydrobiology Laboratory of Muğla Sıtkı Koçman University, Science Faculty Biology Department. For this purpose, the water samples, which were taken to polyethylene bottles in the fieldwork, were carried to the laboratory with cold chain. To determine the water quality of Namnam Stream, the physical, chemical and biological parameters were evaluated according to WPCR, Klee (1991), BBI, and IBI-F indices. As biological parameters, 39 benthic macro invertebrate and 13 fish taxa were used.

Results and Discussion: According to obtained results, physico-chemical and biological water quality classes were found supporting each other. The first three sampling point which were located to the upper basin of the stream were found relatively in high water quality classes, close to each other while the other two sampling points in lower basin of the stream were determined in lower water quality classes. All sampling points were in II class according to WPCR. According to Klee (1991) the quality classes of the sampling points were as following; II-III, II; II-III; II; II-III. According to BBI, the water quality of the sampling points were found as following; II; II; II; III; II. According to IBI-F the water quality of the sampling points were found as following; II-III; II-III; II-III; IV; I-II. The relatively high pollution pressure in the lower basin of the stream should be monitored and the required precautions should be taken to decrease the pollution load although a significant pollution pressure is not yet present

Keywords: Namnam Stream, Water Quality, Köyceğiz, Muğla

Common Freshwater Diatoms of Turkish Inland Waters: 1-Naviculales

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Objective: Biogeographically, Turkey is very heterogeneous due to the high variability in geologic and climatic conditions throughout its territory. There are seven climate zones in Turkey and the diversity of climatic conditions causes high biodiversity in the country. Up to now, about 900 freshwater diatoms were identified inland waters in Turkey. In this study, it is aimed to investigate of common diatoms in the flora of Turkey.

Methods: The material studied was collected from different parts of Turkey between 2005 and 2014. Altogether, 442 samples were collected from ten water bodies in Western (Aegean, Marmara, Thrace regions) and Inner Anatolia. The samples were boiled with H₂O₂ and HCl to remove the organic matter. After repeated washing with distilled water. Permanent diatom preparations were mounted with Naphrax[®]. Light microscopic (LM) observations were performed by means of Nikon Eclipse E 600 with Nikon DS-Fi1 in Szczecin University and OLYMPUS BX51 with Spot Insight Camera in Dumlupınar University.

Results and Discussion: As a result, some members of *Adlafia*, *Craticula*, *Caloneis*, *Diploneis*, *Fallacia*, *Frustulia*, *Fistulifera*, *Fallacia*, *Hippodonta*, *Luticola*, *Mayamaea*, *Navicula*, *Pinnularia*, *Placoneis*, *Sellaphora* and *Stauroneis* were found as common diatoms of Turkish freshwater diatom flora.

Keywords: Common diatom, Naviculales, Turkey.

Acknowledgement: This study was supported by Dumlupınar University Foundation (grant no: 2011-18; 2015-98) and The Scientific and Technological Research Council of Turkey (TUBITAK, grant no: 114Z006).

Morphometric and Meristic Properties of *Gambusia holbrooki* in Mediterranean Basin, Turkey

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Objective: Mosquitofishes, which belong to Poeciliidae family, have high adaptability and they are used in biological control frequently since the beginning of 20th century all over the world (Kumar and Hwang, 2006). One of the families' genus *Gambusia* is indicated in the world especially two species, *Gambusia affinis* and *G. holbrooki*. Both of these species are also known in literature from Turkey inland waters. These species are among the world's 100 most invasive species that have managed to create significant populations as they find wide range all over the world (ISSG, 2013). Except *G. affinis* and *G. holbrooki* there is no species that belongs to this genus in Turkey inland waters. Turkey is an important hot spot. Because there are many species endemic fishes belong to Turkey, mosquitofishes are major threat for their presence. In this study, it is aimed to contribute to morphological studies conducted on *G. holbrooki*.

Methods: In the present study, individuals were sampled from 8 different water resources as Dalaman, Seyhan, Sultansuyu, Alara, Karpuz rivers and Akgöl, Kocagöl, Mercimek lakes which belong to Mediterranean basin, in 2016. While making the determination of species, gonopodium notches of male individuals were utilized. This study includes 176 female and 128 male individuals' total length, standard length, total weight, maximum body depth, maximum body width, caudal peduncle length, caudal peduncle depth, gonopodium length, head length, snout length, eye diameter, interorbital distance, predorsal distance, postdorsal distance and the rations between them, also number of fin rays, number of lateral line scales.

Results and Discussion: Individuals were examined and because of this, it was determined in the basin, *G. holbrooki*. Some measurements of all these female populations are as follows: range for total length 16.62-52.49 mm, range for total weight 0.06-2.22 g, range for maximum body depth 2.68-12.17 mm and range for head length 2.73-11.14 mm. Some measurements of all these male populations are as follows: range for total length 16.73-27.08 mm, range for weight 0.06-0.22 g, range for maximum body depth 2.42-5.56 mm, range for head length 2.69-6.57 mm and range for gonopodium length 3.04-10.44 mm.

Keywords: Introduced, mosquitofish, *Gambusia holbrooki*, morphometric features, Mediterranean Basin

An Investigation on Epilithic Diatoms of Tahar Stream (Elazığ, Turkey)**Feray Sönmez, Bülent Şen, Ümit Yiğiteli***Firat University, Fisheries Faculty, Basic Aquatic Science Department, ELAZIĞ*

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Objective: This study was aimed to species composition of diatoms and their seasonal variations in epilithic diatom associations occurring in Tahar Stream were determined between January and December 2014.

Methods: The Tahar Stream is located in Keban Dam Lake and three representative stations were selected in upper, middle and lower parts of the stream with the distance approximately 3 km away from each other. Stream bed in upper and middle parts consists mainly of rocks, stones and gravels whilst gravel and sands are dominant substrates in the lower part of the stream.

Water samples were collected using a water bottle. The water temperature, pH and dissolved oxygen of the stream were measured directly by means of a oxygen meter (YSI 55) and a pH meter (YSI 100). Total hardness, total alkalinity and organic matter were determined through titration analysis whilst spectrophotometric method was employed for the analysis of ammonium, chlorine, chemical oxygen demand (COD), nitrite, nitrate, sulphate, silica, total phosphorus, total nitrogen and ortho-phosphate. Flow rate of Tahar Stream was measured with flotation method and current value was calculated.

The epilithic diatoms were scrapped from stones/gravels into a plastic container. Olympus model with microscope was employed for both identification of species and counting cells. The relative abundance method was applied for individual numbers of diatoms and results were expressed as “% organism” since it was hard to identify the live cells during counting process through inverted microscope. At least 100-200 individuals based on the abundance of diatoms were observed and counted in per sample.

To prepare permanent diatom slides, subsamples were taken and acid solution was added to digest organic material. These samples were boiled on a hot plate for 15 minute to expedite the digestion process and were subsequently left the cool. Samples were neutralized by rinsing with distilled water and dried on coverslips that were mounted on glass slides with Entellan. Diatom species were identified according to Krammer and Lange-Bertalot (1986, 1988, 1991a, 1991b). Species named updated in accordance with Guiry and Guiry (2017).

Results and Discussion: All the values of physicochemical parameters yielded that the studied parts of Tahar Stream can be classified as Class I Water Quality (exclusive of the maximum concentration of ortho-phosphate in may; appeared to be resulted through runoff coming from agricultural lands usually fertilized in spring) according to Surface Water Management Guide-Inland Water Resources Quality Criteria.

A total of 32 diatom taxa all belonging to pennales were identified throughout the study. Members of the genera *Cymbella*, *Diatoma*, *Epithemia*, *Gomphonema*, *Navicula*, *Nitzschia* and *Surirella* were common epilithic diatoms in the stream. *Nitzschia* was the richest in species composition. *Cocconeis pediculus*, *Cymbella affinis*, *C. helvetica*, *Diatoma elongata*, *Fragilaria acus*, *Gomphonema intricatum*, *G. olivaceum*, *Navicula radiosa*, *Nitzschia sigmoidea* and *Ulnaria ulna* were noticable diatoms with respect to frequency of occurrence and individual numbers in epilithic diatom at all stations. Variations in occurrence of diatom species and their abundance were compared at stations and discussed in relation to physicochemical properties of stream water.

Keywords: Epilithic diatom, water quality, taxonomy, Tahar Stream, Keban Dam Lake, Turkey.

Evaluation of Surface Water Quality of Sarıyar Dam Lake

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Objective: In this study, it is aimed investigation of the monthly and seasonal changes of the water quality parameters, determination of water quality characteristics and pollution problems, ascertainment of suitability for aquatic life and also classification of the water quality according to Surface Water Quality Control Regulation in Sarıyar dam lake.

Methods: The water samples were taken from six sampling sites for analysis and measurements were performed in situ at monthly from June2016 to May2017. Water temperature, dissolved oxygen, oxygen saturation, pH, electrical conductivity and salinity (salinity) were measured by means of WTW Multi field measurement set. Water samples were taken by means of polypropylene bottles and transferred to laboratory. Nitrite, Nitrate, Phosphate, Ammonium, T.Nitrogen, T.Phosphatase, COD and sulfat were measured according to spectrophotometric method with WTW. Chloride, organic matter, calcium, magnesium, alkalinity and total hardness were determined with titrimetric method. The physical and chemical analyzes performed in the laboratory were made according to the methods of APHA 1995, TSE 1989 and WTW 2005.

Results and Discussion: As a result of analyzes, when the Sarıyar dam lake is evaluated according to the surface water quality standards, the values measured are very variable by months and most of the values well above the limit values. It has been determined that the current water quality of the Sarıyar dam lake is III. class water quality according to the Surface Water Quality Management Regulation (SWQMR) (classification of inland water resources). According to this results, precaution must be taken to improve the current state of the Sarıyar dam lake.

Keywords: Water Quality Parameters, Sarıyar dam lake

Length-Weight Relationships For Fish Communities of Bakırçay River Estuary in Çandarlı Bay (Central Aegean Sea, Turkey)

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Objective: The present study was conducted to measure length weight relationships of fish caught with various catching gears in the estuary of river Bakırçay into Çandarlı Bay.

Methods: Fish captured by each gear in the study area were brought in separate boxes to the lab. Measurements were made in the lab when fish were still wet. They were measured in the laboratory for total length (TL) to the nearest cm and wet weighed (W) to the nearest g. The length-weight relationships were calculated using the equation of $W=aL^b$ (Ricker, 1979). The statistical significance level of correlation coefficient (r) was estimated by linear regressions on the transformed equation, $\log W=\log a + b.\log TL$. All statistical analyses were evaluated at $p<0.01$ significance level.

Results and Discussion: Length-weight relationships were calculated for 57 fish species from Bakırçay estuary in Çandarlı Bay. A total of 3487 fish specimens were captured with beach seine, handline, fyke net, scoop net, castnet and trammel net in 2012–2015. The sample size ranged from 9 individuals for *Gasterosteus aculeatus* to 133 for *Solea solea*. r^2 values varied between 0.84 and 0.99. All regressions were highly significant ($p < 0.01$). Values of the exponent b in the length-weight regression ranged from 2.371 for *Engraulis encrasicolus* to 3.490 for *Syngnathus acus* and the median value was 3.134 with 25–75% of the values ranging between 3.010 and 3.170.

Key words: Length - weight relationship, Bakırçay estuary, Çandarlı Bay, Aegean Sea,

Growth and Feeding Features of *Anguilla anguilla* Population, in West Mediterranean Region of Turkey (Özlen Creek-Fethiye)

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Objective: The eels enter the inland of countries that are coastal to the Mediterranean, completing their growth and development. However, obstacles such as hydroelectric power plant (HEPP), dams and irrigation regulators, vital wishes such as breeding and feeding of eels are prevented. The eels (*Anguilla anguilla*) are Critically Endangered A2bd+4bd (CR) according to IUCN data. In this study; it was investigated growth features and feeding habits of the elver eel and yellow eel of Özlen Creek (Fethiye-Muğla) during entry into the rivers from the sea.

Methods: The population structure of *A.anguilla* in Özlen Creek was studied using 108 fish samples at November 2011, March and May 2012. It was observed weight and size compositions of samples. In addition, the total length-weight relationship and condition factor was calculated. Food selection was expressed. Food organisms founded in the alimentary canal were identified.

Results and Discussion: The length-weight relationship were estimated as $W = 0.005 L^{3.4998}$ ($r = 0.9898$). The studies of the food intake in date were determined by composition of the digestive track content. According to the coloration state and morphology of samples were observed in the 3 groups form (group 1 transparent elver, group 2 translucent elver, group 3 yellow eel).The 11 different organisms groups in the digestive tract were described. Feeding habits of eel elver and yellow eel when analyzed according to the capture period were determined to be the most dominant food *Chironomus thummi* at all periods.

Keywords: eel, feeding, growth, Özlen Creek, Anatolia, Turkey

Age, Growth and Mortality of The Common Carp (*Cyprinus carpio*) Population in Merdjet Sidi Abed, Algeria

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Objective: we tried to estimate age, growth parameters, condition factor, length-weight relationship, mortality rates (Z , M , and F), recruitment pattern of the common carp in merdjet Sidi Abed dam.

Methods: Common carp *Cyprinus carpio* (Linnaeus, 1758) specimens were captured by long line between April and June 2013 in Merdjet Sidi abed dam (Wilaya of Ghelizane). Total length (L) was measured with an ichthyometer to the nearest 0.1 cm and total weight (W) weighed with 1 g precision digital scale. Length-weight relationship and condition factor were calculated as follows: $W=aL^b$ and $C=(W*100)/L^3$ respectively. the Von Bertalanffy growth function was used to describe the growth of this cyprinidae. The Battacharya method was employed to determine age of individuals. Length-converted catch curve was used to estimate total annual instantaneous mortality rates (Z), natural mortality was calculated using Pauly formula [$\ln(M) = -0.0152 - 0.279 \ln(L_{\infty}) + 0.6543 \ln(K) + 0.463 \ln(T)$] Recruitment patterns were determined from the routine implemented in FISAT II.

Results and Discussion: 220 individuals were collected and weights ranged between 265.5 and 620.3 g while the total length ranged between 26.3 and 35.6 cm. For all individuals ($n = 220$) of the common carp, the relationship between total length and body weight was: $W = 0.0384 L^{2.70}$ ($r^2 = 0.906$) for females and $W = 0.0467 L^{2.653}$ ($r^2 = 0.976$) for males a minor allometry was found for this species, mean condition factor K was estimated at 1.41. The maximum value of recruitment was recorded in March-April period with 19.56 and 15.20% respectively. The Battacharya method was used to estimate age of individuals that was comprised between 1 and years 3. The equation of Von Bertalanffy growth was: $L = 36.75 [1 - e^{-0.46(t + 0.33)}]$ for all the population. total mortality (Z), natural mortality (M) and fishing mortality (F) were as follows: $Z = 1.08$, $M = 0.82$, $F = 0.26 \text{ yr}^{-1}$ while exploitation ratio (E) was evaluated at 0.24 indicating an under exploitation of this local resource

Keywords: Common carp, *Cyprinus carpio*, merdjet Sidi Abed, age, growth, mortality.

Age and Growth of Mirror Carp (*Cyprinus carpio*) Population in Keban Dam Lake (Elazig, Turkey)

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Objective: In this study, it is aimed to determine the age and growth of mirror carp (*Cyprinus carpio* L., 1758) population of Keban Dam Lake, Elazığ, Turkey.

Methods: Fish samples were obtained from the area near the set of Keban Dam Lake (38° 48' 23.67"N and 38° 46' 23.88"E) using 20-40 mm mesh size gill nets during November 2016 and December 2016. Total length (TL) and total body weight (W) of them were measured to the nearest 1 mm and 0.1 g, respectively. Scales were extracted from each fish for age determination and they were kept in 3% KOH solution for nearly 1 hr and then washed under tap water and fixed in 96% ethyl alcohol for further observation. The age of fishes were determined by reading of the growth rings formed on scales under a binocular stereoscopic microscope (Leica S8APO) combined to a computer. Length-weight relationship and condition factor were calculated with $W=a*TL^b$ and $CF=(W/L^3)*100$ equals, respectively. The von Bertalanffy growth function (VBGF) was fitted to individual length and age data for the mirror carp population and expressed by the equation: $L_t=L_{\infty}[1-e^{-K(t-t_0)}]$. Longevity was calculated using equation: $t_{max}=3/K$. The growth performance index (Φ) was estimated in each case according to the formula: $\Phi=LogK+2LogL_{\infty}$. In addition, absolute, relative and instantaneous growth rates of fish were also calculated.

Results and Discussion: Total of 120 mirror carps (54 females and 66 males) were examined. They ranged from 2 to 8 in age, from 21.50 to 37.50 mm in total length and from 172.66 to 789.17 g in total body weight. Nonlinear relationship was found between total length and weight of fish ($W=0.0135*TL^{3.0403}$; $r^2=0.9724$; $p<0.001$). The growth parameters were estimated as 43.09 cm, 0.176 years⁻¹, -2.423 years, 17 years, 2.51 and 1.62 for L_{∞} , K , t_0 , t_{max} , Φ and CF respectively. Age-at-length data fitted to the von Bertalanffy Growth Function was determined as $Lt=43.09*[1-e^{-0.176(t+2.423)}]$. Absolute, relative and instantaneous growth values of mirror carp from Keban Dam Lake were the highest in age range 2-3, followed by age range 3-4. After age 4, the values decreased at a significant level ($p<0.05$).

According to the exponent b value (3.04), the mirror carp (*C. carpio*) population of Keban Dam Lake showed isometric growth ($b=3$). Similar b value has been found for common carp (*C. carpio*) population of Gelingüllü Dam Lake (3.023), Kemer Reservoir (3.037) and Sakarya River (2.98). However, some population of common carp showed negative allometric growth ($b<3$) in Altınkaya Reservoir (2.825), Lake İznik (2.830) and positive allometric growth ($b>3$) in Almus Dam Lake (3.319) and Ömerli Reservoir (3.140). According to these results, it can be concluded that the water quality and the nutritional status of reservoir are very important for the growth of fish.

Keywords: Mirror carp, growth parameters, Keban Dam Lake, Turkey

Assessment of Population Structure and Size of Medicinal Leech *Hirudo verbana* Inhabiting some Model Wetlands of Turkey

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Objective: Medicinal leeches are used for bloodletting and the other medical purposes. They are also the model organisms in life sciences as the classic laboratory objects for educational purposes. The international trade of medicinal leech, *Hirudo verbana* is being regulated by CITES due to heavy exploitation pressure on the stocks and habitat destruction. The effective conservation and sustainable management of the endangered and exploited populations may be possible through true conservation and management policies. Creation and implementation of these policies need regular monitoring of the populations, assessment of structure and size of them. It was aimed to estimate the structure and size of *H. verbana* populations inhabiting the wetlands around Lake Eğirdir (Turkey) which are regarded as model habitats for medicinal leech populations with this study.

Methods: The study was conducted in five distinct wetlands around Lake Eğirdir in May, June, July and August in 2014. Population size was estimated by removal methods (Maximum likelihood (Zippin, 1956) and Regression (Leslie and Davis, 1939)). The individual weight and length of the leeches were determined and their condition factor was calculated. The age classes were estimated from length frequencies by Modal Progression Analysis (Bhattacharya's) method.

Results and Discussion: The population size in all wetlands was estimated to be $1\ 562\ 696 \pm 805\ 613$ leeches (467.26 ± 172.91 kg). It was highest in Gelendost wetlands with $1\ 205\ 999 \pm 514\ 871$ leeches (260.93 ± 139.18 kg), whereas was lowest in Boyalı wetlands with $2\ 106 \pm 3\ 163$ leeches (3.04 ± 4.15 kg). Totally, three age classes (0+, I+ and II+) were determined, 0+ age group was the dominant group with 78.6%. The mean weight, body length and condition factor were 0.52 ± 1.19 g, 4.5 ± 2.4 cm and 0.620 ± 0.123 , respectively. 89.9% of the populations were less than 1 g, whereas the proportion of the broodstock was only 7%.

The removal methods were found convenient for estimate of medicinal leech, *H. verbana* population size. *H. verbana* populations in the wetlands around Lake Eğirdir are considered being protected and maintained when comparing to previous studies. This is thought to be due to ecological balance such as stability of the lake's water level, enough the variety and abundance of the host in the undamaged habitats, rational sales policies, protectionist approach of local people to leeches and the actions that exerted in the area to conservation and control by official conservation bodies.

Keywords: CITES, removal methods, sustainable management, conservation, ecological balance.

Acknowledgement: This study was supported by Süleyman Demirel University, Scientific Research Projects Coordination Unit (SDU-BAP 3341-D2-12). The authors are grateful to Eğirdir Fisheries Research Institute for laboratory support. We thank also Dr. Ramazan KÜÇÜKKARA and Ufuk AKÇİMEN for their help in the laboratory.

Evaluation of the Artificial Neural Networks Approach of crayfish in different habitats in Turkey

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Objective: The main purpose of the present investigation was to study length-weight relation and artificial neural networks for growth in crayfish. Thus, the present study provides on the properties of the crayfish in Dikilitaş Lake, Yeniçağa Lake and Uluabat Lake in the last years. Crayfish properties in three locations were compared with ANNs approach.

Methods: Within the scope of the study, crayfish were examined at Dikilitaş Lake (260 individual), Yeniçağa Lake (455 individual) and Uluabat Lake (540 individual). The total length (TL), total weight (TW), carapace length (CL), carapace width (Cw), abdomen length (AL), abdomen width (Aw), chela length (ChL) and chela width (Chw) of each specimen were measured with a digital caliper to the nearest 0.1 mm, weighted to the nearest 0.01 g, and each specimen was sexed (Rhodes and Holdich 1979). The length-weight relationships were estimated from the formula, $W = aL^b$, where W is total body weight (g), L the total length (mm), a and b are the coefficients of the functional regression between W and L (Ricker, 1973). Artificial Neural Networks (ANNs) are simulations of biological nervous systems using mathematical models. The same data were evaluated with the ANNs approach. Sum Squared Error (SSE) and Mean Absolute Percentage Error (MAPE) are used as performance measures. Artificial neural network modeling was done using matlab application.

Results and Discussion: Total of 1255 crayfish caught fork lengths and weight (min-max) were between 85 – 163 mm and 14.99 – 105.60 g, respectively. LWR and ANNs models was found for females, males and all individual as a local habitat. Length-weight relationship was found between crayfish length and weight ($W=0.022 L^{3.02}$; $R^2=0.96$ for Dikilitaş Lake, $W=0.0111345 L^{2.80993}$; $R^2=0.970$ for Yeniçağa Lake and $W=0.03634341 L^{2.8450}$; $R^2=0.961$ for Uluabat Lake). The results obtained by ANNs and LWR equation are compared to those obtained by the growth rate of the crayfish caught from Dikilitaş Lake, Yeniçağa Lake and Uluabat Lake. MAPE value (Mean Absolute Percentage Error) of the forecast of ANNs and and the value of LWR were found 0.182 and 0.034 and 1.763 and 4.885 for Dikilitaş Lake ; 0.454 and 0.786 and 2.535 and 2.914 for Yeniçağa Lake; 1.431 and 0.667 and 2.323 and 2.042 for Uluabat Lake, respectively. Thus, ANNs gives better results than LWR at Dikilitaş Lake, Yeniçağa Lake and Uluabat Lake. ANNs can be alternative as a evaluated for growth forecast.

Keywords: Artificial Neural Networks, Length-Weight Relationships, crayfish

Artificial Neural Network Approach of Sand Smelt (*Atherina boyeri* (Risso 1810)) in Çekerek Dam Lake, Turkey

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Objective: In this study, it is aimed to forecast of length-weight relationship parameters by using Artificial Neural Networks (ANNs). The present study was calculated Length-Weight Relationships (LWR) and ANNs for growth in fish. Thus, the present study provides the biological properties of the sand smelt, *Atherina boyeri* (Risso 1880) in Çekerek Dam Lake.

Methods: The samples (*Atherina boyeri*) were collected from Çekerek Dam Lake. During the study, 394 fish specimens were caught between May 2015 and May 2016. The LWR were estimated from the formula $W = aL^b$, where W is total body weight (g), L is the total length (mm), and a and b are the coefficients of the functional regression between W and L. ANNs are computational systems that simulate biological neural networks and can be defined as a specific type of parallel processing system based on distributional or connectionist methods. The ANNs provides a better model because it produces better predictions for lower values, and the normality of the residuals and their independence from the predicted variables are also improved. The sum squared error (SSE) and mean absolute percentage error (MAPE) were used in the study as the two performance criteria by MATLAB. SSE was used as a criterion to determine training during the training of the network.

Results and Discussion: The length and weight (min-max) of the fish were 29 – 81 mm and 0.225 – 4.062 g, respectively. There were 32.49 % females, 67.51 % males. LWR and ANNs models was found for females, males and all individual. Length-weight relationship was found between fish length and weight ($W=0.01359338 L^{2.7553}$; $R^2=0.982$ for females, $W=0.0111345 L^{2.80993}$; $R^2=0.970$ for males and $W=0.01026462 L^{2.8659}$; $R^2=0.971$ for all individual).

The results obtained by ANNs and LWR equation are compared to those obtained by the growth rate of the fish caught from Çekerek Dam Lake. It was found that MAPE value (Mean Absolute Percentage Error) of the forecast of ANNs was 0.182 and 0.034, and the value of LWR was 1.763 and 4.885 for length–weight of all individuals. Thus, ANNs gives better results than LWR. ANNs can be alternative as a evaluated for growth forecast.

Keywords: Artificial Neural Networks, Length-Weight Relationships, *Atherina boyeri*, sand smelt, Çekerek Dam Lake

Preliminary Data on Present Status of Endangered *Emys orbicularis eiselti* Fritz et al. 1998 in Southern Anatolia, Turkey

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Objective: *Emys orbicularis eiselti* was described from Gaziantep by Fritz et al. (1998) based on only four specimens (2 males, 2 females) collected in 1966 and 1972. Up to 2007, no additional specimen was found at the type locality and its vicinity. Today, the type locality is destroyed, mainly from drainage for agricultural activities. We aimed to determine conservation priorities for this rare subspecies.

Methods: We conducted extensive field studies between 1998 and 2009. In order to catch turtles, cage like fykes made from nets were used. During field studies we also caught and noted the abundance of another freshwater turtle species for comparing relative abundance in their natural habitats.

Results and Discussion: We did not encounter any pond turtle in the vicinity of the type locality. However, in June 2007 we discovered seven pond turtles (5 males, 2 females) in the Asi Delta (Samandağ, Antakya). In 2008, we captured further six individuals (2 males, 4 females) in a nearby site. This population is close to the southernmost border and a new important record of *E. orbicularis*. We captured 358 (96%) *Mauremys rivulata* during our study, but only 13 (4%) specimens of *E. o. eiselti*. At Samandağ alone, we captured 126 (91%) *Mauremys rivulata* specimens and 13 (9%) *E. o. eiselti*. Our results confirm that conservation and management studies are urgently needed for the conservation of *E. o. eiselti*. For this purpose, we will start in early May 2011 a project about the population status and conservation of *E. orbicularis* in the Mediterranean region of Turkey, focusing on *E. o. eiselti* and another, yet unnamed subspecies. Both are critically endangered and deserve the highest conservation priority.

Keywords: *Emys orbicularis eiselti*, conservation, Turkey.

Length–Weight Relationships for *Squalius aristotelis* in Tuzla Stream, Çanakkale, Turkey

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Objective: Length-weight relationships provide useful information about population dynamics. In this case length-weight relationships for endemic *Squalius aristotelis* Özuluğ & Freyhof, 2011 from Tuzla Stream, Northern Aegean River Basin, Western Anatolian Region of Turkey reported in this study.

Methods: Samples were collected from Tuzla Stream Behramkale, Çanakkale province in Northern Aegean River Basin. 46 samples were collected by electrofishing with ‘SAMUS 725-MP’ and fixed in formalin (4%). Identification of the fish species were done according to literature. Length and weight of samples were measured after fixation. The relationship between length and weight was calculated using the Ricker length-weight relation model; $W=a.TL^b$ equation.

Results and Discussion: This study provides length-weight relationships and new maximum length (16.9 cm) for *S. aristotelis* according to literature and also FishBase, which the exponent b in the length-weight relationship is 3.1989. Information of length-weight relationships will be useful for researchers especially in conservation. Population status of the presented endemic species needs to be monitored carefully

Keywords: *Squalius aristotelis*, length-weight relationship, Tuzla Stream, Turkey

Biological Properties of Anatolian Endemic Killifish *Aphanius anatoliae* (Leidenfrost, 1912) in Lake Eğirdir Türkiye

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Objective: In this study, growth, reproduction and feeding properties of Killifish was investigated

Methods: Sampling activities was carried out between June 2010 – May 2011 on five stations. Gillnet, seine net and electroshocker were used in sampling activities. Von Bertalanffy equations were used for find the growth in length for both sexes. Gonadosomatic Index was used for determination of reproduction season.

Results and Discussion: Total 7102 samples were obtained as a result of sampling activities. Sex percentage of sample population 46.3 % (3288 specimen) of male and 53.7 (3814 specimen) of female. Total 1217 sub-samples length and weight were measured. Age variation between was ranged 1 – 6.

The growth parameters for females and males were estimated to be $L_{\infty} = 7.21$ cm, $L_{\infty} = 4.56$ cm respectively. We also found that the length-weight relationships were $a = 0.0109$, $b = 3.295$ for females and $a = 0.0100$ and $b = 3.374$ for males and $a = 0.0107$, $b = 3.313$ for sampling population. According to t-test analysis female, male and combined sexes were showed positive allometric growth. Reproduction period was determined from June to September according to GSI values. When investigated to other studies on the other *Aphanius* species that distribute in our country and world, L_{∞} values lower than *A. danfordii*, *A. sureyanus*, *A. mento* and *A. fasciatus*; bigger than *A. sophiae*, *A. ginaonis* were determined. This differencies result from species, habitat and ecological conditions in their living areas. Growth type is similar to other species. *A. anatoliae*, are shared the same habitat with two invasive species (*Atherina boyeri* and *Pseudorasbora parva*) this situaiton might be a problem. As a result of our studies, strong reproduction strategy of *A. anatoliae* are been advantage for competition with this invasive species.

Keywords: Freshwater, reproduction, growth, feeding

Is Reproduction of Rainbow Trout in Naturel Environment Possible?

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Objective: In this study, it is aimed to contribute to the discussion of rainbow trout *Oncorhynchus mykiss* reproduction in naturel environment.

Methods: Aygır lake is a crater lake at the top of the Keşiş mountains in Erzincan. It is known as Ağır lake by the local citizens and accepted as a holy region. The altitude of lake was measured at the range of 2646-2750 m and the range as 7.5 acres. Fish sampling were captured with the suitable fishing tools.

Results and Discussion: The dominant species of Aygır lake was determined as rainbow trout, *Oncorhynchus mykiss*. This was a surprising finding because of the conditions of lake. Aygır lake is an isolated environment and too far from human living. After the interviews with the local people, the person who leaved the young fish to lake, in 2003, was reached.

In these 14 years fish were acclimated and adapted to lake water. The reproduction of *O. mykiss* in this natural water was determined.

Keywords: Rainbow trout, *Oncorhynchus mykiss*, reproduction, naturel environment

Impacts affecting fish assemblages and fisheries landings in Lake Bafa (Aegean Region, Turkey)

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Objective: The aim of the present study is to reveal that which anthropogenic and ecological impacts affect fish assemblages and fishery landings of the Lake Bafa.

Methods: Survey of the study was performed in 2014 and 2015. Findings were derived from face to face interviews with fishermen and managers of the NGOs. Results of previous studies and completed projects were also considered. Study method includes evaluation of the environmental projects, current situation analysis, identification of ongoing problems emerged in recent years and improvement of recommendations.

Results and Discussion: A few environmental projects such as levee, rubber dam and regulator (Serçin inlet and feeder channel), constructed on and around Büyük Menderes River, to restore the natural life of the Lake Bafa that has been spoilt and irrigation schedule of Söke Plain which causes insufficient flows to the Bafa have risen to major changes in the hydrology, ecology and productivity of the Lake Bafa. Recent studies have also indicated that polluted waters of Büyük Menderes, drainage waters from agriculture and wastewater of surrounding enterprises have polluted the lake. These major changes have increased salinity, polluted the water of the lake, caused extinction of freshwater fish species and reduced fish landings. In order to avoid penetration of the Lake Bafa's salty and dirty water into the Büyük Menderes River, lagoon channel has closed by the irrigation association of Söke Plain in 2011. This intervention led to death of the Sakızburnu barrier trap which had high amount of fish landings in the past. Unless water regime of Great Meander River is regulated in favour of the lake when water quality adjustment is needed especially in summer months and if the entering water to the lake is not cleaned up, it may not be possible to sustain fishing as it was in the past (higher landings). Ecosystem based management plan, which takes all aquatic biota, their interactions and their habitat needs into consideration together with physical and chemical characteristics in the basin, is needed in order to establish sustainable fishery in the Lake Bafa.

Keywords: Lake Bafa, Büyük Menderes River, levee, rubber dam, salinity, fishery, landing.

Comparison of Gillnet and Trammel Net Selectivity for Prussian carp (*Carassius gibelio* Bloch, 1782) in Marmara Lake, Turkey

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Objective: This study was aimed to compare the differences between multifilament gillnets and trammel nets selectivity for Prussian carp (*Carassius gibelio* Bloch, 1782) in Marmara Lake (Manisa, Turkey).

Methods: The study was conducted on Lake Marmara which has 79 m altitude and surface between 3200-6800 ha based on depth differences. Lake depth is changing year by year of about 3-4 m. Samplings were carried out in three different stations identified in eastern, middle and western areas along the longitudinal length of the lake. Both multifilament gillnets and trammel nets were used in the fishing trial. The tools had the same characteristics: each panel was 35 m in length, 4, 6, 8 and 10 cm stretched mesh size and 210 denier/2 twine thickness. Caught fish were classified according to the nets and total lengths were measured with 1 mm precision measurement board. SELECT method was used to determine selectivity (Millar 1992, Millar and Fryer 1999, Millar and Holst 1997). Data were analyzed by R version 3.1.2 (R Development Core Team 2014) using the R-codes developed by Millar (2009) and Millar (2010).

Results and Discussion: A total of 854 Prussian carps ranging in total length between 10.2 – 27.5 cm were caught. It was found that, the trammel nets were more efficient than gillnets for *C. gibelio* fishing (68.3% of fish were caught by trammel nets). The most suitable model was the bi-normal model for gillnets and normal location model for trammel nets. Model lengths were estimated as 11.66 cm for gillnets and 12.27 cm for trammel nets for 4 cm mesh size. Estimated model lengths for trammel nets were higher than gillnets. Moreover, significant differences were founded among estimated model lengths for trammel nets and gillnets. Greater than 250 gr (approximately 24.8 cm total length) *C. gibelio* has high market value then smaller ones. Therefore, in terms of commercial approach, over 10 cm mesh size gill and trammel nets should be used in Lake Marmara

Keywords: Gillnet, Trammel net, Prussian carp, *Carassius gibelio*

Analysis of temporal and monthly fishery landings of Köyceğiz lagoon (Aegean Sea, Turkey)

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Objective: Köyceğiz lagoon is one of the most important ecosystems constitutes a critical nursery, reproduction and feeding grounds for many fish species, among which commercially high-valued species are targeted by traditional lagoon fishery. In the present study, we analysed temporal and monthly fishery landings recorded by Dalko (Dalyan Fishery Cooperative) for sustainable fishery.

Methods: Monthly and temporal landings data sets by species were available for the last five years (2012-2016) and time series (1974-2016), respectively. While trend analysis was used for the time series, one sample paired t-test was applied to compare landings between last five years and whole landings for total, grey mullets (*Mugil cephalus*, *Liza aurata*, *Chelon labrosus*, *Liza saliens* and *Liza ramada*), gilthead sea bream (*Sparus aurata*) and sea bass (*Dicentrarchus labrax*). Related-Samples Friedman's Two-Way Analysis of Variance was also used for identifying the effect of different months and years on the landings of the species.

Results and Discussion: Köyceğiz is the only lagoon that extensive and intensive aquaculture activities are practised in Turkey. Total fish landing exploited by barrier traps is about 365 tonnes (2015) representing 40% of Turkey's. In addition to extensive culture, 30 tonnes sea bass and gilthead sea bream production provided from intensive mariculture in 2014. Although mean annual landing is about 300 tonnes period of 1974 to 2016, there was a substantially higher fluctuation among the years. For this reason polinom line gave the best fit with its equation (R^2 0.36) in time series trend analysis for total landings.

The fish populations of the lagoon are mostly migratory of marine origin. Grey mullets are the most abundant species accounting for 86% of the total biomass of the landing for the 43 years period, followed by common carp (*Cyprinus carpio*), European eel (*Anguilla anguilla*), sea bass, gilthead sea bream and others. The percentage of grey mullets landed in 2016 increased to 97. The mean annual landing of the last five years were higher from the previous years (1974-2011) for grey mullets and total ($p < 0.05$). While sea bass landings have decreased along the years ($p < 0.05$), gilthead sea bream's is same level with higher variability ($p > 0.05$). Two different trapping events were observed in Köyceğiz lagoon barriers. The first one was ontogenetic migrations of grey mullets in summer and winter months and the second one concerned offshore migration of the species linked to their reaction to the environmental changes. However, landings of winter grey mullets and other species from the Dışbüyük barrier prolonged to the March sometimes even April. Friedman test shown that there were no statistical differences in the landings among the months of the last five years for grey mullets, sea bass and others ($p > 0.05$). However, there were significant differences for gilthead sea bream and stripped sea bream (*Lithognathus mormyrus*) ($p < 0.05$). Through the years, there were no differences in grey mullets roe production among the months ($p > 0.05$).

Köyceğiz is the only lagoon that landings amounts have not declined for a long time in Turkey due to strictly protected its environment by special rules and fishing management and strategies by Dalko. Recently total landings have shifted towards almost only grey mullet species by the reasons of facing extinction of freshwater species, landing quota of the European eel and overfishing on marine fishes in vicinity.

Keywords: The Aegean Sea, Köyceğiz lagoon, barrier trap, landings.

Selectivity and Catching Efficiency of Gillnet and Trammel Net for Common Carp (*Cyprinus carpio*) Fishery

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Objective: Common carp (*Cyprinus carpio* Linnaeus, 1758) is important commercial species for fishery in Demirköprü Dam Lake (Manisa Province) which is one of the most important fishing area and the largest surface area in the Aegean Region. Commercial fishermen use 65, 70, 75 and 80 mm bar length multifilament gillnets for common carp. This study aimed to compare gillnet and trammel net in terms of selectivity and catching efficiency in common carp fishery in Demirköprü Dam Lake.

Methods: 45 catching experiments were conducted with 65, 70, 75 and 80 mm bar length multifilament gillnets and trammel nets between June 2015 and December 2016 with commercial fishermen. The minimum, maximum and average values of carp length and weight were calculated for each net group. The catch per unit (CPU) was calculated to assess of catching efficiency. Selectivity analyses were performed with the GILLNET computer program based on the SELECT method. The selectivity parameters were calculated using the Normal Scale model, which gave the lowest standard deviation.

Results and Discussion: The common carp was the dominant species in the catch composition. A total of 690 carps ranging in size from 8 to 87 cm were caught. The higher catching efficiency was found in only 65 mm mesh size gillnet compared to trammel net. In terms of selectivity, the modal length and spread values (in parenthesis) of 65, 70, 75 and 80 mm mesh sizes of gillnet were calculated as 52.85 (7.14) cm, 56.91 (7.61) cm, 60.98 (8.15) cm and 65.04 (8.70) cm, respectively. The modal length and spread values also were calculated for trammel nets as 50.84 (7.39) cm, 54.75 (7.96) cm, 58.66 (8.53) cm and 62.57 (9.10) cm, respectively.

When gillnets were converted to the trammel nets, catching efficiency (CPU values) increased in three net samples except for 65 mm mesh size. On the other hand, the selectivity of nets were influenced negatively due to the modal length of common carp decreased and spread values increased. Both gillnets and trammel nets provided modal length that was higher than minimum landing size (40 cm) for the target species, common carp. It has been determined that these fishing gears did not threaten the carp stock.

Keywords: Selectivity, Catching efficiency, Common Carp (*Cyprinus carpio*), Gillnet, Trammel net, Demirköprü Dam Lake

Acknowledgement: The study was sponsored by TUBITAK (214O632 Numbered Project).

Mortality Rates and Stock Assessment of Chub (*Squalius cephalus* L., 1758) in Lake Yeniçağa, Bolu, Turkey

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Objective: This study is the first investigation on mortality rates and stock assessment of chub *Squalius cephalus* in Lake Yeniçağa. The aim of this study was estimate of growth parameters (K , L_{∞} , t_0), mortality rates (Z , M , F), stock biomass (B), maximum sustainable yield (MSY), and suitable fishing effort (f). The presented information on these parameters are expected to be helpful in fishery management of the chub in Lake Yeniçağa.

Methods: A total of 729 chub were sampled between March 2009 and July 2010 in Lake Yeniçağa, Bolu, Turkey. The fork length of chub was measured as cm, and the weight was measured using digital scale with 0.1 g sensitivity. The age of chub was determined by using the scales. The total mortality coefficient (Z) was determined according to $Z = n \times k / (n+1) \times \ln [(L_{\infty} - L) / (L - L^1)]$ equation, based on average length of fish, where n is the number of fish used in the calculation of average length of fish, k and L_{∞} are von Bertalanffy growth constants, L is average length of fish, and L^1 is initial length of fishing. The natural mortality coefficient (M) was calculated from the empirical formula $\ln M = -0.0152 - 0.279 \times \ln L_{\infty} + 0.6543 \times \ln k + 0.463 \times \ln T$, where T is average annual temperature of lake surface water. Fishing mortality coefficient (F) was derived from equation $F = Z - M$. The survival rate (S) and stock exploitation rate (E) were calculated using equations $S = e^{-Z}$ and $E = F / Z$. The stock biomass (B) was estimated using the Jones' length-based cohort analysis. In order to estimate maximum sustainable yield (MSY) and optimum fishing effort from the biomass-yield relationship, Thomson-Bell method was applied.

Results and Discussion: The age of sampled chub ranged from I to VIII. The age group II was dominant in the population. Fork-length ranged from 12.8 cm to 34.6 cm. The growth parameters were determined as $L_{\infty} = 36.88$ cm, $k = 0.248$ y⁻¹, and $t_0 = -1.278$. Natural mortality rate ($M = 0.50$) was rather high in total mortality rate ($Z = 0.68$), whereas fishing mortality rate ($F = 0.18$ y⁻¹) was quite low in the population. Stock exploitation rate was $E = 0.27$ y⁻¹, and survival rate was $S = 50.14$ %. Annual catch and stock biomass (B) were estimated 4800 kg (24209 individuals) and 16770 kg (108369 individuals), respectively. Maximum sustainable yield (MSY) was calculated 5709 kg and could be obtained by increasing 87 % of the current fishing effort. The fishing pressure on chub population was insufficient due to lower fishery activities and chub population wasn't exploited economically in Lake Yeniçağa.

Keywords: Chub, *Squalius cephalus*, mortality rates, MSY , stock assessment, Lake Yeniçağa, Turkey.

The Comparison of the Amount of (CPUE) Freshwater Crayfish (*Astacus leptodactylus* Eschscholtz, 1823) Catching in Different Regions of the Keban Dam Lake, Turkey

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Objective: In this study, it is aimed to determine the comparison of CPUE values of crayfish captured by fyke-nets of local fishermen in different regions of in the Keban Dam Lake.

Methods: This study was carried out between 1 July – 15 September 2016 in Keban (3th region), Agın (2th region), Cemisgezek (4th region) of Keban Dam Lake (Elazig, Turkey). This study was conducted with local fishermen in the region. The fishermen catching crayfish was discussed five fishermen (5 boats) in the Keban region, five fishermen (5 boats) in the Agın region, six fishermen (6 boats) in the Cemisgezek region. The fyke-nets of local fishermen were used 4700 unit in the Agın, 9500 unit Cemisgezek and 5000 unit fyke nets in Keban region. The fykenets were used 5 with rounded, 2 funnel throats, 17 mm of mesh size (knot-to-knot), 2.5–3 m of leader length, 50 cm of height (measured at first hoop), 5 m of total length.). The catching crayfish was conducted at 10-13 m depths. Population density of crayfish was estimated using CPUE and total annual fyke-net effort. The total catch of was calculated using the equation $C_t=f(ct/ft)$ (Qvenild and Skurdal, 1984). Where is C_t : total catch, f : total annual catch effort, ct/ft : catch per unit effort. Differences in CPUEs between the three different region of the lake and months were determined through ANOVA.

Results and Discussion: The total annual catch of crayfish was determined as 13.15 tonnes in catching season. The annual catch of crayfish was calculated as 5.6 tonnes (4700 unit fyke net) in the Agın (2th region), 4.3 tonnes (9500 unit fyke nets) Cemisgezek (4th region), 3.25 tonnes (5000 unit fyke nets) in Keban (3th region). The CPUE was found as 1.98 crayfish/fyke-net/6 night for crayfish catching season in Agın region, 1.08 crayfish/fyke-net/ 6 night for in Keban region, 0.83 crayfish/fyke-net/ 6 night for in Cemisgezek region in 2016. The CPUE of crayfish for the three different localities of the lake were somewhat different, but differences between the localities were not statistically significant ($p>0.05$). The productivity of the hectare were determined as 1.19 , 0.45 and 0.65 kg / hectare in Agın, Cemisgezek and Keban region in the Keban Dam Lake.

Keywords: Crayfish, *Astacus leptodactylus*, Fyke-Net, Catch per Unit Effort, Keban Dam Lake, Turkey

New Method to Struggle With Illegal Fishing At The Beyşehir Lake; Preliminary Results

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Objective: This study aim to present use of unmanned aerial vehicles (UAVs) as a new tool to catch in to act illegal fishermans and help to struggle of prevent illegal fishing.

Methods: Unmanned aerial vehicles (UAVs) have been used in Beyşehir Lake since May 2017. Beyşehir Lake has average 650km² area and depth can change between 6-11m. Reeds covers ¾ of shore of lake. *Cyprinus carpio* (Linnaeus, 1758) and *Sander lucioperca* (Linnaeus, 1758) are most important and highly economic species. Fishing is prohibited between 15 March and 15 June during the spawning periods of the species. Commercial fisherman allowed to use trammel and gillnet, however illegal fishing methods (liftnet, electroshock, harpoon etc.) also being done especially fish breeds in reeds. Illegal methods commonly use in reeds and reeds can reach 4m length, so fisherman can find to chance for hide in reeds and it is getting impossible track and catch them in the act. In some case, intentional incorrect notice can mislead officials. In this view restricted area to overcome these kind of difficulties, UAVs began to use as auxiliary device. Two DJI Phantom 4 drone were supplied and used for struggle with illegal fisherman.

Results and Discussion: In 2017, 331 control operations were conducted and 52 illegal fishing were detected in the act at Beyşehir Lake. Fifty of those controls were carried by using UAVs and 4 of them (2 electroshock and 2 harpoon) penalized. Additionally, 3 ghost net and 15 illegal boat recovered by using UAVs. Advantages of use UAVs use; make controls and catch in the act process easier, give chance to quick response to notifications, reduce oil consumption of control boat, make possible to scan a wide area in a short time and have quick maneuver ability, gather more and higher quality visual evidence than mobile phone and hand camera. Despite all these, there are some restrictions; rain and snow make impossible to use UAVs, battery life and range getting shorter cause of strong wind, lack of zoom and thermal properties of camera restrict use of UAVs at night and at low light conditions. To struggle illegal fishing, technology can serve as subsidiary item. UAVs can be dissuasive, however, the money to be earned with a completed illegal fishing operation is much higher than charge of penalty. So, magic words for struggle with illegal fishing is “deterrent sanction”.

Keywords: Beyşehir Lake, Illegal fishing, Unmanned Aerial Vehicle

Amateur Sportive Hand-line Fishing in Denizli Gökpınar Dam Pond: 1st Prussian Carp Catching Competition

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Objective: In this study, it was aimed to examine socio-economic conditions and reason of participating into the competition of individuals participating into 1st Prussian Carp Catching Competition organized by Denizli Amateur Sportive Hand-line Fishers and Fishery Protection Association (DENOLDER) in Denizli Gökpınar Dam Pond and supported by Amateur Sportive Hand-line Fishing Federation and Denizli Metropolitan Municipality with purpose of introducing, ingratiating and binding hand-line fishing fanciers, in addition and most importantly raising awareness of society relating to damages of ecologically harmful species to aquatic life in our inner waters. The competition was conducted pertaining to provisions of notification regulating amateur purposed fishery hunting numbered 3/2.

Methods: A questionnaire was applied with direct interviewing method to the individuals participating in the 1st Prussian Carp Catching Competition in Denizli Gökpınar Dam Pond on 4-5 June 2016 and the original study data was obtained. In the study conducted as questionnaire application, participations were enabled among participants of competition randomly and on voluntariness basis. In these prepared questionnaire forms, totally 23 questions such as their ages, socio-economical questions such as profession and fish consumptions, questions relating to amateur fishing, their information relating to Prussian Carp, types of their baits and fishing rods, their ideas relating to the competition etc. were asked to the participants. As there is no record relating to amateur fishery rate within the whole population in our country, the value of 4.8% indicated for Europe by Pitcher (1999) was used in determination of sample size. Confidence interval was accepted as 95% and margin of error as 10%. In accordance with this sample size equation, the questionnaire study was applied to 49 individuals from the group comprising 25 teams from 55 teams. According to the questionnaire study, existence of hand-line fishing certificate was determined by chi-square test in accordance with all variables and possibility of error was selected as $\alpha=0.05$. The questionnaire results were evaluated using The Statistical Package for the Social Sciences (SPSS) and EXCEL package programs.

Results and Discussion: The questionnaire was applied to 49 individuals in this competition with a participation of 55 teams from 6 provinces. At the end, 83% of the participants were couples, 6% were females, 62.5% were over 36, 77% were married, 37.5% were higher education graduates, 46% were private company employees. 84.5% had social insurance, 52.1% were insured from social insurance institution and 75% worked with a salary under 3000 TL. Moreover, 79% of the participants participated from Denizli. 25% of the study participants had been interested in amateur fishery for more than 20 years and 75% had amateur fishery certificate. 73% knew Prussian Carp, and 96% knew that the species was harmful. The baits used in fishing during the competition were mostly worm, corn and dough, the used fishing rod types were ringed roller rod and different lengths of non-ringed lake rod. The ratio of those participating into such a competition for the first time was only 27%. Moreover, all teams indicated that they would participate again in case of repetition of such an organization. It is very important to protect fishes having an important place within fishery products, particularly natural species. It should be our responsibility to raise public awareness relating to invasive species.

Keywords: Prussian carp, *Carassius gibelio*, Gökpınar Dam Pond, Denolder, Denizli

Some Socio-Demographic Properties of Turkey Inland Amateur Fishermen by Interactive Survey

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Objective: In this study, it was done in order to determine some socio demographic characteristics of social media users interacting with freshwater amateur fishermen.

Methods: Fishers were surveyed using an online questionnaire. The survey comprised 32 questions. The first set of questions collected demographic data and was compatible with other major recreational fisher surveys. A total of 2045 surveys were conducted between March 2017 and July 2017 for the amateur fishermen in the social media.

Results and Discussion: Online survey was conducted from 71 different cities of Turkey. Most of the amateur fishers who participate in the survey are male amateur fishermen (%99.9). When the occupational distributions of fishermen are examined, the most common occupation is the unemployed (41.7%). This is followed by self-employment (26.3%), civil servants (16.2%), retirees (8.1%) and students (6.2%). Although the retirement ratios participated in the surveys in the other studies are high, the participation rate of retirees is low because this study is conducted interactively. In support of this belief, 76.7% of respondents are between the ages of 25-46. The average monthly income of the sportive fishermen who are single (76.7%) is 2845 TL. Half of the participants (%51.2) in the survey are in the range of 1500-3000 TL. The majority of the amateur fishermen (40.6%) were high school graduates and 41.5% were trained in universities (undergraduate and graduate). In this study, It can be said that the education level of amateur fishermen participating is higher than Turkey's commercial fisheries in many lakes and dams

Keywords: Amateur fishing, angling, socio-demography

Effect of boric acid on sperm quality of endangered Anatolian trout *Salmo rizeensis***Filiz Kutluyer¹, Mehmet Kocabaş²**¹Munzur University, Fisheries Faculty, 62000, Tunceli, Turkey.²Karadeniz Technical University Faculty of Forestry, Department of Wildlife Ecology & Management 61080, Trabzon, Turkey.

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Objective: The aim of the study was to test the usefulness of boric acid for improvement of sperm quality in endangered Anatolian trout *Salmo rizeensis*.

Methods: Different activation media (NaCl, 0.3%; NaHCO₃, 1%) were supplemented with boric acid (0.5, 1, 2, 3, 4 and 5 mM). Sperm motility and duration were determined in sperm samples.

Results and Discussion: The findings from the present study indicated that addition of boric acid (0.5 mM) to activation medium (NaHCO₃) was increased the percentage and duration of motile sperm in endangered Anatolian trout (*S. rizeensis*) while highest percentage and duration of motile sperm were at concentration 3 mM in activation medium (NaCl). On the other hand, the motility rate decreased with increasing the concentration of boric acid in activation media (NaCl) ($p < 0.05$). In particular, a remarkable increase was observed after concentration 3 mM. Consequently, sperm quality was affected by quantitative changes different concentrations of boric acid and the best results were obtained at concentration 0.5 mM (NaHCO₃) and 3 mM (NaCl).

Keywords: endangered species, *Salmo rizeensis*, Anatolian trout, boric acid.

Effect of boric acid on sperm quality of *Salmo coruhensis***Mehmet Kocabas¹, Filiz Kutluyer²**¹*Karadeniz Technical University Faculty of Forestry, Department of Wildlife Ecology & Management 61080, Trabzon, Turkey.*²*Munzur University, Fisheries Faculty, 62000, Tunceli, Turkey.*

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Objective: The aim of the study was to test the usefulness of boric acid for improvement of sperm quality in *Salmo coruhensis*.

Methods: Different activation media (NaCl, 0.3%; NaHCO₃, 1%) were supplemented with boric acid (0.5, 1, 2, 3, 4 and 5 mM). Sperm motility and duration were determined in sperm samples.

Results and Discussion: The findings from the present study indicated that addition of boric acid to different activation media was increased motility rate and duration in *S. coruhensis*. Highest motility (99%) was at concentration 2 mM in activation solution containing NaCl whilst highest duration of motility (65 s) was obtained from control group. Highest motility (98%) was at concentration 0.5, 1, 2 mM in activation medium containing NaHCO₃ while highest duration of motility (164 s) was obtained at concentration 0.5 mM. On the other hand, an increase in the concentration of boric acid in activation media caused a significant decrease the motility rate of sperm *S. coruhensis* (p<0.05) after concentration 2 mM. Consequently, sperm quality was affected by quantitative changes different concentrations of boric acid and the best results were obtained at concentration 0.5 mM.

Keywords: *Salmo coruhensis*, sperm quality, boric acid.

Intestine Villi Morphology of Black Sea Trout (*Salmo trutta labrax* Pallas, 1811): In Seawater and After Freshwater Transfer

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Objective: This study was conducted to determine the effect of the environment-dependent change on the distal intestine villi morphology of Black Sea trout (*Salmo trutta labrax* Pallas, 1811).

Methods: Fifth-generation (F5) Black Sea trout were used in this study which was started in November 2014 and was completed in July 2015. The fish (17.3±4.5g; 10 months age) were kept in seawater (8.3-16.0°C, salinity ‰18) for 6 months. When the seawater reached to 16°C (May), they were transferred to the freshwater ponds (8.7-14.8°C) fed by the stream where they were kept for 2 months. Distal intestine samplings were performed twice: before transferring to freshwater and in the 2th month (July) after transferring to freshwater. Of twenty fish from both groups, distal intestine tissues were analyzed by placing the samples into 10% formalin then into the tissue cassettes for dehydration process and embedded in paraffin blocks, and subsequently cut 5-µ thickness and placed on a slide. Each sample were stained with hematoxylin and eosin solution by using standard paraffin-embedding procedure. After embedding process, villi length (VL), villi width (VW) and villi length to villi width (VL/VW) were evaluated by using an image processing and analysis system. Data were analyzed by independent samples t test. Statistical analyses were computed using SPSS 15.0.

Results and Discussion: While fish reached an average weight of 335.5±44.4g in seawater for 6 months, weighted as 341.2±55.8g in 2th month after transferring to freshwater. Although there was no difference in the growth of fish, VL and VW significantly decreased in the freshwater. VL (µm), VW (µm) and VL/VW were 794.63±15.91, 175.83±5.15 and 4.69±0.18 in seawater, and 575.80±11.27, 123.15±3.40 and 4.89±0.15 after transferring to freshwater, respectively. The water quality has significant effects on the growth of fish. Water quality of sea cages are more stable than other aquaculture environments, and in addition to the feed given, fish can be fed with aquatic organisms that can enter the cage. Freshwater ponds are similar to sea cages in terms of the presence of aquatic organisms. But the water quality of the freshwater ponds can change instantly with rainfall, activities in stream valley and its bed. Between May and July when the fish were kept in the freshwater ponds, the water was mostly turbid due to stream reclamation works. Turbidity has vital importance for trout fed especially by seeing. In this study; growth rate, VL and VW values decreased due to feed intake of fish was negatively affected by turbidity. It has been concluded that intestine villi morphology can change depending on feed intake. And also effects on the intestine villi morphology of characteristics such as age, sex, environmental conditions and nutrition should be examined.

Acknowledgements: This research was done as a preliminary study for the project named “Possibilities of using some phytobiotic added diets in nutrition of Black Sea trout (*Salmo trutta labrax* Pallas, 1811)” supported by General Directorate of Agricultural Research And Policies.

Keywords: Black Sea trout, *Salmo trutta labrax*, intestine, villi morphology

Determination of Phenotypic Antibiotic Resistance of the Bacteria Isolated from Cage Areas in Eastern Black Sea

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Objective: In this study, we aimed to investigate (1) isolation and identification of *Escherichia coli*, *Enterococcus* spp. and *Lactococcus garvieae* from fish and sediment samples and (2) determination of their antimicrobial susceptibilities.

Methods: During Autumn 2015 and Spring 2016, fish, water and sediments were sampled seasonally from Gumushane, Samsun, Trabzon and Ordu (freshwater and seawater). Liver and kidney samples of fish were aseptically streaked on Tryptic soy agar and incubated at 25°C for 3 d. Also, sediment samples were collected below the open net cages with a Beckman grap. For each sediment sampling in each station, sample was collected from three cages and control sample was collected from one 1 km away from the cages. The sediment was diluted with Laure Bertani Broth and incubated for 24 h at 37°C. One milliliter of dilution was transferred into Bile Esculin Azide Agar and Chromocult Coliform ES Agar for isolation of *Enterococcus* spp. and *E. coli*, respectively. Also, all strains of bacteria were further identified by sequencing of the 16S rRNA genes. Minimum Inhibitory Concentration (MIC) and antibacterial susceptibility of isolated bacteria were determined for 8 different antibiotics. Also, MAR index values were calculated for each bacteria species.

Results and Discussion: A total of 74 *Escherichia coli*, 85 *Enterococcus faecium* and 24 *Lactococcus garvieae* strains were isolated from the sediment and fish samples. According to the MIC test results, the highest resistance to penicillin and vancomycin were determined in coliform bacteria, while sulfamethoxazole+trimethoprim was the highest in fish pathogenic bacteria. The most effective antibiotics were erythromycin and florfenicol for all bacteria. The highest MAR index value was in *E. coli*. Average MAR index values for *E. coli*, *E. faecalis* and *L. garvieae* strains were 0.27, 0.19 and 0.09, respectively. Antibacterial resistances of bacteria isolated from bottom of cage were significantly higher than that of isolated control sediment. In conclusion, the results of this study revealed phenotypic antibiotic resistance in sediment and fish pathogenic bacteria. These results indicate that the net cages areas can play an important role in the development of antibiotic resistance in aquatic environments.

Keywords: Net cages, Fish, Sediment, Antibiotic resistance

The Embryological and Larval Development of Electric Yellow Cichlid (*Labidochromis caeruleus* Fryer, 1956): Morphometrical and Histological Examination

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Objective: The aim of this study was to make a detailed determination of the embryological and larval development stages of African electric yellow cichlid (*Labidochromis caeruleus*).

Methods: Eggs were collected from 5 female brood stock's oral cavity kept in water at $27\pm 1^\circ\text{C}$, 8.2 ± 0.5 pH, 9.65 ± 0.2 mg/L dissolved O_2 and 12-hour dark/12-hours light photoperiod. Water renewal rate in the system was 10% per day. Mean total length of females were 7.46 ± 0.68 cm, condition factor 1.73 ± 0.16 , total egg number 140 and fecundity 28.0 ± 13.13 eggs/female. Fish were anaesthetised with 20-30 mg/L Eugenol. For histological examination larvae samples were fixed for 24 h in 4% buffered formaline. After dehydration by passing tissues through a series of ethanol solutions (50, 75 and 98%), the samples were vacuum embedded in paraffin. The histological sections (4–5 μm ; Shandon) were stained for general morphological purposes with haematoxylin and eosin (H&E), and analysed and documented photographically (Micro Cam Software ver. 1.5) with a Leica CME microscope. All procedures above were approved by the Institutional Animal Ethics Committee of Ankara University (HADYEK, 22.06.2016, #2016-14-144).

Results and Discussion: Eggs short axis length (ESAL) and long axis length (ELAL) were measured as 2.84 ± 0.06 mm, $R^2=0.53$ and 3.86 ± 0.04 mm with $R^2=0.24$. One and half hours after fertilization the first blastomer and in 38 hours the first embryo structure and also in 74 hours hatching were occurred. According to daily larvae lengths and vitellus sac measurements vitellus was absorbed 25-27 hours after hatching completely. Additionally, the vitellus long axis lengths (VLAL): $R^2=0.87$ and vitellus short axis lengths (VSAL): $R^2=0.89$ were decreased day by day and larval total lengths (5.86 ± 0.25 on day 1, and 17.30 ± 0.25 mm on day 30, $R^2=0.99$) were increased. In conclusion beside the morphometric results, development in the early and post-embryonic stages of African electric yellow cichlid tissues were histologically identified in this study.

Keywords: Cichlidae, Embryology, Larval development, Histology

The effects of cypermethrin related oxidative stress on sperm quality of an endangered native trout *Salmo coruhensis*

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Objective: There is little information in the scientific literature about the effects pesticide pollution in water on fish sperm. *In vitro* effect of cypermethrin on sperm quality and oxidative stress has not yet been fully explored. In this study, the effects of cypermethrin, a type II pyrethroid insecticide, on the antioxidant mechanism and quality of fish sperm were examined via *in vitro* exposure.

Methods: To explore the potential *in vitro* toxicity of cypermethrin, fish spermatozoa were incubated with different concentrations of cypermethrin (1.025, 2.05 and 4.1 µg/l) for 2h. The motility rate and duration of sperm were determined after exposure to cypermethrin.

Results and Discussion: Our findings showed that the percentage and duration of sperm motility significantly decreased with exposure to cypermethrin. Biochemical assays revealed that activity of and MDA, CAT and GSH levels increased in a concentration-dependent manner while GSH-Px and SOD activity decreased ($p < 0.05$). In conclusion, the oxidant and antioxidant status and, sperm quality were negatively affected by increasing concentrations of cypermethrin.

Keywords: Cypermethrin, endangered trout, oxidative stress indices, *Salmo coruhensis*, spermatozoa.

Oxidative stress related to Lambda-cyhalothrin exposure in endangered trout *Salmo coruhensis* spermatozoa: Effects on sperm quality

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Objective: The use of pesticides has increased along with increasing agricultural activities. This might have adverse consequences on the receiving environment. In particular, non-target organisms, including fish, are affected by toxic pesticides. Therefore, the effects of Lambda-cyhalothrin (LCT) on antioxidant mechanism and sperm quality of an endangered native trout were investigated *in vitro*.

Methods: To explore the potential *in vitro* toxicity of LCT, fish spermatozoa were incubated with different concentrations of LCT (0.6, 1.2 and 2.4 µg/l) for 2h. Reduced glutathione (GSH), Superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), catalase (CAT) and malondialdehyde (MDA) in spermatozoa were examined for determination of oxidative stress status. Sperm motility rate and duration were determined in endangered trout (*S. coruhensis*).

Results and Discussion: Our findings showed that the percentage and duration of sperm motility significantly decreased with exposure to LCT. Biochemical assays revealed that activity of and MDA, CAT and GSH levels increased in a concentration-dependent manner while GSH-Px and SOD activity decreased ($p < 0.05$). Consequently, the oxidant and antioxidant status and, sperm quality were negatively affected by increasing concentrations of LCT.

Keywords: Lambda-cyhalothrin, endangered trout, oxidative stress indices, *Salmo coruhensis*, spermatozoa.

Seasonal Distribution of Metazoan Parasite Fauna of *Garra rufa* Heckel, 1843 Inhabiting Göynük Stream

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Objective: In this study, it was aimed to determine the seasonal distribution of parasitic infections of doctor fish's (*Garra rufa* Heckel, 1843) helminth fauna in Göynük Stream (Bingöl, Turkey).

Methods: This study was conducted monthly between February 2015 and January 2016. A total of 110 fish were examined from two different stations. Dissection of fish was done to search for parasites. The total length, forks and standard length of the fishes were measured in millimeters (mm) and the weight measurements were made with a scale of 0.1 gr.

Results and Discussion: A total of 686 metazoan parasites were recorded, including 5 different parasite species. These parasites respectively are; three species of Monogenea (*Dactylogyrus rectotrobus*, *Gyrodactylus* sp., and *Paradiplozoon bingolensis*), one species of Digenea (*Diplostomum spathaceum*), and one species of Copepoda (*Ergasilus sieboldi*). The prevalence of recorded parasite samples was calculated from the highest value to the lowest value respectively; *P. bingolensis* (for adults 91.8%, and post-oncomiracidium solitary larva known as diporpa 17.6%), *D. spathaceum* (53.6%), *D. rectotrobus* (3.6%), *Gyrodactylus* sp. (%1,8), and *E. sieboldi* (1.8%). Among these recorded parasite species, *D. spathaceum* and *E. sieboldi* are the first records on *G. rufa*. In particular, in this study, it was mainly focused on the host specificity of *P. bingolensis*.

Keywords: Doctor fish, *Dactylogyrus rectotrobus*, *Gyrodactylus* sp., *Paradiplozoon bingolensis*, *Diplostomum spathaceum*, *Ergasilus sieboldi*.

Toxicological Evaluation of Antimicrobial Agents in Rainbow Trout

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Objective: In this study, it is aimed to investigate the chronic toxic effects, blood DNA damage and gene expression effects of Borax, Triclosan on rainbow trout (*Oncorhynchus mykiss*).

Methods: Rainbow trout were subjected to chronic exposure of Triclosan and Borax for 40 days. Blood erythrocytes were drawn from tail vein of fish and Comet assay was applied to assess genotoxicity. The fold change in expression of the SOD1, GPX1, GPX2, GSTA, HSP90BB, HSP90BA, and HSC70A genes were determined in liver and kidney tissue.

Results and Discussion: The comet assay results indicated especially triclosan have mutagenic effects on blood DNA of fish. Borax posed less DNA damage than triclosan. Triclosan and borax induced expression of all genes significantly in the liver and kidney. The use of antibacterial chemicals, especially in hand soaps, have led to these chemicals getting washed down drains and into the water system. Studies show that these chemicals resistant to degradation and it has been found in streams and wastewater all around the world. Therefore, genotoxic, mutagenic and other potential effects of these compounds should be assessed in the aquatic environment.

Keywords: Antimicrobial agent, Comet assay, genotoxicity, Borax, Triclosan

Effects of Different Sources of Dietary Vegetable Oils on Growth Performance and Fatty Acids of Turkish Crayfish, *Astacus leptodactylus*

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Objective: The aim of this study was to investigate the effects of four vegetable oils on growth performance and fatty acids composition of *A. leptodactylus*.

Methods: Five isonitrogenous and isolipidic diets were prepared to contain 35% protein and 8% lipid. The levels of the experimental diets were the same except for the lipid source and based on soybean meal, solvent-extracted menhaden FM and krill meal as main protein sources. As lipid sources, fish oil (FO), peanut oil (PO), cottonseed oil (CSO), linseed oil (LO) and hazelnut oil (HO) were added to the basal diet at a level of 7%. Each test diet was fed to crayfish two times daily to satiation for 60 days in a recirculation system. Juvenile Turkish crayfish averaging 24.14 ± 0.23 g (SD) were captured from the Keban Dam Lake. All tanks were cleaned daily in the morning by siphoning off accumulated waste materials and moults. Water temperature was maintained at 21°C using water chiller. Continuous aeration in the culture system was provided by a blower and diffuser tubing inside the fibreglass tanks. Approximately 5% of the total water volume was replaced daily with dechlorinated tap water. Lighting was provided by overhead fluorescent ceiling lights at a 12:12 h light: dark cycle. Each tank contained 5-cm section of 2.54-cm diameter PVC pipes for shelter.

Results and Discussion: In the experiment, among five different diets that were fed to the juveniles for 60 days, HO sustained the highest final weight ($P < 0.05$). While FCR was calculated as 1.53 in this group, this value ranged between 2.15 and 2.50 in other experimental groups. In general, in spite of their very low level of EPA (20:5n-3) and DHA (22:6n-3), vegetable oil sources promoted good growth with a high nutritional performance and successful moultings in the study. The reason for this is attributed to high contents of MUFA's in the vegetable oils that can be more efficiently converted to energy through β -oxidation as compared to n-6 PUFA's. Accumulation of MUFA's was highest in LO (35.51%) and HO (35.02%) in the abdominal tissue, especially 18:1n-9 in HO (25.06%) ($P < 0.05$). This fatty acid was measured as 22.30, 19.76, 19.57 and 19.20% in PO, LO, FO and CSO, respectively. As expected, highest EPA was found in FO, but this fatty acid was also accumulated in crayfish fed on vegetable oil sources to a level close to the control group. Although the highest DHA in FO with 9.76%, it ranged between 6.84% and 7.70 in other treatments. The richest group in terms of PUFAs was FO (46.36%, $P < 0.05$) followed by PO and CSO (44.56% and 43.34%), while poorest were LO and HO with 40.08 and 42.40% respectively. Our results show that PO and HO with high levels of MUFAs can fully substitute FO in *A. leptodactylus* feeds on condition that fish and krill meals are used at 26% in the formulation.

Keywords: vegetable oil, fatty acids, *A. leptodactylus*

***Lactococcus garvieae* pathogen caused an outbreak in rainbow trout (*Oncorhynchus mykiss*, Walbaum) broodstocks in Turkey**

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Objective: In this study, *Lactococcus garvieae* pathogen was isolated in rainbow trout broodstocks (approx. 3500g) from a farm in Turkey.

Material & Methods: The lactococcosis outbreak occurred in March 2017 Fethiye, Mugla. The cumulative mortality was obtained as 30% at 14°C water temperature. Infected broodstocks exhibited lethargy, bilateral exophthalmos and eyeball disruption. Necropsy findings included enlarged spleen, hyperemia and hemorrhage in the internal organs and muscle. Bacterial inoculation were made from visceral organs on Tryptic Soy Agar (TSA) medium. The colonies were obtained from kidney, liver and spleen following incubation at 22°C for 48 h. Conventional microbiological tests and RAPID ID 32 Strep tests (bioMe'rieux) were used for further phenotypic characterization of isolates. For molecular identification, *L. garvieae* specific PCR was run. Disc diffusion assay on Mueller–Hinton agar were used for antimicrobial sensitivity of the isolate and evaluated according to NCCLS standards.

Results and Discussion: The isolates were identified as *Lactococcus garvieae* by morphological, physiological, and biochemical characterization by conventional, RAPID ID 32 Strep tests (bioMe'rieux) and confirmed by PCR (species-specific primers) techniques. They were found to be sensitive to erythromycin, doxycycline, tetracycline, amoxicillin, amoxicillin/ clavulanic acid, florfenicol, enrofloxacin, chloramphenicol, nalidixic acid, furozolidone *in vitro*. The antibiotics (doxycycline and florfenicol) were performed to treat infected fish in the farm.

Keywords: Rainbow trout, *Lactococcus garvieae*, phenotypic characteristics, molecular diagnosis

Effect of *Artemisia vulgaris* L. on Resistance Against *Vibrio anguillarum* and Growth Performance in Rainbow Trout (*Oncorhynchus mykiss*, Walbaum)

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Objective: The microbial diseases cause economic losses in aquaculture on global scale and the use of commercial antibiotics for disease treatment produces undesirable side effects. The wide and frequent use of antibiotics in the past has resulted resistance development in pathogens. The recent banning of antibiotic additives in animal feeds by the European Union in January 2006 requires more sustainable control of bacterial infections in aquaculture industry for further development. Natural plants with immunostimulant and/or antibacterial properties could be useful alternatives to antibacterial drugs that have adverse side effects on fish, environment and consumers. The objective of this study was to determine the effects of *Artemisia vulgaris* L. on the growth parameters and disease resistance against *Vibrio anguillarum* in rainbow trout (*Oncorhynchus mykiss*, Walbaum).

Methods: *Artemisia vulgaris* L. was incorporated into the diets of rainbow trout (20.48±0.19—20.81±0.04 g) as powder (0.1%, 0.5%, 1.0%, 2.0%) and ethanol extracts (250, 1000 mg kg⁻¹). Fish were fed to apparent satiation three times a day for 90 days and final body weight, weight gain, specific growth rate and feed conversion ratio were obtained. After 45 days of feeding, fish were challenged with *V. anguillarum* and cumulative mortality was recorded over 21 days. The relative per cent survival (RPS) was calculated according to Amend (1981).

Results and Discussion: Results showed that dietary phyto-genic supplementation improved ($p<0.05$) the final body weight, weight gain, specific growth rate, feed conversion ratio in compared to 0% (control) group. Fish fed with 0.1% and 1.0% of *A. vulgaris* containing diets had better feed conversion ratio than 0% (control) group and the other experimental groups (0.5%, 2.0%, 250 and 1000 mg kg⁻¹ feed). Fish fed with 1.0% and 2.0% *A. vulgaris* containing diets also showed the highest resistance against *V. anguillarum* by having no mortality. These results indicate that *A. vulgaris* could be added to rainbow trout feeds as growth promoter and a natural antibacterial agent to improve disease resistance.

Keywords: *Artemisia vulgaris* L., *Vibrio anguillarum*, *Oncorhynchus mykiss*, growth

Growth Performance of Brown Trouts and Their Hybrids

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Objective: To investigate the growth performance of *S.t. labrax*, *S.t. caspius*, *S.t. abanticus* and their hybrids.

Methods: All possible cross types (n=9) were successfully produced and used in growth performance study. 90 fish were randomly sampled from each group (each cross-type) and placed in 30 L triplicate aquariums (30 fish per aquarium) supplied with flow-through system. Fish were fed 6-8 times a day with commercial extruded trout feed and maintained at ambient temperature and natural photoperiod throughout the study. 20 fish were randomly sampled from each group in every two-week period and length and weight of fish were calculated. FCR and specific growth rates were evaluated for each group. Growth rates were compared using one-way ANOVA.

Results and Discussion: After 22 weeks starting experiment, no significant differences was observed in length and weight gain among groups. First significant differences was observed at 24th week. At the end of the 44 weeks, FCR values were ranged between 0.61 (*S.t. labrax* x *S.t. labrax*; LL) and 1.38 (*S.t. caspius* x *S.t. caspius*; CC). SGRs were also significantly changed among groups. The highest SGR was observed in LL (3.22) while lowest SGR was found in CC (2.64). Meanwhile, at the end of the 44th week, highest weight gain was calculated for LL group (116.5±2.82 g) and lowest growth rate was calculated for *S. t. caspius* X *S. t. caspius* group (56.08±0.85 g). Growth rates, SGR and FCR of other hybrid and homospecific groups were in the ragen of those of LL and CC groups. Homospecific *S.t. labrax* appeared to be the best performing fish in terms of growth and FCR but other parameters such as diseases resistance of homospecific groups and hybrids should be further checked.

Keywords: *S.t. labrax*, *S.t. caspius*, *S.t. abanticus*, hybrid

Isolation of *Saprolegnia* spp. from Freshwater-Crayfish (*Astacus leptodactylus*) in Eğirdir Lake

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Objective: The aim of the study is to draw attention to the infection of *Saprolegnia* in Eğirdir crayfish.

Methods: We used conventional mycological methods for isolation and identification of these fungus.

Results and Discussion: Twenty crayfish, brown melanised in the abdominal area were kept frozen at -80 ° C during the controls in Eğirdir Lake in August 2010. These samples were solved and examined by mycological methods. 14 *Saprolegnia* spp. isolated from twenty crawfish samples. While the agent was not isolated in 3 crayfish, the fungi isolated from the remaining 3 were not identified yet. Work is underway to identify these. Colony morphology of the fungal isolates: Dark grey colour (Making brown that passed days), rarely plaited, plentiful hiphae, fast and spread to every direction featured. After lactophenol strain from the culture, the hyp-haes that have different wide, seldom septa, hyaline hiphae structer were observed. Researchers have reported that *Saprolegnia* strains have poor pathogenicity and is usually caused melanization by stimulating the crayfish cellular defense reaction. However, these lesions decrease the marketing value of crayfish and increase the risk of catching other infections. The study supports the knowledge that *Saprolegnia* species can be responsible from melanisation in crayfish in Eğirdir Lake.

Keywords: *Astacus leptodactylus*, *Saprolegnia* spp., Eğirdir lake.

A Study on Modelling of Yolk Sac Consumption and Feeding of Brook Trout (*Salvelinus fontinalis*) Alevin

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Objective: In this study, it was aimed to determine the best model for yolk sac consumption rate and feeding of brook trout alevins.

Methods: The eggs obtained from 10 female broods and fertilized spermatozoa of 5 male fish. Eggs were incubated at a vertical incubator at 12.5-12.9 °C about 35 day. After 20 days of hatching 1000 alevins (mean length 20.9±1.1 mm, weight 59.3±12.8 mg) were selected and separated into two groups at different aquaria. The trial lasted for 10 days. One group was fed with 0.3 mm commercial trout feed (55% crude protein and 10% crude oil) whereas the other group was starved. Every day alevins were fed and 15 minutes after feeding 10 larvae sampled randomly. The larvae were anesthetized with 50 ppm benzocaine for sampling, and then photographed using a stereo microscope. Stomach contents and yolk sac were analyzed with Quantiscan 3.0.0 software.

Results and Discussion: The data were evaluated for different methods, and best described by an exponential model. The time and yolk consumption equation was $= 29 e^{0.1141 t}$ ($r^2=0.804$), and time and feed consumption was $= 100 e^{-0.248 t}$ ($r^2=0.824$). The result of this study can be used by fish farmers to properly quantify the feeding time of cultivated brook trout alevins to avoid wasting expensive feed.

Keywords: Brook trout, yolk sac, feeding, modelling.

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Cypermethrin Toxication Leads to Histopathological Lesions and Induces Inflammation and Apoptosis in Common Carp (*Cyprinus carpio* L.)

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Objective: Cypermethrin (Cyp), a known neurotoxic pesticide, is widely used in agricultural applications. In the present study, the aim was to determine the histopathological effects of Cyp toxication and evaluate the activation of inducible nitric oxide synthetase (iNOS) and 8-hydroxy-2-deoxyguanosine (8-OHdG) using an immunofluorescence assay. Thereafter, we identified the expressions of caspase 3, capsase 8, iNOS, and metallothionein 1 (MT1) genes in common carp using quantitative reverse transcription polymerase chain reaction (qRT-PCR). High and low doses of Cyp were administered to experimental groups for 24, 48, 72, and 96 h.

Methods: The fish were exposed to the chemical for periods of 24, 48, 72 and 96 h in static aquarium systems. The fish in group I and II were the control. The fish in groups III and IV were given high dose 0.01 ppm (1/5 LD50), V and VI were given low dose 0.005 ppm (1/10 LD50) concentrations of cypermethrin. First, we evaluated the histopathological changes in gill, liver, and brain tissue exposed to Cyp. iNOS and 8-OHdG activation were assessed using an IF assay, and caspase 3, caspase 8, iNOS, and MT1 mRNA expression levels were measured in brain tissue exposed to Cyp using qRT-PCR.

Results and Discussion: As a result, necrotic neurons in different stages and desquamation of ependymal cells due to necrosis were detected in the brain. Histopathological changes, including hyperplasia of lamellar cells, telangiectasia of lamellae and thickening due to cellular infiltration in gills, hemorrhage, diffuse hydropic degeneration, and focal necrosis in the liver were observed in the experimental groups. Immunopositive reactions of 8-OHdG were clearly observed in the nuclei and cytoplasm of neurons, and positive reactions for iNOS were detected in the cytoplasm of neurons and in the glial cells of the experimental groups. Furthermore, we found that caspase 3, capsase 8, iNOS, and MT1 genes were up-regulated in the brain when exposed to both high and low doses of Cyp. In conclusion, our findings revealed that Cyp toxication harms the organs of common carp, particularly the brain, and also gives rise to inflammation, DNA damage, and apoptosis. Therefore, the use of Cyp should be restricted to protect the health of aquatic animals.

Keywords: Cypermethrin; Caspase 3; Caspase 8; iNOS; 8-OHdG; *Cyprinus carpio*.

Acute Toxication of Deltamethrin Results in Activation of iNOS, 8-OHdG and Up-Regulation of Caspase 3, iNOS Gene Expression in Common Carp (*Cyprinus carpio* L.)

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Objective: Deltamethrin is a widely used synthetic pyrethroid pesticide that protects agricultural yields, including crops, fruits, and vegetables from insect-pests. It is known that deltamethrin toxication leads to metabolic disorders and has detrimental effects on the brain and liver in different organisms. However, the harmful effects of deltamethrin toxication on aquatic animals remain unclear. In the present study, we aimed to evaluate the adverse effects of deltamethrin toxication by performing a histopathological examination, an immunofluorescence assay, and a qRT-PCR on common carp.

Methods: Fish were divided into six groups. There was two aquarium for each group. Each aquarium contained ten fish and totally 60 fish were used in the present study. The fish in groups I and II were the control. The fish in groups III and IV were given dose of 0,08 μM (1/5 LD50), V and VI were given dose of 0,04 μM (1/10 LD50) concentration of deltamethrin. First, we assessed the pathological alterations by using a histopathological examination and an activation of iNOS and 8-OHdG by using an immunofluorescence assay (IF) as a result of DLM toxication on the gills, liver, and brain of common carp. Thereafter, qRT-PCR was used to determine whether or not the DLM toxication changes the caspase-3 and iNOS mRNA expression levels in the brain.

Results and Discussion: We observed that a low-dose (0.04 μM) and a high-dose (0.08 μM) of deltamethrin exposure caused lamellar cells hyperplasia and inflammatory cells infiltration in the gills, hyperemia, diffuse hydropic degenerations and focal necrosis in the hepatocytes, necrotic changes in the neurons, and also induced activation of inducible Nitric Oxide Synthase (iNOS) and 8-hydroxy-2-deoxyguanosine (8-OHdG) in the gills, liver, and brain depending on the exposure time (24 h, 48 h, 72 h and 96 h). In addition, deltamethrin toxication caused the up-regulation of caspase-3 and the inducible Nitric Oxide Synthase (iNOS) of the gene expression depending on the dose (0.04 μM and 0.08 μM) and the exposure time in the brain ($p < 0.05$, $p < 0.01$, $p < 0.001$). Our results indicated that long-term deltamethrin exposure could lead to inflammation, oxidative stress, DNA damage, and apoptosis on the different organs in common carp. Thus, deltamethrin toxication is dangerous for common carp populations, and the usage of deltamethrin should be controlled and restricted in agricultural areas.

Keywords: Deltamethrin; iNOS; 8-OHdG; Caspase 3; Immunofluorescence assay; Pesticides; Toxicity; Inflammation; Oxidative stress; DNA damage; Apoptosis.

Histopathological effects, responses of oxidative stress, inflammation, apoptosis biomarkers and alteration of gene expressions related to apoptosis, oxidative stress, and reproductive system in chlorpyrifos-exposed common carp (*Cyprinus carpio* L.)

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Objective: In this study, we aimed to identify the toxic effects of chlorpyrifos exposure on the tissues of common carp. For this purpose, we evaluated histopathological changes in the brain, gills, liver, kidney, testis, and ovaries after 21 days of chlorpyrifos exposure. Activation of 8-OHdG, cleaved caspase-3, and iNOS were assessed by immunofluorescence assay in chlorpyrifos-exposed brain and liver tissue. Additionally, we measured the expression levels of caspase-3, caspase-8, iNOS, MT1, CYP1A, and CYP3A genes in chlorpyrifos-exposed brain tissue, as well as the expression levels of FSH and LH genes in chlorpyrifos-exposed ovaries, using qRT-PCR.

Methods: The fish were exposed to the chemical for periods of 21 days in static aquarium systems. The fish in group I and II were the control. The fish in groups III and IV were given dose of 0.2 mg/L (1/5 LC50), V and VI were given dose of 0.1 mg/L (1/10 LC50) concentration of chlorpyrifos for 21 days. This study provides current information about the harmful effects of CPF on common carp. We assessed histopathological effects using histopathological examination, activation of iNOS, 8-OHdG, and cleaved caspase using IF, and alteration in several gene expressions including caspase-3, caspase-8, iNOS, MT1, CYP1A, CYP3A, FSH, and LH using qRT-PCR in chronic CPF-exposed common carp.

Results and Discussion: We observed severe histopathological lesions, including inflammation, degeneration, necrosis, and hemorrhage, in the evaluated tissues of common carp after both high and low levels of exposure to chlorpyrifos. We detected strong and diffuse signs of immunofluorescence reaction for 8-OHdG, iNOS, and cleaved caspase-3 in the chlorpyrifos-exposed brain and liver tissues. Furthermore, we found that chlorpyrifos exposure significantly upregulated the expressions of caspase-3, caspase-8, iNOS, and MT1, and also moderately upregulated CYP1A and CYP3A in the brain tissue of exposed carp. We also noted downregulation of FSH and LH gene expressions in chlorpyrifos-exposed ovary tissues. Based on our results, chlorpyrifos toxication caused crucial histopathological lesions in vital organs, induced oxidative stress, inflammation, and apoptosis in liver and brain tissues, and triggered reproductive sterility in common carp. Therefore, we can propose that chlorpyrifos toxication is highly dangerous to the health of common carp. Moreover, chlorpyrifos pollution in the water could threaten the common carp population. Use of chlorpyrifos should be restricted, and aquatic systems should be monitored for chlorpyrifos pollution.

Keywords: Chlorpyrifos; toxicity; common carp; histopathology; immunofluorescence; gene expression; caspase-3.

Use of Dietary Ginger (*Zingiber officinale*) as Immunostimulant in Rainbow Trout (*Oncorhynchus mykiss*)

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Objective: Use of dietary ginger (*Zingiber officinale*) as an immunostimulant in rainbow trout (*Oncorhynchus mykiss*) was investigated in this study.

Methods: Dried ginger's root tubers (DGRT) and commercial trout feed were powdered, (DGRT) were included at rates of 0.0 g/kg (control), 0.5 g/kg, 1.0 g/kg, 2.5 g/kg, 5.0 g/kg, 10.0 g/kg and 20.0 g/kg and then repelleted. Rainbow trout (*Oncorhynchus mykiss*) having 108.7 ± 17.0 g of average initial weight were used in the trial. Growth and nutrient utilization performance were measured, and the blood parameters related to the non-specific immune system were determined in each group after feeding 7th, 15th, 25th, 40th and 60th days, respectively. In addition, experimental challenge with *Yersinia ruckeri* infection was carried out after 14 days of feeding at the same doses and the blood analysis was performed on the 20th day of infection. Comparisons between groups were evaluated by one-way ANOVA or Kruskal-Wallis test depending on the data normality test.

Results and Discussion: There were statistical differences in HCT, MCV, MCH, MCHC, MPV, RDW-SD and RDW-CV values in 1.0, 2.5 and 5.0 g / kg dose groups after 7 days of feeding, in protein, WB, GRAN and PLT values in 1.0 g/kg and 2.5 g/kg dose group after 15 days feeding, in protein, MCH, MCHC and RDW-CV values in 0.5 g/kg, 1.0 g/kg and 2.5 g/kg dose group after 25 days feeding, in protein, HCT, MCV, RDW-CV, PLT and MPV values in 0.5 g/kg, 1.0 g/kg and 2.5 g/kg dose groups after 40 days of feeding, in protein, WBC, LYM, MID, GRAN MCV, MCH, MCHC, RDW-SD and RDW-CV values after 60 days of feeding according to control group in 0.5 g/kg, 1.0 g/kg and 2.5 g/kg dose groups. Some disturbances in the blood parameters were detected at doses of 5.0 g/kg dietary DGRT after 15 days on. Significant differences were found in lisosyme, WBC, LYM, MID, GRAN, MCV, MCH and MCHC values in fish were fed with 1.0 g/kg, 2.5 g/kg and 5.0 g/kg DGRT after challenge with *Yersinia ruckeri* infection. In conclusion, 1-2.5 g/kg and 0.5-2.5 g/kg concentration of ginger added feed for the first 15 days and 15-60 days using, respectively is recommended. The daily dose for body weight 20-50 mg/kg and 10-50 mg/kg for the first 15 days and 15-60 days using, respectively should be chosen according to findings of the study.

Keywords: *Zingiber officinale*, *Oncorhynchus mykiss*, trout feeding, immunostimulant

The effects of Bacillus Probiotic on growth performance and immune responses of European Catfish

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Objective: We designed and carried out experiments to study and evaluate the effects of a probiotic additive on the growth and immune responses of the European catfish. This probiotic additive was made of 5 Bacillus species: *B. circulans*, *B. coagulans*, *B. licheniformis*, *B. megaterium* and *B. subtilis*.

Methods: The experiment was carried out in the fish laboratory of the University of Pannonia, Georgikon Faculty, in Keszthely, Hungary. The experiment was done for 42 days from on 11 of April to 23 of May, 2014. Fish were held in a recirculation system with a total volume of 4 m³. The experimental system was consisted of nine 350 L fish tanks and five 300 L filtering tanks. Perlton wool was used as filter material. In addition UV lamps and NO₃⁻ selective resin were applied in order to eliminate harmful parasites and nitrate. Faeces and unconsumed feed were removed from the system in every morning. Daily water exchange was approx. 10 %. The lights in the room were dimmed and the temperature was held between 23-25^o C with an electric heater, water temperature was measured daily (mean±SE: 24.0±0.8°C). For oxygen aeration system, each fish tank was supplied with two air diffuser, it was always operated until the end of the experiment. During the experiment, dissolved oxygen, pH were monitored daily and maintained at 6.85 ± 0.1 mg/L and 7.5 ± 0.2, respectively. For experimental treatments, we designed two treatments (T1 and T2) and one control (C), which were applied in triplicates, can see it at Table 1 to get more detail. We mixed the control feed with 8.0x 10⁴ bacillus probiotic to get T1 treatment and 4.0x10⁸ Bacillus to get T2 treatment. Four days before the experiment, feeding was suspended, in order to avoid the presence of any gut content from previous feeds and weight of the fish with empty guts was measured. For feeding, we already used nine automatic belt feeders for 9 fish tanks as well, the feed was offered with automatic belt feeders for 12 hours in during daytime. Portion was 2.7% of actual body mass, the amount was changed in every week according to the results of the measurements. Individual body weight was measured on a regular basis. Measurements were carried out in water with 0.1 g accuracy by scale.

Results and Discussion: No significant improvements of weight gain or specific growth rate, feed conversion ratio were observed in the probiotic fed groups, but the growth parameters of Bacillus strains treatments were higher than the controls. Serum lysozyme activity, total protein level, total immunoglobulin concentrations showed no significant difference between the treatments and the control during the whole experiment period but the results of Bacillus treatments were slightly higher control. The total white blood cells of fish fed diets T1 and T2 were significantly higher than that of fish fed control diet after 42 days of feeding. In generally, at supplemented level of 8.0x10⁴ cells/g Bacillus showed the best result. In conclusion, the results demonstrated that Bacillus could not improve growth performance and immune responses of *Silurus glanis* in this study.

Keywords: probiotics, growth parameters.

Oogonial Stem Cell Isolation and Culture From Brown trout (*Salmo trutta macrostigma*, 1858 Dumeril)

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Objective: This study was aimed to find a practical technique for isolation and culture oogonial stem cells from female brown trout (*Salmo trutta macrostigma*).

Methods: Twenty-four wild female juvenil *S.t. macrostigma* were obtained from Kılıç Trout Fish Farm (Kahramanmaraş, Turkey). The juvenils were taken alive to the aquaria unit and stored in a 1000 litre capacity fibreglass tank. The ovary structure of *S.t. macrostigma* were histologically studied in order to identify the appropriate size, age and ovary structure of *S.t. macrostigma* for oogonial stem cell isolation and culture. Histological examination were done according to Çek et al. (2001), Çek and Yılmaz (2009). Photomicrographs were taken to illustrate the correct fish size, age and weight in order to be successful in the oogonial stem cell isolation and culture of *S.t. macrostigma*. 24 female juvenil *S.t. macrostigma* were anesthetized with 0.04% 2-phenoethanol (Sigma Chemicals, UK). Then all fish were incubated on ice. The surface of the fish was sterilized with 70% ethanol. 24 female fish were divided into two groups for enzyme digestion, and each group was divided into four replicates (three fish per replicate). Ovary tissue of group one were digested by 0.25% trypsin-EDTA, and ovary tissues of group two were digested by 0.05% trypsin-EDTA. The ovary were removed from the peritoneal cavity, connective tissue including the peritoneum and blood vessels were avoided. Ovary of six fish from one replicate were weighed and placed in a 15 ml centrifuge tube, containing 5 ml of anti-agent medium (Hanks' Balanced Salt Solution, HBSS, with 1 µg/ml NaHCO₃, 100 unit/ml penicillin and 1001 µg/ml streptomycin). Weight of ovary was calculated by using the weight of the centrifuged tube containing the medium. Thereafter, the tubes were transferred into a biosafety cabinet to undergo cleaning and sterilization. Minced ovary tissues of each replicate were transferred into one 50 mL autoclaved glass flask which contained a stir bar. All the samples were incubated on ice for 30 min followed by 1 hr at 22 °C with a magnetic stirrer to achieve higher digestion efficiency. The cell suspension from each replicate was then filtered using a 40 µm cell strainer (nylon mesh, Falcon) and centrifuged at 500 g for 10 min. The supernatant was discarded and the pellet resuspended in 2 mL HBSS. Five µL of cell suspension were gently mixed with 45 µL Trypan blue. The concentration and viability of cells was measured by hemocytometer.

Results and Discussion: First, appropriate age, size and weight of the female *S.t. macrostigma* for oogonial stem cell isolation and culture were identified as 2.5+ month old, 14.65±1.6663 cm, 28,225±7.79246 g respectively. Then morphological and histological ovary conditions were assessed. Finally, isolation and culture conditions were optimized for *S.t. macrostigma*. The highest oogonial stem cells were measured in the perinucleolar stage of the ovary. Survival rate of oogonia and mitotic activities in L-15 culture media, with 5% serum of *S.t. macrostigma* (Culture media pH, 7.65; temperature 20°C) were developed. Density of oogonial stem cells were measured as 5.4*10⁵ ±2.6*10⁵ cells/ml. However, oogonial volume was recorded as 13,5ml. In this thesis, germ line chimera was developed for *S.t. macrostigma* in order to be used in surrogate reproduction technologies and gene transfer systems. After culture of oogonial stem cells it was suggested that 2.7*10⁶ ± 1,3*10⁶ cells/ml, cell count should be used in transplantation technologies.

Keywords: *Salmo trutta macrostigma*, Oogonial stem cell, Culture and Isolation

Potential Probiotic Lactic Acid Bacteria from Rainbow Trout for Inhibitory Activity against *Flavobacterium psychrophilum* and *Aeromonas hydrophila*

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Objective: The use of probiotics to increase disease resistance and improve the health of fish has long been investigated. Lactic acid bacteria are often used as probiotics in aquaculture because of their beneficial effects. *Flavobacterium psychrophilum* and *Aeromonas hydrophila* are important pathogens for rainbow trout industry. The aim of this study, determination of *in vitro* antagonistic effect of potential probiotic lactic acid bacteria against *F. psychrophilum* and *A. hydrophila*.

Methods: Inhibitory activity of potential probiotics lactic acid bacteria strains isolated from rainbow trout against *F. psychrophilum* and *A. hydrophila* were investigated with Well Diffusion Agar Assay.

Results and Discussion: Based on *in vitro* antagonism, *L. lactis subsp. cremoris* strains 1-1 and 1-5, *Lactococcus garvieae* strains 1-3 and 1-4 showed *in vitro* antagonistic properties against these pathogens. However, these lactic acid bacteria should be further studied to explore their probiotic effects *in vivo*.

Keywords: Probiotics, Lactic acid bacteria, Well Diffusion Agar Assay, *Flavobacterium psychrophilum*, *Aeromonas hydrophila*

Effect of Boron Additives on Post-Thaw Quality, Fertilization Ability and DNA Damage of Cryopreserved Brown Trout (*Salmo trutta macrostigma*) Sperm

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Objective: Boron has been considered as an essential nutrient for decreasing lipid peroxidation and improving antioxidant mechanism in different animal species. Whether their effect may improve sperm quality or reduce sperm DNA damage after cryopreservation in fish sperm still remains unclear. Thus, the aim of the present study was to analyse the effect of extender supplemented with boron on post-thawed motility, viability, fertility and DNA integrity of brown trout (*Salmo trutta macrostigma*) sperm following cryopreservation.

Methods: Sperm collected from twelve individuals was cryopreserved in an ionic extender containing different boron concentrations (0.1, 0.2, 0.3, and 0.4 mM) using a controlled freezer at two different freezing rates (FR-I: 10°C/min from +4°C to -40°C and FR-II: 15°C/min from +4°C to -40°C) before storage in liquid nitrogen at -196°C. For thawing, straws (0.25-ml) were immersed for 30 s in a water bath at 25°C. Cell motility, viability, fertilization, eyeing and DNA fragmentations were determined in post-thawed samples. DNA damage was evaluated by comet assay technique.

Results and Discussion: The results demonstrate freezing rate-I provided significantly higher results in terms of fertilization and eyeing rates compared to freezing rate-II ($p < 0.05$). Higher post-thaw motility ($62.8 \pm 1.4\%$) and fertilization ($75.2 \pm 0.9\%$) rates were obtained with the 0.4 mM boron concentration at the freezing rate-I. Supplementation of the extender with boron increased the fertilization and eyeing rates and also decreased DNA damages at both freezing rates. Consequently, we can recommend using of sperm cryopreserved with ionic-based freezing extender supplemented with boron (0.4 mM) at freezing rate of 10°C/min from +4°C to -40°C to facilitate improvement of the spermatozoa cryopreservation techniques in brown trout.

Keywords: cryopreservation, DNA damage, comet assay, sodium pentaborat, *Salmo trutta macrostigma*

Artificial Propagation Technics and Optimum Stocking Ratio in RAS during Advanced Fry Rearing of Orfe, *Leuciscus idus* (Linnaeus, 1758)

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Objective: The main objectives of this study were to illuminate the artificial propagation technics of Orfe, *L. idus* (L., 1758), and to determine the optimum stocking ratio in RAS during advanced fry rearing.

Methods: The study was conducted in the RAS of the Department of Aquaculture, SzIU, in Hungary. The broodstock was captured from natural waters right before the breeding season (mid of March 2017) and stocked separately according to sex. Carp pituitary were used as stimulant for ovulation. Both sexes were injected once (5.0 mg/kg for females, 2.5 mg/kg for males) and ovulation occurred 40 hours after pituitary injection at 12°C. The basic measurements such as fertilization ratio, hatching rate etc. were recorded. In the second study, the effect of different stocking ratios (25, 50, 75, and 100 larvae/L) on growth and survival rate were tested for 21 days in RAS. Larvae were stocked into 12 L tanks and the initial average length and weight were 10.4 ± 0.4 mm and 2.4 ± 0.51 mg, respectively. At the end of the study, total length and weight gain and survival ratio were calculated.

Results and Discussion: The relative weight of stripped eggs compared to the body weight before stripping was 15-20%. According to results, the fertilization ratio was quantified as around 55%. Hatching occurred 10 days after fertilization at 12°C. In the second study, the lowest survival rate was observed in 75 ind/L group (75.7±7.2 %) and the highest was 86.8±4.9% in the 25 ind/L group. There were no statistical differences on the total length and weight gains between groups (p>0.05).

Keywords: Orfe, artificial propagation, stocking density, growth rate, survival ratio

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Effects of Different Dietary Oligosaccharides on Growth of *Clarias gariepinus* in Recirculated Aquaculture System: Preliminary results

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Objective: In this study, African sharp tooth catfish, *Clarias gariepinus* as a candidate aquaculture species was cultured in recirculating aquaculture system (RAS) with minimum water changes. We aimed to determine the effects of different dietary oligosaccharides (FOS, GOS and MOS) on growth of *C. gariepinus* larvae in RAS environment.

Methods: The study was conducted in Aquaculture Research and Application Unit of Agricultural Faculty of Ankara University, Ankara, Turkey. The experiment was conducted in 21 (40 L water volume) fiberglass tanks (40 fish in each) for 3 months larval raising period. The inflow of freshwater was maintained at 3 L/min over first 30 days, 3,5 L/min over the second 30 days and 4.5 L/min during the last phase (last 30 days') of the study. The ranges of physicochemical parameters, such as water temperature, saturation and dissolved oxygen were recorded as 25±1°C, 7,8±0,5 mg/L, %80±5 respectively in the RAS environment. 20-25 days old fish after hatching were used (initial weight 0.22±0.07 g, total length 2.91±2.89 cm). The commercial diet 150, 300, 500 µm (for rainbow trout) with supplemented 1‰ and 2‰ levels of Furucto oligosaccharide (FOS1 and FOS2), Galacto oligosaccharide (GOS1 and GOS2) and Mannan oligosaccharide (MOS1 and MOS2) in 3 replicates with a control (C) groups were used throughout the experiment. Every 10 days' live weight and total lengths of fish were measured and growth parameters were calculated. All procedures above were approved by the Institutional Animal Ethics Committee of Ankara University (HADYEK, 25.03.2015, #2015-5-99/#2017-6-54).

Results and Discussion: The results showed that fish larvae reached 13.03±1.99 cm (control) to 16.71±2.56 (MOS2) in terms of total length and 12.11±2.67 g (control) to 15.93±1.88 (MOS2) in weight. At the end of the study, generally enhanced growth performances were observed in catfish fed on diet containing MOS2≥GOS2≥MOS1>GOS1≥FOS2≥FOS1≥C (p>0.05). Average total lengths displayed the same order MOS2>GOS2≥MOS1>GOS1>FOS2>FOS1>C (p>0.05). In conclusion, %2 MOS, %2 GOS and also %1 MOS supplementations could be used as a healthy growth promoter in *C. gariepinus* diets.

Keywords: Catfish, Furucto oligosaccharide, Galacto oligosaccharide, Mannan oligosaccharide

Assessment of Fishery Sector in Çankırı Province based on Swot Analysis and Field Studies

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Objective: The goal of this study is to analyze the current situation of Çankırı's fishery sector in terms of strategic management perspective and submit strategic recommendations to make this industry to be more effective. We aimed to explore current constraints and future possibilities of the fishery sector in Çankırı to provide information to policy makers for future developments. An examination of both internal and external factors of the sector may assist in shaping the future of fishery sector.

Methods: We analyzed Çankırı fishery industry by using SWOT analysis technique as a general tool designed to be used in the preliminary stages of decision-making and as a precursor to strategic planning in various kinds of applications. To explore the strengths and weaknesses, and threats and opportunities of the fishery sector we made a SWOT analysis by using literature, statistical and field data. We made field studies and samplings in some manmade ponds, trout farm and Tatlıçay, Devrez and Acıçay tributaries in Çankırı, On the other side, interviews were made with the owners of trout farms. Through primary and secondary data we prepared a swot analysis with a systematic approach to scrutinize the sector.

Results and Discussion: Our field results showed that Ilgaz and Yapraklı district and Tatlıçay and Devrez tributaries are most suitable for trout farming. Manmade lakes are suitable for sport fishing and potential for leisure and tourism activities especially in Eldivan, Korgun and Yapraklı districts. Manmade lakes in Şabanözü district were not suitable for trout farming since their catchment surrounded by agricultural areas. Manmade lakes that were surrounded by forest are also suitable for trout farming in Eldivan district. Monitoring studies must be implemented for the evaluation of Water Quality of man-made lakes and Carrying Capacity for Trout Culture must be estimated according to these results. Based on the SWOT analysis results, the main strengths and opportunities of the sector are rich and clear inland water resources (15 natural lake, 22 manmade lakes and 13 more is in under construction, 6036 ha water surface area), increasing fishing demand in Turkey, low transport costs to main markets,, especially to neighbor big cities; leisure and tourism potential especially for sport fishing, incentives for fisheries sector. The main weaknesses and threats are marketing problems, low fish consumption of local people, non-educated employees and workers in sector, financial difficulties (high commercial fish-feed and production costs), weak infrastructure, non-professional family farming, absence of fisheries cooperatives, water quality degradation in drought periods. To overcome all these problems specific steps should be taken such as; constituting fisheries cooperatives, special discount for production costs of fish farms, making fisheries management and production plans for whole Çankırı province, implementing water resources monitoring studies, changing consumer's preferences. In conclusion, this sector has a great potential to improve in the future if the opportunities are evaluated with strengths and internal weaknesses are improved by taking advantage of external opportunities.

Keywords: Fish Production, Inland Waters, Çankırı

Parasite Fauna of Turkey's endemic Sakarya barb, *Capoeta baliki*, Turan, Kottelat, Ekmekçi & İmamoğlu, 2006, (Cypriniformes: Cyprinidae) from Seydi River, Turkey

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Objective: This study aimed to bring to light the parasite fauna of the Sakarya barb (*Capoeta baliki*), an endemic fish species to Turkey, in Seydi River.

Methods: A total of 65 individuals (34 female, 31 male) belonging to *Capoeta baliki* were collected by electroshock method from Seydi River (39°16'59.0"N 30°31'59.0"E). Fish sampling was carried out monthly in two stations, during the months of February, March and April of 2017. The specimens caught were identified, put into individual bags, frozen and later taken to the Parasitology Laboratory in the Biology Department under the Faculty of Arts and Science, Uludağ University, for parasitological examination. The frozen samples were thawed at room temperature before dissection. The weight, Standard Length (SL), Fork Length (FL) and Total Length (TL) of the fish were measured and recorded first before the fish were dissected. The gills and external surface were examined for ectoparasites and the gastro-intestinal tract was examined for endoparasites. The parasites found in the organs examined under the stereomicroscope were collected, identified, counted, and then fixed in 70% ethyl alcohol. Parasites were then diagnosed using parasites keys provided by Markevich (1951), Yamaguti (1961), Moravec (1994) and Anderson (2000).

Results and Discussion: Three parasite phyla were observed in this study. A protozoan parasite along with a total of 65 metazoan parasites was observed. These parasites were: 1 protozoa, *Myxobolus* sp., a digenea, *Allocreadium isoporum*, three (3) nematodes, *Contracaecum* sp., *Eustrongylides excisus* and *Rhabdochona denudata*. *Myxobolus* sp. was found in 18 fish, with a prevalence of 27.69%. The myxozoan parasite was of high significance as it had made a visible cluster on the gills of the fish. *A. isoporum* was found in 12 fish (18.46%) with a mean intensity of 3.92 and an infection range of 1-10. *Contracaecum* sp., *E. excisus* and *R. denudata* were found in eight (8) fish which accounted for 12.31% of the fish. Only one *Contracaecum* sp. was found in one fish. That translated to a prevalence of 1.54 and mean intensity of 1. *E. excisus* was found in two fish with a prevalence of 3.08% and a mean intensity of 1.5. *R. denudata* was found in five fish with a prevalence of 7.69% and a mean intensity of 2.8. There was significant parasite-fish weight or length relationship and also significant parasite-host sex relationship. This study provided the first ichthyoparasitological data for *C. baliki*. However, the parasites observed have also been found in previously studies on different fish in Turkey. Despite the rich parasite fauna, two helminth species were not encountered in the same host.

Keywords: Digenea, Nematodes, Protozoa, new host records

The Effects of Trout Farm in Rural to the Gastronomic Tourism

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Objective: Because of the need for continuous fresh and quality water, trout production is close to water resources, usually in rural areas. The fact that food parameters are influential on the perception of tourism increases the importance of gastronomic tourism. Consumers often prefer the restaurants of the trout plantations where they can see the fish live for their fresh fish consumption. In this study, a questionnaire study was conducted to determine the effects of trout farm in rural on the gastronomic tourism.

Methods: Survey technique was used as data collection tool in the research. The questionnaire was made with interviews with 202 female and 228 male consumers who came to trout farm's restaurant in the Central Anatolia Region during summer. The demographic characteristics of the participants and how long participants spent outdoors, their economic and educational levels were determined. The questionnaire also included a scale consisting of the destination and arrival distance of the region to determine the effect of the fishery facility to gastronomy tourism of the region. Research data were analyzed with the help of a SPSS statistical package program. Frequency and percentage distributions were used to determine the demographic characteristics of the participants.

Results and Discussion: The age distribution of percentages of participants was %13.95 for 14-20, 15.12% for 21-30, 20.23% for 31-40, 21.86% for 41-50, 22.56% for 51-60 and 6.28% for over 60. The fact that 14-20 years of age is close to other ages shows that families go eating fish with children. It seems that the aim of coming to area of participants is only to eat fish with 93.72%. That is, a significant amount of participants came to eat fish to the region no matter how long they come from. The highest distances which consumers travelled to the facility were Ankara (399 Km/1.86%), Kırşehir (204 Km/5.12%), Mersin (177 Km/12.33%), Adana (171 Km/30.93%), Kayseri (135 Km/3.95%), Nevşehir (108 Km /8.37%) and Niğde (60 Km/37.44%). The present study shows that the interviewees went to the trout farm in the rural to see live fish and eating freshly. Trout production farm in a rural with restaurant parts gives important and positive effects to the gastronomic tourism. It is clear that the people of the region are also selling their local products at the facility outlets and trout farms can also affects the marketing of local products outside the food dimension.

Keywords: Gastronomic tourism, trout farm, fresh fish.

Climate Change and the Future of Turkish Aquaculture Sector: Stakeholders' Perspective under the CERES Project Scenarios

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Objective: This study aims to investigate the opinions of Turkish aquaculture sector stakeholders on the possible impacts of climate change on the Turkish aquaculture sector. Stakeholders' opinions are gathered within the context of socio-political scenarios for the fishery and aquaculture sector in Europe. These socio-political scenarios are developed by the CERES (Climate Change and European Aquatic Resource) Project, with reference to IPCC (Intergovernmental Panel on Climate Change) release scenarios.

Method: This study is conducted using data gathered from two stakeholder workshops. First workshop is jointly organized by Mersin University CERES Project Team and Elazığ Aquaculture Research Institute on May 4, 2017 in Elazığ, Turkey. Second workshop is jointly organized by Mersin University CERES Project Team and Kılıç Deniz Inc. on May 22, 2017 in Muğla. In these two workshops, first CERES Project, along with its aim and scope, is introduced. Then the four socio-political scenarios for the fishery and aquaculture sector in Europe are explained to the participants. These four socio-political scenarios, developed by the CERES Project, are namely World Markets, Global Sustainability, National Enterprise and Local Stewardship Scenarios. CERES Project defines the "possibility-space" of these scenarios with an axis representing "global to local" and an axis representing "sustainability to consumerism". After explaining these socio-political scenarios, participants are requested to fill-out a semi-structured questionnaire consisted of 12 questions to gather data on participants' opinions about the likelihood of these scenarios to occur in the future; possible impacts of climate change on the Turkish aquaculture sector and their strategies (if any) to manage the impacts of climate change. In these two workshops, total of 20 stakeholders (12 producers and 8 other types of stakeholders) are volunteered to participate in the questionnaire.

Results and Discussion: Analysis of the collected data shows that the most likely scenario in the future is the World Markets Scenario. 13 participants have foreseen this scenario as the most likely scenario, while 5 participants have foreseen the Global Sustainability Scenario and 2 participants have foreseen the National Enterprise Scenario as the most likely scenarios in the future. None of the participants has foreseen the Local Stewardship Scenario as the most likely scenario in the future. Analysis results also show that the majority of participants believe that the climate change will have negative impact on aquaculture sector. However, nearly no participant has any strategy in their mind to manage the impacts of climate change. Among very few, the most notable strategy is the government to take active part by arranging meetings with the sector, predicting the impacts of climate change and enacting necessary legal regulations.

Keywords: Climate change, aquaculture, CERES socio-political scenarios

Reproductive Characteristics of Female Brood Stocks in an Established Rainbow Trout Hatchery and Preliminary Responses to Mass Selection

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Objective: The goal of this study was to evaluate the present reproductive characteristics of female brood stocks of an established rainbow trout hatchery located in the South Western part of Turkey prior to initiation of a farm based breeding program.

Methods: Reproductive characteristics of female brood fish from two different origins were evaluated in terms of total and relative fecundity, and eyeing ratio. Females ovulated in natural spawning season or out of the spawning season via photoperiod manipulation were lightly sedated with 2-phenoxyethanol. Their total lengths were measured to the nearest mm. Their weights were measured to the nearest g prior to or after stripping of eggs into a dry pan. Total volume of eggs was measured using a graded cylinder and the number of eggs stripped was assessed by means of volume replacement method. Eggs were fertilized from a pool of sperm obtained from 10-20 males by stripping and quality checked in regularly intervals under a binocular microscope. Each egg batch obtained from an individual female were placed into partitioned vertical incubators after water hardening. Eyeing ratio of eggs from females having relative fecundities within the highest 25% quartile were evaluated by checking eye spots in between 230-250 degree-days. Five hundred eyed eggs from each batch with $\geq 75\%$ eyeing ratio were taken, and raised to maturity in communal groups established based on hatching date closeness and stock origin. Reproductive characteristics of some selected females were similarly evaluated at the first and second year of maturity (2-3 years of age) and compared with their parents.

Results and Discussion: Total fecundity values showed increase by age and size of females. Relative fecundities, as expected, followed an opposite pattern of continues decline with increasing age and size of females from 3138 eggs/kg (for 1300 g and 1 year old fish) to 1390 eggs/kg (for 4113 g 3-4 year old fish). Eyeing ratio of eggs showed variation based on the spawning time (in or out of season), age of females, and individual females. Effects of mass selection for higher relative fecundity and realized heritability of this character in these stocks are going to be evaluated and discussed in details.

Keywords: Rainbow trout, *Oncorhynchus mykiss*, fecundity, eyeing ratio, mass selection

Comparison of PON, MDA and HDL levels of Young and Mature Rainbow Trout (*Oncorhynchus mykiss*, W. 1792) Obtained with Different Heat Shocks Applications

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Objective: MDA is a marker used to assess the effects of oxidative stress. PON is used to reduce the negative effects of oxidative stress in tissues and cells and it has a close relationship with HDL (Karatas and Kocaman, 2012). In this study, we aimed to determine the relationship between serum paraoxonase activity (PON), malondialdehyde (MDA) and high-density lipoprotein (HDL) levels of young and mature rainbow trout obtained with different heat shocks treatments (15 °C, 20 °C and 25 °C).

Methods: Fertilized eggs were shocked for 7 minutes in the batches provided to 15 °C, 20 °C and 25 °C±0.1 °C by aquarium heaters. The experiments were set up as a total of four groups, one control (9,6 °C) and three hot shocks (15 °C, 20 °C and 25 °C). The fish obtained by different heat shock treatments were subjected to a 17 month growth period. Alterations in PON, MDA and HDL levels of young (61-75 gr) and mature (1194-1417 gr) fish were recorded. Serum HDL, PON and MDA levels were measured according to methods described by Karakoç (2008) and Karatas and Kocaman (2012).

Results and Discussion: The malondialdehyde (MDA) levels of young and mature fish have been found important to be 25 °C > 20 °C > 15 °C, respectively (p > 0.05). The paraoxonase (PON) and high density lipoprotein (HDL) levels of young and mature fish have been found to be 15 °C > 20 °C > 25 °C > K, respectively (p > 0.05). In our study, MDA levels of young fish were found to be lower than mature fish. The low MDA level in young fish can be explained by the high level of serum paraoxonase (PON) activity. Another reason for the increase in serum PON enzyme activity may be an increase in HDL level. Because the serum PON enzyme is an enzyme found in HDL particles in the circulation. The increase in HDL synthesis will directly lead to an increase in PON concentration and consequently an increase in activity. The PON / HDL ratio was calculated to determine whether the increase in PON activity was due to the increase in HDL levels. PON / HDL ratio was found to be at an equal level among the groups. In our study, when serum PON values were compared with the literature, serum PON enzyme activity in all groups was found to be higher. This difference may be due to differences in water characteristics, nutrition, environmental variability, fish size and species

Keywords: *Oncorhynchus mykiss*, heat shock, MDA, PON, HDL

NOTE: This work is summarized from the doctoral thesis of Tayfun KARATAŞ

The Determination of Future Strategies for Aquaculture Activities in Avşar and Eşen Basins in Mugla Province where Aquaculture Production is Intense.

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Objective: This study is aimed at contributing aquaculture activities carried out in Turkey to get an eco-system friendly and sustainable structure. In order to achieve study's goals, the results of two projects conducted by Mugla Sıtkı Koçman University, Faculty of Fisheries in two different regions (Avşar and Eşen Basin) in Mugla where aquaculture activities are carried out intensely are compiled and summarized. Another purpose is to determine a future strategy by examining current situation analyses of aquaculture activities.

Methodology: Some of the data used in this study is obtained with in situ measurement; some is obtained with laboratory analyses and the rest is obtained from the results of survey studies, meetings and workshops. Physical parameters (temperature, salinity, pH, dissolved oxygen, total dissolved solids) used for detecting water quality are measured with a YSI multi-parameter instrument. Water samples are taken in order to reveal the effects of aquaculture facilities on the environment and then these samples are analyzed for nutrients (nitrite, nitrate, phosphate and ammonium nitrogen), solid suspended matter (SSM) and chemical oxygen demand (COD). Nutrients and COD analyses are conducted with spectrometric techniques; SSM is measured with the gravimetric technique. All the activities (survey studies, meetings and workshops) joined by shareholders are organized for the purpose of determining present management-organization and production processes of all the businesses/enterprises related to aquaculture sector and revealing some points which are missing and/or needed to be improved. All the results are also analyzed with IBM SPSS 20.0 statistically.

Discussion and Conclusion: As a result of this study, it is determined that according to the water quality analyses which have been conducted both by this project members directly and by enterprises in a regular and compulsory way, COD values of effluent waters of aquaculture facilities in both of the basins have never reached the limits (50 mg L⁻¹, Anonymous, 2008) written in the regulations. It is found out that unlike other enterprises, land-based aquaculture facilities do not produce complex pollutants (fat, grease oil, pesticides etc.); they just increase organic loading amounts in water. For these reasons, it is thought that the effluent water of aquaculture facilities should not be regarded as waste water. In order to monitor environmental effects in a healthier way, monitoring parameters of aquaculture facilities should be redetermined and their limit values should be capable of being distinguishable from other industries. It is also understood that both bearing capacity and water budget (surface/underground) of these two basins which are outstanding in aquaculture industry of Turkey are not exactly known. So as to ensure the sustainability of aquaculture activities in inland water in these two basins that contribute to country's economy significantly, a project should be conducted which can reveal water budget and bearing capacity of the regions where these activities are carried out.

Keywords: Avşar Basin, Eşen Basin, aquaculture, sustainability, COD.

Using of Potential Probiotic in Fish Feeding

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Objective: The objective of this study, using lactic acid bacteria (*Lactococcus lactis* subsp. *lactis*) isolated from freshwater fish as potential probiotic in Rainbow trout (*Onchorhynchus mykiss*).

Methods: In this study, 6 CTP circular tank with Ø 150 cm dimension and 1150 L capacity were used. For experiment, a total of 210 rainbow trout weight of 19±22g were used and each tank contained 35 fish species. Regular and constant water flow was supplied to tanks. Water temperature and dissolved oxygen was measured daily. The bacterial suspensions mixed with 100g commercial trout feed to obtain 10⁶-10⁸ (cfu/g) bacteria cell in 1 g of feed. Rainbow trout juvenile were fed with basic diet and probiotic supplemented feed for 28 days and survival rate and body composition were determined. The experiment was carried out in 3 replicates and SPSS 15.00 package program was used for statistical analysis.

Results and Discussion: At the end of the experiment, there were differences between the experimental group and the control group fed with probiotic diet in terms of live weight gain, live weight proportional growth, longitudinal growth and longitudinal proportional growth. There was no statistically significant difference in survival rates. This study showed us feeding including *Lactococcus lactis* subsp. *lactis* have positive effect on trout juvenile in terms of growth.

Keywords: probiotic, *Lactococcus lactis* subsp. *lactis*, feed

First Report of *Streptococcus parauberis* from Turkey**Zübeyde Hanol Bektas¹, Füsün B.Uçar², Soner Savaşer¹**¹*Fisheries Research Institute, Egirdir-ISPARTA*²*Aegean University, Faculty of Science, Department of Biology*

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Objective: *Streptococcus parauberis* is an alpha-hemolytic gram-positive coccoid bacterium belonging to the *Streptococcaceae* family. This bacterium cause streptococcosis is a major disease in cultured fish due to intensification of aquaculture and causes significant economic losses in fish farm industry. So our aim is isolate and identify *Streptococcus* species from freshwater fish species.

Methods: Firstly, the isolation of bacteria was carried out. After that biochemical and phenotypic characterization of bacteria isolates was made. For this the selective growth media such as M17, MRS agar were used. DNA isolation was carried out with the rapid phylogenetic analysis. For the molecular biological identification 16S rDNA about 1.5 kb regions of the 37 isolates were amplified with 27F (5' -AGAGTTTGATCCTGGCT-CAG- 3') and 1492R (5' -GGTTACCTTGTTACGACTT-3') primers using ARDRA PCR.

Results and Discussion: Upon the completion of the phenotypic tests, it was found that 25 of the 37 isolates belonged to the genus *Streptococcus*, 5 of them belonged to the genus *Lactococcus* and 2 of them belonging to the genus *Vagococcus*. After being amplified with universal primers definitive identification was made by sequence analysis. However, after the sequence analysis, while 34 of these 37 strains were identified, 3 were not. According to our knowledge this is first report for isolation and molecular identification for *S. parauberis* from wild fish and farm fish in Turkey. Due to the *S. parauberis* cause major disease in fish species we must alarm the relevant bodies against any disease outbreaks and we need to take precautions in fish farming Turkey. So this study can be helpful in the prevent of disease outbreaks and may help researchers in further scientific works.

Keywords: *Streptococcus parauberis*, fish diseases, molecular identification

Dietary protein requirements of zebrafish (*Dania rerio*)**Hüseyin Sevgili, Soner Sezen, Mahir Kanyılmaz, Özgür Aktaş, Faruk Pak***Mediterranean Fisheries Research, Production and Training Institute, ANTALYA*

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Objective: Zebrafish is widely used in research laboratories as a model animal but its dietary requirements is little known. This study was planned to estimate dietary protein requirements of zebra fish growing from 85 mg to 300 mg.

Methods: Thirty fish (total fish number 720) with an average weight of 88.61 ± 0.82 mg were randomly allocated to each of 24 10-L tanks connected to a recirculation system. Eight isoenergetic diets (18 MJ kg⁻¹ gross energy (GE)) were formulated to provide crude protein (CP) levels from 20 to 55% by 5% increments. Fish were fed *ad libitum* by hand at 09:00 and 16:00 h for 6 weeks. Each feed was tried in triplicated tanks. Fish were weighed biweekly intervals after an anesthetization. Initial and final whole body compositions were determined. Polynomial contrasts were used to detect linear and quadratic effects of dietary protein levels on the observed response variables. To estimate dietary protein requirement, a two-break points non-linear model was used based on 4th week and final specific growth rates (SGR_{Week4} and SGR_{Final}).

Results and Discussion: There was a quadratic trend of dietary protein levels on 4th week weight but it disappeared at the final. SGR values at week 2 and 4 were quadratically affected by the treatments, which also vanished at the end of the experiment. Dietary protein levels had a strong linear effect on daily feed intake, feed conversion ratio and protein efficiency rate. Minimum dietary protein requirements for SGR_{Week4} and SGR_{Final} were estimated by the a two-break points non-linear model as 27.69 and 28.93% respectively. This study suggests that zebrafish does not require very high protein levels, at least for the stages studied here.

Keywords: Zebrafish, dietary protein, two-break points, growth, feeding

Various Feeding Regimens in Larval European Catfish, *Siluris glanis*

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Objective: Aquaculture of European catfish has been attracted a serious attention in several European countries. However, more attention should be paid to feeding strategies during larval stages. This study was planned to test various feeding regimens during the larval stage of European catfish.

Methods: Nine feeding schedules in a 19-day-period after hatching were tried in triplicated 10-L tanks. The treatments included administrations of 19-day-artemia, *Artemia salina*, 19-day-daphnia, *Daphnia magna* (<1000 µm), 19-day-powdered commercial rainbow trout diet (150-300 µm) (CTD), 19-day-two commercial marine microparticle diets (A and B), 3 and 7 days artemia and then CTD and 7 days A and B and then CTD. 50 fish with an average weight of 12.37 mg were randomly allocated to each of 27 tanks connected to a recirculation system. Fish were fed abundantly over the experiment. One way analysis of variance (ANOVA) was used to detect the effects of dietary treatments on final weight, weight gain, weight and length specific growth rates (SGR_w and SGR_L) and then Tukey HSD test was performed to discriminate different treatments.

Results and Discussion:

Final weights of fish ranged between 79.9±2.9 mg in fish fed continuously CTD and 380.8±38.8 mg in those on daphnia, which was significantly higher than the other treatments except 3 day artemia and then CTD. Weight gain showed a similar trend. Final length, and SGR_L values were significantly higher in daphnia treatment than the rest. SGR_w values displayed a slightly different trend with comparable differences among fish on continuously daphnia, 3 artemia and then CTD, continuously microdiet A, and 7 day microdiet A and then CTD. Survival rates of catfish changed between 15.55% and 41.33 without significant differences. Briefly, the present result showed that the best growth was observed in European catfish fed with continuously daphnia.

Keywords: European catfish, micro diet, live food

Helminth Communities of Eğirdir Barb, *Capoeta pestai* (Pietschmann, 1933)**Nesrin Emre¹, Ayşegül Kubilay²**¹*Mediterranean Fisheries Research Production & Training Institute Antalya, TURKEY*²*Fisheries Faculty, Suleyman Demirel University, Isparta, TURKEY*

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Objective: It was aimed to determine the helminth parasite fauna of Eğirdir Barb, *Capoeta pestai*, an endemic freshwater fish to Turkey with this study.

Methods: A total of 150 specimens of *C. pestai* were collected by electrofishing method in Çayköy stream flowing to Lake Eğirdir (Isparta, Turkey) seasonally between January 2013 and February 2014. Fish samples were transported to the laboratory. They were kept alive in an aquarium until dissection. All fish specimens were weighed and measured and their sex was determined. The gill filaments, eyes, fins, body surfaces and the internal organs (gastrointestinal tract, liver, kidney, heart, swim bladder) of fish samples were examined under a dissection microscope. The parasite species were identified, counted and photographed using a stereo microscope which is equipped with a digital camera. The collected parasite specimens were identified using Bychovskaya (1962), Gussev (1985), Gussev et al. (1987), Moravec (1994, 2004). The parasitological parameters, prevalence, mean intensity and abundance values for each parasite species were calculated according to Bush et al. (1997).

Results and Discussion: A total of two species *Allocreadium isoporum* (Loos, 1894) (Digenea: Allecreadiidae) and *Rhabdochona denudata* (Dujardin, 1845) (Nematoda: Rhabdochonidae) were identified. All parasites were found in the intestine of fish specimens. *R. denudata* was the dominant parasite species with 592 individuals in 110 fish samples. The prevalence of *A. isoporum* was less than the other one with 188 individuals in 58 fish samples. The parasitological findings of the identified parasite species were evaluated and discussed in relation to host sexes, age, length group and seasons.

Keywords: endemic fish, *Capoeta pestai*, Digenea, *Allocreadium isoporum*, Nematoda, *Rhabdochona denudata*.

Replacement of Dietary Fish Meal by Soybean Meal and Cottonseed Meal on Growth Performance of Sturgeon (*Acipenser güldenstaedti* Brandt, 1833)

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Objective: In recent years, the incorporation of alternative protein sources in the diet by reducing dietary fish meal gained a specific concern. In this study, the effect of replacement of fish meal by soybean meal and cotton seed meal on the growth performance of sturgeon was investigated.

Methods: Five experimental diets were formulated to be isonitrogenous (49% protein) and isolipidic (20% lipid). Experimental diets were obtained including, as fed basis, graded levels of soybean (SM) and cotton seed (CM) meals [FM (control diet, with no SM and CM inclusion, with fish meal), SM20 (20% SM inclusion), SM40 (40% SM inclusion), CM20 (20% CM inclusion) and CM40 (40% CM inclusion)]. The feeding trial was carried out at the Kepez Unit of Mediterranean Fisheries Research Production and Training Institute, Antalya, Turkey. At the start of the trial, fish weighing 50.00 ± 0.06 g were randomly distributed into twenty-one 500-L square tanks at 25 fish per tank. Fish were weighed in bulk biweekly after suspending feeding for 1 day. Fish were fed near satiation by hand at 08:00; 12:00 and 16:00 hours for 12 weeks. Feed was carefully administered by dropping a few pellets until the feeding activity ceased.

Results and Discussion: Sturgeon fed CM20 and CM40 diets displayed higher specific growth rate (SGR) when compared with fish fed SM40 and FM ($P < 0.05$). The feed conversion ratio (FCR) of all cotton seed meal diets was lower when compared with the SM40 and FM diets ($P < 0.05$). The results of this study demonstrated that dietary cotton seed meal could be used for enhancement in growth performance of juvenile sturgeon.

Keywords: Cotton seed, soybean meal, sturgeon, growth

Fish Consumption Habits in Konya

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Objective: This study; aimed to determine fish consumption habits in Konya province.

Methods: The survey was conducted with 424 people using face-to-face question and answer, using a simple random sampling method with equal probability. Twenty-six questions were asked for 128 female and 296 male participants and the results were analyzed and interpreted in the Ms-Excel program.

Results and Discussion: It was determined that 27% of the individuals who participated in the survey are between the ages of 19 and 24 and 40% of them are students and 53% of them were university and 26% were high school graduates. It is understood that 51% of the respondents prefer to fish at least once a month, 97% prefer fresh fish and 60% fry in vegetable oil. While 47% of the respondents consume all types of meat, 27% consume red meat, 13% chickens and 12% prefer fish meat. According to the fish species, it was found that the anchovy was preferred with 44%, the sea bass with 14% and the sea bream with 11%, respectively. Fish meat was found to be consumed less than red meat and poultry meat. Similar results were obtained with other studies in terms of monthly consumption frequency, consumption quantities and cooking preference.

Keywords: Fish consumption, habits of consumption, survey, Konya

Meat Yield, lipid level, and Fatty Acid Profiles of Anatolian Minnow *Pseudophoxinus anatolicus*, Hanko, 1925) from Seydişehir/Konya, Turkey

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Objective: In this study, it is aimed to search meat yield, lipid level, and fatty acid profiles of Anatolian minnow (*Pseudophoxinus anatolicus*, Hanko, 1925), an endemic and an endangered fish species (IUCN Red List) from Kuğulu Park-Seydişehir/Konya, Turkey.

Methods: Total length and total body weight of the fish specimens were measured to the nearest 0.1 cm with a measuring board and weighed with 0,01 g precision digital scale, respectively. Meat yield was calculated as the ratio of fillet weight to body weight. Determination of the crude lipid was performed by using modified Bligh & Dyer by (Olley and Hanson, 1963). A GC-MS (Gas Chromatography-Mass Spectrometry) was used to determine fatty acids of the fish flesh. One way ANOVA was performed to see the differences between male and female. Significance was established at $p < 0.05$.

The fish used in this study were a part of a preliminary study of a project which was about cultivating of this species. Fish were caught by seine net and tried to catch alive with a careful handling for breeding however some mortality inevitably happened for some reasons (catching, handling, transporting, and adaptation process).

Results and Discussion: The average total length of the female and male Anatolian minnow were measured to be 10.0 and 9.8 cm, respectively. The mean body weight of female and male the Anatolian minnow were weighted to be 14.36 g and 10.31 g, respectively. Additionally, the meat yield of female and male Anatolian minnow were calculated very close to each other. Additionally, the saturated fatty acids and polyunsaturated fatty acids of the male Anatolian minnow were found to be slightly higher than female ones. The monounsaturated fatty acids of both gender of the fish muscle constitute nearly 50% of the whole fatty acid identified in this study. The major fatty acid was oleic (C18:1n9) acid followed by palmitic (C16:0) and linoleic acid (C18:2n6) in muscle of the female and male Anatolian minnow. The levels of arachidonic acid (C20:4n6) of the fish were found to be closer to 1%. Omega-3 fatty acids constitute almost 10% of the total fatty acids. eicosapentaenoic acid and docosahexaenoic acid in the fish lipid were in lower amounts. Data of this research showed that female and male Anatolian minnow can be considered as an excellent healthy food item due to higher amount of lipid content which is qualitatively and quantitatively suitable for a healthy diet.

Keywords: Anatolian minnow, *Pseudophoxinus anatolicus*, fat, fatty acid, omega-3

Control of Microflora in Seafood Plant by Chemical Disinfectants

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Objective: The aim of this study is to provide a review on the available information about the disinfectants used in seafood plants and also investigate new developments on disinfection method.

Introduction: The consumption of fish and seafood has been increasing by each year because of their value as a diet and for person's health. Moreover, these products reach to the consumers in each region of the world. Microbiological controls in fish production area and processing area cause the good quality of the food products. Fish might contain in different numbers of microorganism from different sources such as; seafood plants, areas where they are caught and stored, environment where they are produced. In order to control the microorganisms, attention should be paid to these sources and equipment or materials that may cause other sources of contamination must be cleaned by using disinfectants. The selection of the disinfectants in seafood plants depends on many factors. For example, the type of microorganism, the structure of the surface and equipment, the chemical structure of disinfectant, the cost and others must be taken into account.

In seafood plants, the disinfection is carried out applying three different chemicals following to each other. The disinfectants that use in seafood plants are chlorine and chlorine compounds (sodium hypochlorite), quaternary ammonium compounds (benzyl-C12-16-alkyldi methylchlorides), aldehydes (glutaraldehyde solution). All disinfectants are prepared as concentration of 2% in pure water before used. These disinfectants are usually applied to the surfaces using pressurized equipment with a spraying method. On surfaces where disinfectants are applied, the activity may vary depending on concentration, duration of disinfectant and also temperature of the environment.

In conclusion, the increased microbial load during processing of food reduces the shelflife of the processed fish and the microbial quality of the food. The continuous use of a selected disinfectant in the same environment could lead to development of resistance in microorganisms. Especially, in seafood plants, it is priority to show high attention to remove microorganisms from the surfaces where fish contact by applying effective disinfectants which are not harmful to human health. In this regard, there is need to search for new products or chemicals for using as disinfectants in seafood plants.

Keywords: Disinfection, processing, microorganisms, aldehyde, chlorine, disinfectant

Determination of Seasonal Variations of Fatty Acid and Amino Acid Profiles of *Squalius berak* Heckel, 1843

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Objective: The aim of the present study is to determine the seasonal variation of fatty acids (FA) and amino acids (AA) in the muscle tissue of *S. berak* from Özlüce Dam Lake (Bingöl/Elazığ), Turkey.

Methods: The level of fatty acids, and amino acids of *S. berak* were determined in 60 specimens obtained from Özlüce Dam Lake. Fish were caught between January and December (2016). 15 fishes were taken from each season for analysis of fatty acid and amino acid components. Muscle samples (without skin) taken from each fish were homogenized. Lipids of muscle samples were extracted with hexaneisopropanol(3:2 v/v). Nearly 1 g tissue sample was homogenized with 10 ml hexaneisopropanol mixture. The homogenate was centrifuged at 5000 rpm for 5 min at 4 °C and parts of tissue remnants were precipitated. The supernatant part was used in fatty acid analysis. The fatty acid components were analysed by gas chromatography as the methyl esters. Derivatization of amino acids (AA) with N-(t-butyldimethylsilyl)-N-methyltrifluoroacetamide (MTBSTFA) causes the simultaneous silylation of the amino- and carboxyl groups in a single step. Each sample protein was hydrolyzed and was spiked with 1 mL of the internal standard working solution (1.5 µg) and evaporated to complete dryness. Finally, the sample was heated at 70°C for 20 min to achieve the chemical derivatization of AA and the derivatives were analyzed by GC-MS. Methyl esters were analyzed with the Shimadzu GC-17 Ver. 3 gas chromatography (Kyoto, Japan). For this analysis, 25 m of long Machery-Nagel (Germany) capillary column with an inner diameter of 0.25 µm and a thickness of 25 micron film was used. During the analysis, the column temperature was kept at 120-220°C, injection temperature was kept at 240°C and the detector temperature was kept at 280°C. The nitrogen carrier gas flow was 1 ml/min. The methyl esters of fatty acids were identified by comparison with authentic external standard mixtures analyzed under the same conditions. After this process, the necessary programming was made and the Class GC 10 software version 2.01 was used to process the data. The analysis of AA derivatives, a Shimadzu gas chromatograph (2010 plus) modified for glass-capillary work and a FID were used. AA derivatives were separated on a 20 m Supelco S1b 5 ms capillary column (Supelco, Sigma, 0.25 mm ID 0.25 m film thickness) operating with helium carrier gas (45 cm/sec) under the following temperature program: from 120 to 150 C at 120 C/min (5 min hold), to 240 C at 7 C/min and finally to 285 C at 20 C/min (18 min hold). The temperature of the injector and detector was kept constant at 240, 300 C, respectively. The identification of AA derivatives was based on comparison of their FID chromatogram and retention times with those of authentic reference

Results and Discussion: In this study, *S. berak* was examined for fatty acid and amino acid variety. Amino acids and fatty acids were identified at the seasonal variation. The fatty acids were grouped as saturated fatty acid (SFA), mono unsaturated fatty acid (MUFA) and poly unsaturated fatty acids (PUFA). The results of present study showed that 20 different fatty acids ranging from C8:0 - C24:1 were found in the fatty acid profile of *S. berak*. In all seasons, major (C16:0) palmitic acid as the saturated fatty acid, major (C18: 1 ω9) oleic acid as the monounsaturated fatty acid and major (C22:6 ω3) docosahexaenoic acid (DHA) as the polyunsaturated fatty acid were found. The results of present study showed that 18 different (8 essential and 10 non-essential) amino acids were found in the amino acid profile of *S. berak*. Among the amino acids analysed in all seasons, Aspartic acid (Asp) and Alanin (Ala) were the highest followed by Glutamic acid and Leucine (Leu). As a result, differences in the proportions of fatty acids and amino acids were determined seasonally. Higher amino acids and polyunsaturated fatty acids (PUFA) content have been identified, especially during the winter seasons. Finally, we can suggest *S. berak* as a good source of amino and fatty acids for human health especially winter season.

Keywords: Lipid, Protein, Fish, Turkey

Seasonal Changes of Length-Weight, Meat Yield and Chemical Composition of Khramulya Fish (*Capoeta antalyensis*)

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Objective: In this study, it was aimed to determinate of seasonal changes of length-weight, meat yield and chemical composition of khramulya fish (*Capoeta antalyensis* Battalgi, 1943).

Methods: Totally 125 fish were used in the study, which of 31 fish in the spring, 10 fish in the summer, 23 fish in the autumn, and 61 fish in the winter was caught by using gill nets in the Sorgun Dam. The fish were brought to laboratory in cold chain condition. The length of fish was measured, and the weight was weighed. The sexuality of fish was determined macroscopically. The viscera, head, the backbone, and the fins were weighed to determination of the meat yield. The fish filleted, and then the fillets with skin were weighed and also skinless fillets. The skinless fillets were homogenized with a blender. The ash value (%), the moisture value (%), protein value (%), the lipid value (%) of minced fish was determined.

Results and Discussion: The fish used in the study were determined 79 female, 43 male, but the sexuality of 3 fish not identified. The highest length of fish was 36.7 cm (measured in the summer), and the lowest was 17.7 cm (measured in the spring). The highest weight of fish was 526.91 g (weighed in the spring), and the lowest was 57.03 g (weighed in the spring). The age of fish changed among 1-6. The length-weight relation for all fish was determined as $W=0.0203X^{TL2.7743}$. Condition factor mean value (K) was 0.99 (for all samples), and relative condition factor (K') was 1.00. The fillet weight was weighed with skin the highest as 200.21 g and the lowest as 37.01 g (in the spring), also, for the skinless the highest as 173.02 g, and the lowest as 32.32 g (in the spring). The meat yield was found for the fillet with skin as the lowest 50.2 %, and as the highest 56.42 %, also for the skinless fillet as the lowest 40.65 %, and as the highest 48.12 %. The lowest and highest chemical composition value were changed for ash among 1.00-1.42 %, for moisture 79.83-81.73 %, for protein 14.06-15.73 %, and for lipid 2.38-2.87 % for all season. The length and weight value obtained by us in this study were determined the higher than the reported value for this species until now.

Keywords: Khramulya fish, condition factor, chemical composition and meat yield

Detecting the Consumer's Fish / Yogurt Perceptions (Central Anatolia Model)**Sertan Aytac¹, Emre Yavuzer¹, Mebrure Nuket Yavuzer²**

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Objective: In this study, it is aimed to detect the consumer's perception about fish with yogurt. Lots of people believes that fish and yogurt can cause poisoning when they have eaten together. However, its known that when fish and yogurt are fresh enough there will not be any biogenic amine toxins and poisoning. In this study, a questionnaire study was conducted to determine the consumer's fish/yogurt perceptions on 88 female and 112 male consumers who eats fish regularly.

Methods: Survey technique was used as data collection tool in the research. The demographic characteristics of the participants and how long participants spent outdoors, their economic and educational levels were determined. Research data were analyzed with the help of a SPSS statistical package program. Frequency and percentage distributions were used to determine the demographic characteristics of the participants.

Results and Discussion: In this study, participants consisted of post graduates (12%), university graduates (32%), high school graduates (54%) and secondary school graduates (3%). The study results showed that 1 percent of participants eat fish 2-3 times per week, 1 percent of participants consumed fish once a week, 13 percent of participants 1 times per fifteen days, 37% of participant once or two times per month and 49 % of participant one time per 2 or 3 months. The consumers were asked "What kind of fish do you buy?" 66% of participants answered as aqua cultured fish, 27% of participants answered hunted fish and 7% of participants answered frozen fish. 31% of participants answered as "Yes" to the question of "Do you eat fish and yogurt at the same time" while 69% of them answered as "No". In study a new question asked to the "No" group which does not eat fish and yogurt together. The question was "Why Don't you eat fish and yogurt together?" 7% of participants said "I know it does not make poisoning but I don't like them together" and 93% of participants said "I think that they make poisoning when eating them together" The last question asked only this group as "If an expert says you fish and yogurt do not make poisoning when they eaten together, do you change your opinion?" 90% of participants said "No" when others (10%) says "Yes". The present study shows that fish/yogurt perception on consumers is quite large and only a few of them's perception is changeable.

Keywords: Fish/yogurt perception, consumer's behaviors.

Different Packaging Methods Effects on Chemical Quality and Sensory Criteria of Marinated Crayfish (*Astacus leptodactylus* Esch., 1823)

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Objective: In this study, it is aimed to determine the effects of vacuum packaging, sous-vide packaging and in brine on sensory and chemical parameters of marinated crayfish (*Astacus leptodactylus* Esch., 1823) in the storage at 4±1°C for 120 days.

Methods: In the present study, 22 kg of crayfish (*Astacus leptodactylus*) were caught from the natural environment in Keban Dam Lake with the fyke net. Then crayfish samples were boiled for 10 minutes and separated from their carapace and then were immersed in solutions containing acetic acid and NaCl. After the marination process, the samples were packed in three different methods (in brine, vacuum packed and sous-vide) and stored at 4±1°C. During storage, sensory, pH, total volatile base- nitrogen (TVB-N), thiobarbituric acid (TBA) and peroxide value (PV) were done periodically.

Results and Discussion: At the end of 4 months storage period, TVB-N were 53.25±0.40, 37±0.29 and 27.65±0.24 (mg/100g), TBA were 5.44±0.09, 3.57±0.04 and 2.54±0.04 (mg malonaldehyde/kg), PV were 56.4±0.95, 26.1±0.25 and 10.36±0.6 and pH were 4.93±0.03, 4.59±0.01 and 4.48±0.01 for brine, vacuum packed and sous-vide packed samples, respectively. Throughout the storage period, effect of different package methods on TVB-N, TBA, PV, pH, and sensory issues were significant (p<0.05).

Keywords: *Astacus leptodactylus*, quality properties, vacuum packing, sous-vide

The Future of Ancient DNA in Conservation Genetics

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Objective: The objective of this study was twofold: (i) to develop an optimized DNA extraction protocol for archived otoliths based on NucleoSpin Tissue, Macherey-Nagel commercial kit and (ii) to compare it to the protocol based on EDTA-SDS with the aim to assess DNA quantification.

Methods: In this study, the quantity and quality of DNA, which was extracted from archived otoliths using two varying protocols, were compared. In the first protocol, a commercial kit was used. In the second protocol, we developed an extraction method in order to reduce damage to otoliths by modifying EDTA and SDS-based lysis solution. Later on, DNA was obtained by using standard phenol-chloroform method.

Results and Discussion: Archived otoliths offer valuable sources of material for temporal genetic analysis. These sources however often are limited, fragile and easily damaged. Furthermore, DNA extraction from the archived otoliths is generally difficult when compared to contemporary examples. Therefore, it is of critical importance to develop species-specific combined methods for DNA extraction from archived otoliths without damaging the physical structure of the otolith.

The yield of DNA obtained from archived otoliths is generally low in the studies aiming at revealing the historical genetic variation of populations. In this study, however, the amplification rates of polymerase chain reaction were considerable in the two protocols used in this study. The results of this study are consistent with many studies that reported low amplification success rates from archived otoliths which were used as DNA source.

Keywords: Archived otoliths, DNA, Temporal genetic analysis.

Karyology of Endemic *Luciobarbus kottelati* Turan, Ekmekçi, İlhan & Engin, 2008 (Teleostei, Cyprinidae) in Anatolia

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Objective: The aim of this study is to present the diploid chromosome number ($2n$) and chromosome morphologies of endemic *Luciobarbus kottelati* Turan, Ekmekçi, İlhan & Engin, 2008 (Teleostei, Cyprinidae) from Turkey for the first time.

Methods: The specimens (one female and one male) were collected from Büyük Menderes River. They were transported alive to the laboratory. Chromosome preparations were obtained from the head kidney cells by using the “air drying technique”. At least 10 slides were prepared from each specimen. Preparations were scanned with a Leica DM 3000 microscope and photographs of good metaphase plaques were taken. At least 100 metaphase plaques were counted to determine the $2n$. For calculating the fundamental number (FN) metacentric and submetacentric chromosomes were taken as biarmed whereas subtelo-acrocentric chromosomes were taken as uniarmed.

Results and Discussion: The $2n$ of *L. kottelati* was determined as 100. Karyotype was consisted nine pairs of metacentric, 17 pairs of submetacentric and 24 pairs of subtelo-acrocentric chromosomes. FN was calculated as 152. Morphologically differentiated sex chromosomes were not observed. This study is a contribution to Anatolian cyprinids chromosomal knowledge.

Keywords: Büyük Menderes River, cyprinid, karyotype, *Luciobarbus*

Acknowledgment: This work was supported by the Ahi Evran University Scientific Research Projects Coordination Unit. Project Number: FEF.A3.16.013.

Features of Constitutive Heterochromatin and Nucleolar Organizer Regions of *Luciobarbus kottelati* Turan, Ekmekçi, İlhan & Engin, 2008 (Teleostei, Cyprinidae)

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Objective: The purpose of this study is to determine the properties of constitutive heterochromatin (CH) and nucleolar organizer regions (NORs) of endemic *Luciobarbus kottelati* Turan, Ekmekçi, İlhan & Engin, 2008 (Teleostei, Cyprinidae) from Turkey.

Methods: Individuals of *L. kottelati* (one female and one male) were collected from Büyük Menderes River. Specimens were transported alive to the laboratory. Metaphase chromosomes were obtained from the kidney cells by following the “air drying technique”. C-banding (CH) technique and Ag-NOR staining were performed to the slides. On the average of 10 slides were prepared from each specimen. The slides were investigated with a Leica DM 3000.

Results and Discussion: C-bands were determined on the pericentromeres of several chromosome pairs. Ag-NORs were on the telomeres of the short arms of two submetacentric chromosome pairs. Additionally two, three, five and six signals of Ag-NORs were observed. Obtained data is basis for cytogenetical research of Anatolian cyprinids.

Keywords: Büyük Menderes River, cyprinid, constitutive heterochromatin, nucleolar organizer region (NOR), *Luciobarbus*

Acknowledgement: This work was supported by the Ahi Evran University Scientific Research Projects Coordination Unit. Project Number: FEF.A3.16.013.

Identification of genes responsible for lutein biosynthesis in *Scenedesmus obliquus* by transcriptome analysis

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Objective: The aim of this study is to identify genes involved in lutein pigment biosynthesis in *Scenedesmus obliquus* cells by analyzing RNA-Seq data.

Methods: *S. obliquus* cells were cultured in BG11 medium at 25-30 °C with a 14 hours of light (150 $\mu\text{mol photons m}^{-2} \text{s}^{-1}$) and 10 hours of dark photo-period until the end of the exponential phase. Then, cultures were exposed to the light intensity of 1800 $\mu\text{mol photon m}^{-2} \text{s}^{-1}$ for 10 hours after the last dark cycle to increase the likelihood of genes responsible for lutein synthesis in the cDNA pool. 300 mg dry algae was harvested and used for cDNA library preparation. For library preparation, Illumina TruSeq Stranded mRNA Library Prep kit was used. Illumina HiSeq™ 2000 was used for transcriptome sequencing from generated cDNA library. Trinity package was used for *de novo* assembly of sequence reads to obtain transcriptome data. The data processed through Trinotate software for functional annotation of assembled transcripts. To identify genes responsible for lutein biosynthesis, we downloaded sequence information from NCBI for the genes that are responsible for lutein biosynthesis in other species and compared those to transcriptome data by BLAST analysis.

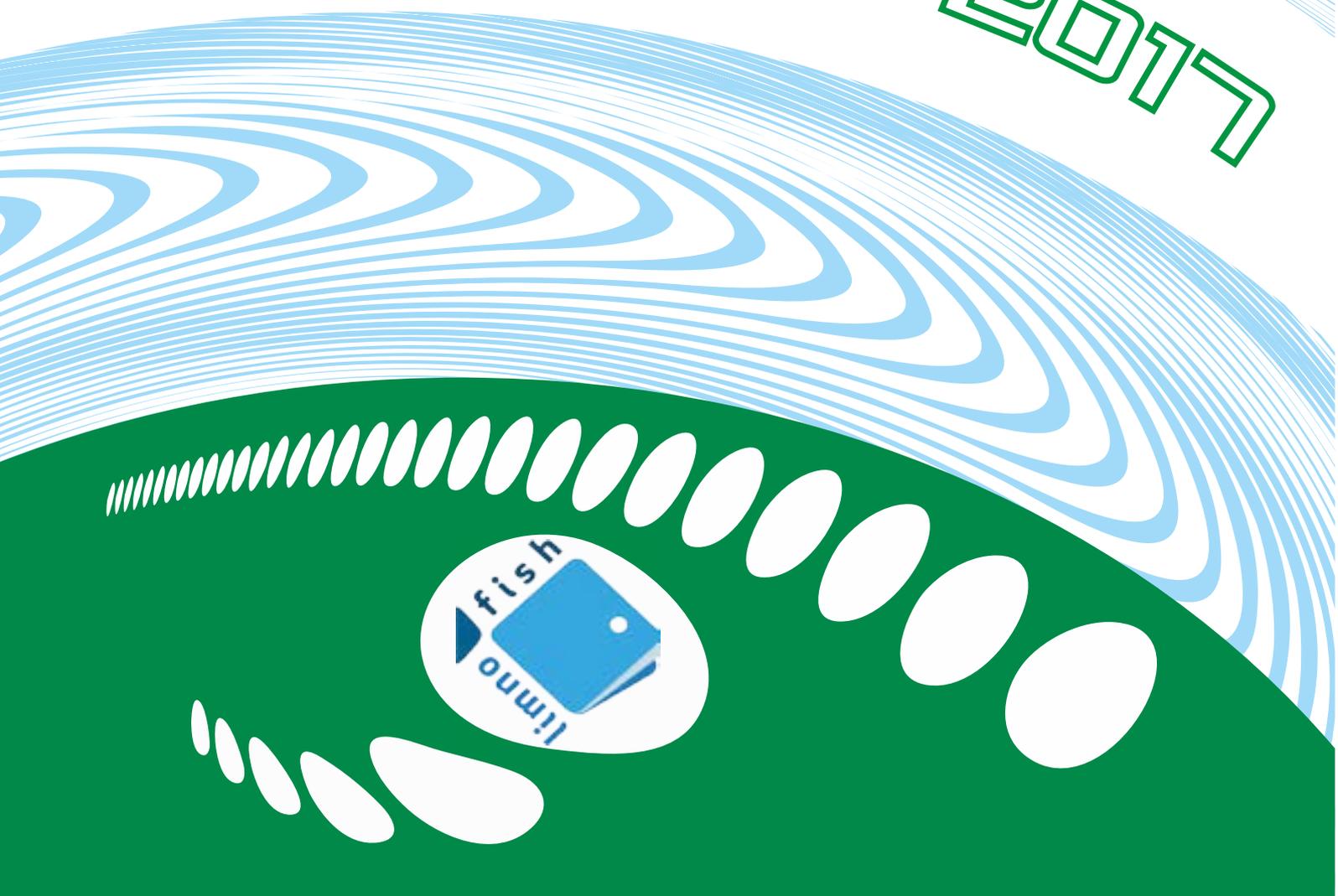
Results and Discussion: Approximately 70 million raw reads were generated by Illumina HiSeq™ 2000 sequence analysis. After *de novo* assembly protocol, a total of 21490 unigenes belonging to 27737 transcripts were obtained. Calculated N50 value was 719.14, and the average contig length was 1032. Larger value of average contig length compared to N50 value shows significant transcriptome assembly. Transcripts were compared against different databases such as BLAST, Pfam, and Swiss-Prot and around 49% of the sequences were functionally annotated. Transcriptome sequence data was further processed to identify genes responsible for lutein biosynthesis. All 10 genes required for lutein biosynthesis in plant and algae species were also identified for *S. obliquus*. This is the most comprehensive study providing the annotation of *S. obliquus* transcriptome. The data produced in this study will be used for molecular approaches in biotechnological applications related with *S. obliquus* such as increasing the yield of pigment production.

Keywords: Trinity, *de novo* assembly, bioinformatics, microalgae

1ST INTERNATIONAL SYMPOSIUM ON LIMNOLOGY AND FRESHWATER FISHERIES

POSTER PRESENTATION

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The Gastropod Fauna of Polat Stream (Malatya, Turkey) and Some Physico-Chemical Parameters of Their Abundance

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Objective: The aim of this study is that to investigate both ecological and biological species assemblages of gastropod fauna of Polat Stream (Malatya/ Turkey).

Methods: Sampling was done seasonally at 5 different stations in Polat Stream using Surber net between July 2013 and May 2014. Gastropods samples were preserved in 70% ethanol within plastic bottles. Furthermore water temperature, pH, dissolved oxygen(DO) and electrical conductivity meter (EC meter) were measured by using YSI 556 model multi-parameter instrument as in situ. The values of nitrate-nitrogen (NO₃-N), nitrite-nitrogen (NO₂-N) were determined in the laboratory within 24 hours according to standart methods. Geographical data (coordinates) were recorded with geographical positioning system (Garmin e-trex – GPS) unit.

Results and Discussion: This study was carried out by the streams of Malatya province (Turkey) to determine gastropod fauna. Gastropod fauna of the stream of Polat was represented by two species of Prosobranchia (*Anadoludamnicola gloeri*, *Anadoludamnicola gloeri brevis* (Koşal Şahin 2012) and, four species of Pulmonata (*Radix labiata* (Rossmässler, 1835), *Physella acuta* Draparnaud 1805, *Ancylus fluviatilis* O. F. Müller, 1774 *Acroloxus lacustris* (Linnaeus 1758). It was also observed the number of species increased in spring and summer and the number of species decreased in autumn and winter. Among the 5 stations in Polat Stream, *Anadoludamnicola gloeri*, *Anadoludamnicola gloeri brevis* were the most widespread species. According to water quality parameters stations were determined to be quality classes I-II. All taxa have been recorded in Polat Stream for the first time.

Keywords: Gastropod, Polat, distribution, Malatya, water quality

Acknowledgements: This research has been supported by Unit of Scientific Research Projects, İstanbul University (Project No: 51379).

Assessment of Marmara Lake (Manisa-Turkey) Water Quality

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Objective: Marmara Lake which is located in Gediz River Basin has been turned into irrigation reservoir since 1953 while it was an alluvium set lake. Fishing activities are also carried out in this lake. Water quality is important in terms of lake ecosystem and efficient usage of lake. Water pollution in Gediz River Basin has been the primary problem in recent times. This study aims to determine the current water quality and trophic level of Marmara Lake.

Methods: This study was carried out monthly at 3 different stations in Marmara Lake between January and December 2016. Suspended solid matter, volatile solids and fixed solids were analyzed with gravimetric methods. Analyses of ammonium nitrogen, nitrite nitrogen, nitrate nitrogen, phosphate phosphorus, silica and chlorophyll-*a* have been performed using a spectrophotometer. Alkalinity (CaCO₃) was analyzed with titrimetric method. Differences between seasons and stations were statistically tested. Water quality and trophic level of the Marmara Lake have been determined referring to Inland Water Quality Standards and the Boundary Values of Trophic Classification System of Lakes, Ponds and Reservoirs (YSKYY, 2015).

Results and Discussion: Average values of water quality parameters were calculated as; 22.53 ± 4.71 mg/l for suspended solid matter, 6.52 ± 1.47 mg/l for volatile solids, 16.01 ± 3.81 mg/l for fixed solids, 0.044 ± 0.008 mg/l for ammonium nitrogen, 0.009 ± 0.001 mg/l for nitrite nitrogen, 0.011 ± 0.006 mg/l for nitrate nitrogen, 0.036 ± 0.008 mg/l for phosphate phosphorus, 26.69 ± 6.76 µg/l for chlorophyll-*a*, 161.54 ± 10.03 mg/l for alkalinity (CaCO₃) and 3.65 ± 0.602 mg/l for silica. The difference between seasons was found statistically significant in all parameters ($p \leq 0.05$). The water quality of the lake has been evaluated in terms of nutrient parameters. Accordingly, Marmara Lake has been categorized as Class-I by means of average ammonium nitrogen and nitrate nitrogen; Class-II by means of nitrite nitrogen and phosphate phosphorus. Trophic level of lake is eutrophic by the phosphate phosphorus value and is hypertrophic by chlorophyll-*a* value. For sustainable use of the lake, lake ecosystem should be protected and water quality must be continuously monitored.

Keywords: Marmara Lake, Water quality, Nutrient parameters, Trophic level, Eutrophic.

Heavy Metal Levels in Mussels from Keban Dam Reservoir (Elazığ, Turkey)

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Objective: Aquatic organisms, sediments and water samples are used to monitor contaminants. The relevance of sediment measurements is limited, since contaminants bound to the substrate by adsorption may not be bio-available for immediate uptake by aquatic organisms. In addition, varying concentrations on the sediment may reflect changes in the binding properties of the sediments rather than variations in the pollution levels of the sediments. The relevance of direct analysis of water is also limited in the case of hydrophobic contaminants, whereas contaminant levels are usually below detection limits. Therefore, living organisms should also be used to monitor environmental contamination, since they may reflect the contamination history of a particular location because they have been exposed during their entire lifetime and are capable of accumulating these toxic substances in their lipid tissue fractions. Mussels are commonly used to monitor heavy metal contamination. In this study, mussel (*Unio elongatulus eucirrus*) was used to monitor heavy metal contamination in the Keban Dam Reservoir.

Methods: In this study, *Unio elongatulus eucirrus* was collected seasonally from 11 sampling sites between autumn 2014 and summer 2015. They were collected by hand. Immediately after collection, all samples were transferred to the laboratory on ice boxes. The soft tissues of mussels were dissected from shells. Cr, Cu, Fe, Mn, Ni, Pb and Zn were analyzed in mussel samples. For heavy metal analysis, 2 g of previously homogenised sample was digested with 10 ml HNO₃ (65%):H₂O₂ (30%) (4:1) mixture in a microwave digestion unit. After cooling to room temperature, the digested solutions were filtered and adjusted to 50 mL with ultrapure water. Pb levels were measured by using a graphite furnace AAS, while levels of other elements in the extracts were measured by a flame AAS.

Results and Discussion: In mussel samples, the most abundant metals were Fe and Mn, whereas Pb and Co were the less abundant. Heavy metal concentrations in the samples followed the order: Fe>Mn>Zn>Ni>Cr>Cu>Co>Pb. In addition, Pb levels were lower when compared with a previous study conducted in Keban Dam Reservoir. The mean levels of Cr, Cu, Pb and Zn were below the maximum permissible levels set by international food standards.

Keywords: Heavy metals, mussels, Keban Dam Reservoir

Zooplankton Composition and Abundance of Hypersaline lake: Lake Acıgöl (Denizli, Turkey)

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Objective: In this study, the zooplankton composition and the some physicochemical properties of Lake Acıgöl has been studied.

Methods: Lake Acıgöl is a shallow athalassic saline lake of a tectonic origin. It is located 836 m above sea level has a maximum length and width of about 45 km and 14 km, respectively, has an area of about 157 km² of which only 55-60 km² are covered by the lake water. Zooplankton and water samples were taken monthly from nine stations between February - November 2016 from Lake Acıgöl. Zooplankton samples were collected by horizontal hauls, using standard plankton net (mesh size 10 µm), and fixed in 4% formaldehyde. Abundance was calculated as the number of individuals per cubic meter of water sampled with a Ruttner water sampler (5 L), based on total sample counts. Temperature, pH, dissolved oxygen, saturation of dissolved oxygen, specific conductivity salinity, and total dissolved solids were measured with an YSI 556 Handheld Multiparameter Instrument.

Results and Discussion: The maximum temperature of the surface water 36.09°C and the minimum was 6.9°C. The pH of Lake Acıgöl varied from a maximum 9.14 and a minimum 4.11. Dissolved oxygen ranged from 0.60 mg/L to 12.91 mg/L, saturation of dissolved oxygen ranged from 13.80 % to 187.70 %, specific conductivity ranged from 1312 mS/cm to 200336 mS/cm, salinity ranged from 0.61 ‰ to 175.03 ‰, and total dissolved solids ranged from 0.80 mg/L to 1815.00 mg/L throughout the study period. For the salinity classification of Venice system, in Lake Acıgöl are classified within saline waters [stations 1, 2, 4, and 5 Hyperhaline (> 40 ‰), stations 3 and 8 Euhaline (30-40 ‰), station 9 Mesohaline (5-18 ‰) and stations 6 and 7 Oligohaline (0.5-5 ‰)]. As a result of qualitative analyses, a total of 63 taxa were identified from Lake Acıgöl, including 54 taxa from Rotifera, 6 taxa from Cladocera, 1 taxon from Copepoda, 1 taxon from Anostraca, and 1 taxon from Ostracoda. All of the taxa were identified are new records for Lake Acıgöl except *Hexarthra fennica* (Rotifera), *Cyprideis torosa* (Ostracoda) and *Artemia* sp. (Anostraca). One rotifer (*Lecane undulata* Hauer, 1938) and one copepod (*Mesochra heldti* Monard, 1935) are new for the Turkish inland fauna. The average total zooplankton abundance ranged between 10598-1088644 ind/m³ (November and July, respectively). Based on their abundance, rotifers were dominant group (96.51%, 320014 ind/m³), followed by Copepoda (3.07%, 10195 ind/m³), Ostracoda (0.19%, 639 ind/m³), Anostraca (0.19%, 622 ind/m³), and Cladocera (0.03%, 109 ind/m³).

Keywords: rotifera, cladocera, copepoda, ostracoda, anostraca, hypersaline lake.

Acknowledgement: This research has been financially supported by Tübitak (115Y492) and Hacettepe University (FHD 2015 6960).

***Gammarus deryae* sp. nov., a new Freshwater Amphipod Species from Turkey
(Amphipoda: Gammaridae)**

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Objective: A new species of freshwater amphipod, *Gammarus deryae* sp. nov., collected from Pınar Pazarı and Yukarı Gökdere villages (Isparta province, Turkey) is described and illustrated.

Methods: Samplings were performed in 2000 and totally 56 specimens were sampled. Specimens were collected with a fine-mesh hand-net, fixed in 70% ethanol in the field, examined and dissected under a stereomicroscope, and examined under a compound microscope. The body length of the specimens was recorded by holding the specimen straight and measuring the distance along the dorsal side of the body from the base of the first antennae to the tip of the telson. Illustrations were made with the aid of a drawing tube mounted on an Olympus CX31 compound microscope and then they were scanned with a conventional HP scanner. A digitizer board Wacom Intuos Pro was connected via the USB port and a standard inking pen from Wacom was used to digitally drawing the scanned figures. All specimens are deposited in the Museum of Faculty of Fisheries, Ege University, İzmir, Turkey (ESFM).

Results and Discussion: The new species belongs to the *Gammarus pulex*-group. The most discriminant characters of the species are elevated urosomal segments and sharply pointed third epimeral plate. In addition, palp of right maxilla 1 has 1 seta along its outer margin. A detailed morphological description and illustrations of the new species are provided and differences from related species are discussed.

At first sight, this species looks very similar to *Gammarus pulex pulex* (L., 1758) mainly because of the setation of flagellar segments of Antenna 2 and pereopods. However, the presence of elevation on urosomites 1 and 2, the shape of third epimeral plate, the setation of peduncle segments of Antenna 2 and having 1 seta on the outer margin of palp of right maxilla 1 differ the present species from it. The new species is also similar to *Gammarus uludagi* G. S. Karaman, 1975; *Gammarus pulex gallicus* S. Karaman, 1935; *Gammarus pulex araurensis* Pinkster, 1972; *Gammarus pulex cognominis* G. Karaman & Pinkster, 1977; *Gammarus lacustris* G. O. Sars, 1863; *Gammarus pseudosyriacus* G. Karaman & Pinkster, 1977; *Gammarus agrarius* G. Karaman, 1973; *Gammarus gonensis* Özbek, 2017; *Gammarus izmirensis* Özbek, 2007; *Gammarus komareki* (Schäferna, 1922), *Gammarus laborifer* G. Karaman & Pinkster, 1977; *Gammarus laticoxalis* G. Karaman & Pinkster, 1977; *Gammarus paricrenatus* Stock et al., 1998 and *Gammarus hegmatanensis* Hekmatara et al., 2011 but differs from them in different character combinations.

Keywords: *Gammarus*, new species, freshwater, Isparta, Turkey

Some Heavy Metal Concentrations In Muscle And Gill Tissues of *Capoeta baliki* and *Squalius pursakensis* living in Sakarya River

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Objective: Freshwater pollution has become a serious problem because of industrial, agricultural and domestic applications. Heavy metals are among the most important environmental pollutants in the aquatic environment for aquatic organisms and human health. Fish are used as bio-indicators, playing an important role in monitoring heavy metals pollution aquatic ecosystems. Sakarya River with a length of 824 km is one of the most important lotic ecosystems of Turkey. In this study, zinc [Zn], copper [Cu] and lead [Pb] in tissues (muscle and gill,) of *Squalius pursakensis* (Hank' o, 1925), *Capoeta baliki* Turan, Kottelat, Ekmekçi and Imamoglu 2006, caught in Sakarya River were determined and some statistical techniques were applied to the results to evaluate the data properly.

Methods: Fish samples were collected from Sakarya River (coordinate: 36 T 0316374 – 4439709) using a modified Honda generator (Honda Motor Co., Ltd., Tokyo, Japan) in spring and summer 2015. The fish were first wrapped in polyethylene plastic, put into an isolated container, and brought to the laboratory. After biometric measurements, the fish were immediately frozen and stored at 20 °C until dissection. Before analysis, the fish were thawed and a 0.5-g sample was taken from each tissue (muscle and gill,). The fish samples were dried for 24 hours at 105 °C. Three thawed, 0.5-g homogenates from each tissue were taken and HClO₄:HNO₃ acids of 1:3 proportions were inserted to the reactors, respectively. Samples were digested in a microwave digestion unit. Afterward, the samples were filtered in such a way as to make their volumes up to 100 ml with ultrapure, distilled water. Heavy metal levels in fish tissues were determined by Analytic Jena ContrAA 700 (high-resolution continuum source atomic absorption spectrometer).

Results and Discussion: The results were evaluated in terms of fish and human health. According to results of the present study, Zn accumulation in muscle tissue of *S.pursacensis* was found higher than permissible levels for Turkish Food Codex Standard and Food and Agriculture Organization (FAO). Cu concentrations of all edible tissues of the species were considerably lower than the permissible levels set by Turkish Food Codex Standard and FAO. Lead concentrations was not detected in the tissues of *S. pursacensis* and *C. baliki*.

Keywords: Sakarya River, Heavy Metal, *Squalius pursacensis*, *Capoeta baliki*

Acknowledgment: This study was supported by the Project numbered as 2014-325 accepted by Eskişehir Osmangazi University, Commission of Scientific Research Projects.

Macro and Micro Element Concentrations In Muscle, Gill and Liver Tissues of *Cyprinus carpio* Linnaeus, 1758 and *Carassius gibelio* (Bloch, 1782) in Sarıyar Dam Lake

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Objective: Sarıyar Dam Lake is located in Central Anatolian Region and fed by Sakarya river. This dam was established for electricity production but is also used for fishing by local people. Domestic and industrial wastes discharge constitutes a significant constant polluting source, whereas seasonal surface runoff of the Sakarya River is another significant polluting resource. The aim of the study is to determine some macro and micro element levels (Ca, Mg, Na, Cd, Zn and Cu) in muscle, gill and liver tissues of *Carassius gibelio* and *Cyprinus carpio*.

Methods: Fish samples were collected seasonally from Dam Lake between April 2015 and August 2015. The fish were first wrapped in polyethylene plastic, put into an isolated container, and brought to the laboratory. After biometric measurements, the fish were immediately frozen and stored at 20 °C until dissection. Before analysis, the fish were thawed and a 0.5-g sample was taken from each tissue (muscle, gill and liver). The fish samples were dried for 24 hours at 105 °C. Three thawed, 0.5-g homogenates from each tissue were taken and HClO₄:HNO₃ acids of 1:3 proportions were inserted to the reactors, respectively. Samples were digested in a microwave digestion unit. Afterward, the samples were filtered in such a way as to make their volumes up to 100 ml with ultrapure, distilled water. Element accumulations in fish tissues were determined by Analytic Jena ContrAA 700 (high-resolution continuum source atomic absorption spectrometer).

Results and Discussion: Although macro and micro element concentrations for the muscle were generally lower than other tissues, there were some exceptions. Zn level in the muscle of *C. carpio* (199.73 mg/kg) was higher than the permissible limit stated by Turkish Food Codex Standard (50 mg/kg) and FAO. The highest seasonal average Ca, Na, Mg and Zn accumulations were determined in the gill of *C. carpio*. Cd accumulations were found to be below the detection limit with Analytic Jena ContrAA 700 atomic absorption spectrometer in all the tissues of the species. Cu concentrations of all edible tissues of the species were considerably lower than the permissible levels set by Turkish Food Codex Standard and FAO. The highest Cu concentrations were determined in liver higher than gill and muscle tissues of *C. carpio* and *C. gibelio* caught in spring and summer season.

Keywords: Heavy Metal, Sakarya River, Sarıyar Dam Lake, *Cyprinus carpio*, *Carassius gibelio*

Acknowledgements: This study was supported by the Project numbered as 2014-325 accepted by Eskişehir Osmangazi University, Commission of Scientific Research Projects.

Geochemistry of Heavy Metal (Cu and Pb) in Limnetic Ecosystem Sediment Pore Water, Turkey

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Objective: The purpose of the study was to determine metal pollution and ecological risk in the limnetic sediment pore water around Deriner Dam Lake. The Deriner Dam Lake is located of the Coruh Basin (Artvin) in northeastern Anatolia in Turkey. The Deriner Dam Lake is a deposit that is under the pressure of increasing mining, aquaculture activities and polluter as anthropogenic. Also, the sediment pore waters are indicators of aquatic environment pollution and the metal concentration in sediment pore water can be reflecting the aquatic pollution level.

Methods: Metal concentrations (Cu and Pb) were determined in a total of 7 stations, 4 of which were lake and 3 of which stream that was lake feeding. The samples were collected range of 1.5-60 m depth, as October, 2016. Metal concentrations were determined using an inductively coupled plasma-mass spectrometer (ICP-MS) analysis in ACME. Pore waters were separated from the sediment layers by centrifugation at 10,160 rcf x g for 30 min at +4 °C and filtered through 0.45 µm cellulose acetate membranes pore water samples were acidified with supra pure HCL (pH < 2). Determining the level of pollution, pore water chemistry (WQC) and Sediment guidance values (SGV) for fresh water sediment were applied.

Results and Discussion: The sand fractions were generally dominant (>51 %) in the surface sediments. Also, values of pH were ranged from 7.31 to 7.74 in October. Oxygen was ranged from 5.96 to 8.57 mg/L. Metal concentrations were varied from 25.1 to 78.31 µg kg⁻¹ for Cu; 17.7 to 37.7 µg kg⁻¹ for Pb. In the highest metal concentrations have been seen stations of D1 and D4, the most highest was observed area. Mean values of Cu and Pb in limnetic sediment pore water were higher than reference value (WQC). According to Sediment guidance values (SGV), mean values of Cu was determined as class B- moderately contaminated; mean values of Pb was determined as class A- low risk. Metal concentrations in sampling area decrease in the order D1 > D4 > D3 > A3 > D2 > A2 > A1. Based upon the results from this study Cu can be considered as contributor to toxicity around the Deriner Dam Lake.

Keywords: Heavy metal, Pore water, Limnetic, Geochemistry, ICP-MS

Surface Water Quality of Tatar Dam Lake, Turkey

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Objective: Tatar Dam Lake is located in Tunceli, Elazığ and partly Bingöl provinces in Eastern Anatolia Region. Tatar Dam Lake is built on Peri river. The dam is a type of rock body fill. The lake volume is 299,6 hm³ and the lake area is 10,84 km². A detailed study on the limnological characteristics of the dam lake has not been done. In this study, it is aimed to determine water quality in Tatar Dam Lake.

Methods: At Tatar Dam Lake, samples were taken from 5 different locations monthly in 2016. The temperature, pH, dissolved oxygen, electrical conductivity, secchi disk depth were measured at the sampling points. Water samples were brought to the laboratory and lithium, sodium, potassium, calcium, magnesium, fluoride, bromide, chloride, sulfate, ammonium nitrogen, nitrate nitrogen, nitrite nitrogen, orthophosphate phosphorus, total nitrogen, total phosphorus, suspended solid matter, total alkalinity, total hardness, biochemical and chemical oxygen demand and chlorophyll-a were determined. Classification of the water quality with the results obtained has been evaluated according to the regulation of surface water quality.

Results and Discussion: Average yearly values temperature 15.6 °C, pH 8.5, dissolved oxygen 10.3 mg/l, electrical conductivity 334 mS/cm, secchi disk depth 2.1 m., lithium 3.9 µg/L, sodium 9.9 mg/l, potassium 1.8 mg/l, calcium 40.1 mg/l, magnesium 12.1 mg/l, fluoride 0.14 mg/l, bromide 3.7 µg/L, chloride 5.8 mg/l, sulfate 25.5 mg/l, ammonium nitrogen 0.017 mg/l, nitrate nitrogen 1.26 mg/l, nitrite nitrogen 0.005 mg/l, orthophosphate phosphorus 0.006 mg/l, total nitrogen 1.24 mg/l, total phosphorus 0.013 mg/l, suspended solid matter 4 mg/l, total alkalinity 156 mg/l, total hardness 150 mg/l, biochemical (1.1 mg/l) and chemical oxygen demand 4.8 mg/l and chlorophyll-a 0.5 µg/L were found in Tatar Dam Lake. In the result of the study, it was determined that Tatar Dam Lake has a high water quality standard (Class I) according to the inland water quality standards defined in Surface Water Quality Regulation in terms of measured chemical and physico-chemical parameters. Tatar Dam Lake was classified as mesotrophic according to the mean value of the dissolved oxygen, secchi disk, total nitrogen, total phosphorus, chlorophyll-a and secchi disk depth.

Keywords: Tatar Dam Lake, water quality, mesotrophic

Determination of Heavy Metal Concentrations of Surface Sediment Samples Sıdıklı Küçükboğaz Dam Lake (Kırşehir), Turkey

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Objective: This study was carried out to examine heavy metals concentration in surface sediment of Sıdıklı Küçükboğaz Dam Lake in Kırşehir, Turkey. The present study was the first research that reports heavy metal concentration in this area.

Methods: The surface sediment samples were collected seasonally between September 2015 and August 2016, from 4 stations. Surface sediment samples (0–20 cm) were collected in triplicate and homogenized in a zip locked polyethylene bag at each sampling site using an Ekman sampler. Sediment samples were prepared with a preliminary digesting process via a CEM MARS-5 model microwave instrument. Heavy metal determinations of all samples were carried out with an ICP-MS -Bruker 820-MS- (Alam, 2001).

Results and Discussion: Heavy metal analyses of sediment samples taken periodically from four stations over a period of 4 seasons showed that the mean levels of aluminum (Al), vanadium (V), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), gallium (Ga), barium (Ba) and lead (Pb) varied between 214.248-3204.650 (2246.891±178.055), 7.713-12.584 (9.686±0.311), 3.532-6.030 (4.723±0.184), 81.446-149.488 (113.324±4.692), 3229.803-5451.602 (4637.034±137.871), 0.695-1.692 (1.271±0.073), 1.988-5.614 (3.250±0.313), 0.157-2.091 (0.970±0.157), 4.000-11.944 (7.194±0.452), 0.142-0.896 (0.580±0.052), 33.767-85.124 (47.231±2.900) and 4.145-8.122 (5.595±0.255) as a µg/g, respectively. Moreover, seasonal changes of heavy metal concentrations in surface sediment were also studied. Also, the means of Cr, Ni, Cu, Zn and Pb in our samples were lower than TEC and PEC values. The present results indicate that heavy metal contamination in the surface sediment of Sıdıklı Küçükboğaz Dam Lake was lower than reference values.

Keywords: Heavy Metal Accumulation, Sediment, Pollution, Sıdıklı Küçükboğaz Dam Lake

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Desiccation Tolerances of Freshwater Mussels from Çine River (Western Anatolia, Turkey)

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Objective: Variations in a river's discharge can be caused by many factors like climate change, land usage or water management and directly influence the aquatic life. Limitedly mobile bivalves can be exposed to desiccation due to these variations. Desiccation tolerances of freshwater mussel species from Çine River (Aydın, Turkey), *Unio* sp. (Unionoida: Unionidae) and *Corbicula* sp. (Veneroida: Cyrenidae) were examined and compared with a series of experiments.

Methods: Mussels were collected from Çine River and transported to the application and research unit of Department of Aquaculture and Fisheries (ADU) in Aydın. Desiccation tolerances were assessed using two different experimental setups for each mussel species. Experiments were started after measurements, size classifications and an acclimatization period. At the first experiments mussels were exposed only dry conditions. Both mussel species were placed in empty plastic containers at stable air temperature (as possible) and monitored during the experimental period until their death. At the second experiments, mussels were buried in sediment in similar plastic containers. Sediment used in the experiments was transported from Çine River. Before the experiments water (again from Çine River) was added to each container until fully soil saturation. Evaporated water was renewed periodically throughout the experimental period. Experimental setups were monitored until the death of all mussels again.

Results and Discussion: According to the results of first experiments which were made in only dry conditions, unionid mussels were more resistant to desiccation and survived longer than the *Corbicula* sp. In the second experiments that the mussels were buried in the sediment, again unionid mussels survived longer than *Corbicula* sp. Generally, being buried in sediment made increase survival times and provided relative protection against desiccation for both *Unio* and *Corbicula* species.

Keywords: *Unio*, *Corbicula*, desiccation tolerance, mortality, Çine River

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Temporal Variability In The Heavy-Metal Content of Seston From The Ceyhan River, Turkey

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Objective: The present investigation was performed on seston, which were sampled from the Ceyhan River poured into the Iskenderun Bay

Methods: Seston specimens were collected from the stations with a 45 µm superficial plankton net at constant speed and 20 minute shots. Samples were brought to the laboratory in ice-cold bottles and protected at -18 °C in deep freeze until analysis. When analyzing, the samples were thawed, 500 ml of seston sample was filtered with 0.45 µm filter paper which was dried and hardly weighed, and the sample was left to dry for 12 hours at 102°C after filtering with water thrombus. The dried sample was weighed out from the oven and weighed and placed in 10 ml HNO₃. The samples were left in the aside for 24 hours. The specimens were held at 60°C in a water bath and the gas was removed by gently loosening the caps as gas accumulation was observed in the tubes. The samples retained in the water bath until clear white smoke were formed were clarified, then cooled and filtered. The filtered samples were made up to 50 ml and ready for measurement (UNEP, 1984).

Results and Discussion: Seasonal averages of physicochemical parameters measured at station; Ceyhan River is classified as Class III - Contaminated water according to the temperature parameter in the summer and it was found to be Class III- Contaminated water according to the dissolved oxygen parameter in the autumn season. The highest averages determined according to the seasons are $16475.3 \pm 844.5 \mu\text{gg}^{-1}$ for Fe and $56.36 \pm 2.83 \mu\text{gg}^{-1}$ for Pb in summer; $277.75 \pm 64.90 \mu\text{gg}^{-1}$ for Zn, $91.01 \pm 23.88 \mu\text{gg}^{-1}$ for Cu in winter; $5.97 \pm 1.95 \mu\text{gg}^{-1}$ for Cd, and $119.25 \pm 16.22 \mu\text{gg}^{-1}$ for Cr in autumn. In the Ceyhan River seston, Fe is measured with the highest amount of $13139.1 \pm 1381.6 \mu\text{gg}^{-1}$ per year and it is determined that heavy metals are classified as Fe > Zn > Cr > Cu > Pb > Cd. In the region of ecological and general health, there is a reasonable need to grow early cautioning location frameworks or biomarkers like seston, which can distinguish the potential effects of contaminations some time before they turn into a hazard to human health. In the study, when the amounts of heavy metals detected in the seston are compared with other researchs, all values are generally different and higher than the others. This investigation proposes that it is critical to control point contaminations, and all wastewater ought to be decontaminated before release to the Ceyhan River bowl.

Keywords: Heavy metals, Seston, Iskenderun Bay, Ceyhan river, Northeastern Mediterranean

Acute Toxicity of Antifouling Copper Pyrithione on Stone moroko (*Pseudorasbora parva* (Temminck & Schlegel, 1846))

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Objective: In this study, acute toxic effects of copper pyrithione (Cu pyrithione) used as antifouling agent/biocide in ship paints were investigated using *Pseudorasbora parva*.

Methods: Fish samples were collected from Mogan Lake. The mean weight and length of fish were 4.4757 ± 0.69 g and 8.4388 ± 0.4154 cm, respectively. After depuration and adaptation period, toxicity experiments were conducted in two stages as range finding test and main test. In each experiment, five different Cu pyrithione concentrations and two control groups were used. The experiment was carried out with static bioassay method during 96 h. Data were evaluated using the U.S. E.P.A. LC50 computer program based on Finney's Probit Analysis Method.

Results and Discussion: According to bioassay results 24 and 96 h LC50 (95% confidence limits) values for *P. parva* exposed Cu pyrithione were 24.94 (10.85-255.33) $\mu\text{g/L}$, 17.70 (7.36-48.48) $\mu\text{g/L}$, $\mu\text{g/L}$, respectively. There was no death fish at the control groups. In conclusion, our study revealed that copper pyrithione is highly toxic to *Pseudorasbora parva*.

Keywords: Bioassay, copper pyrithione, antifouling agents, *Pseudorasbora parva*, acute toxicity

Acute Toxicity of Bisphenol A on *Pseudorasbora parva***Semra Benzer¹, A. Çağlan Günal², Belda Erkmen³, Figen Erkoç²**¹*Gazi University, Education Faculty, Science Education ANKARA*²*Gazi University, Education Faculty, Biology Education ANKARA*³*Aksaray University, Arts and Science Faculty, Biology AKSARAY*

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Objective: In the present study, acute toxicity of Bisphenol A (BPA) used as compound in the production of epoxy resins and poly-carbonate plastics were investigated using *Pseudorasbora parva*.

Methods: Fish samples were collected from Lake Mogan in spring 2017. Mean weight and length of fish were 3.948 ± 0.804 g and 7.293 ± 0.451 cm, respectively. Fish were kept adaptation period for 15 days. After adaptation period, bioassays were conducted in two stages as range finding test and main test. The range finding tests were conducted totally one month with 96 h periods. At adaptation period fish were fed daily with a daily rate of 2% of their body weight. The aquariums were aerated and cleaned by siphoning. In each experiment, five different BPA concentrations and two control groups were used. The experiment was carried out with static bioassay method during 96 h. Data were evaluated using the U.S. E.P.A. LC50 computer program based on Finney's Probit Analysis Method.

Results and Discussion: According to bioassay results 96 h LC50 (95% confidence limits) values for *P. parva* exposed BPA were 5.454 (5.067-5.808) $\mu\text{g/L}$. Mucus secretion was increased in experimental fish when compared to control groups. There was no death fish at the control group aquariums. BPA also has estrogenic potency and is therefore generally mentioned as one of the suspected endocrine disrupter.

Keywords: Bioassay, Bisphenol A, endocrine disrupter, *Pseudorasbora parva*, acute toxicity

Evaluation of Mert Stream Water Quality in Samsun, Turkey Using Water Quality Index (WQI)

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Objective: Water quality is an important factor for health and safety issues associated with public health and also for aquatic life. Water quality issues are becoming more significant concern due to the growth of population, urban expansion and development. Thus, assessment of surface water quality has become an important issue. For this purpose, the paper aims to evaluate spatial and seasonal trends of nutrients in water discharge, and also to compare data with water quality criteria and with water quality index (WQI), identifying the environmental pressures and assessing the impact of the loads to Mert basin.

Methods: In this study, the water quality data obtained from 6 sampling stations between July 2011 and June 2012 at Mert stream was evaluated. Supplying the utility water needs of some villages on the route, Mert stream is very important as it constitutes the irrigation resource of fertile lands of the region. In order to assess the present water quality of Mert stream, different WQI approach (modified WQI_{min}) were applied to a data set expressly collected for the present study. A modified index WQI_{min} that is developed considering 5 most predominant and easily measurable parameters was used in this study (Temperature, pH, DO, EC, TSS). To get the WQI_{min}, the Q-value should be determined for each variable and also weighting and normalization factors are assigned to each variable.

Results and Discussion:

The mean WQI value of the stream is 81.9, which lies on the mid water classification region, so the water is considered at fair quality. The resulted WQI shows that 91.6, 92.5, 74.3, 91.6, 75.2 and 66.1 for sites St1, St2, St3, St4, St5 and St6 respectively. Among stations, there was significant variations in water quality index from poor quality to good quality that St5 and St6 in urban part and St3 in rural part of the stream are under the pressure of pollution. While the reason of the low water quality in 5th and 6th stations is based on domestic and industrial wastes, the reason of poorness in 3th station arises from poultry farm wastes poured intensely from chicken farms near the station into the stream in Kavak district. The most effective water quality parameters are pH, electrical conductivity (EC) and total suspended solids (TSS) on the determination of WQI for the present study. The results clearly show that Water Quality index (WQI) was useful tool to obtain the right decision and evaluating water quality. In future, WQI index based on the microbiological and some physico-chemical parameters can be easily used with indicator algal organisms to evaluate or to monitor water quality of aquatic body.

Keywords: Water Quality Index, Mert Stream, Samsun.

A Preliminary Taxonomical Investigation on the Larval Trichoptera Fauna in the Some Creeks of Malatya Province (Turkey)

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Objective: Malatya province is located at the upper Fırat River basin in the Taurus orogenic belt of the mountainous district of the Eastern Anatolia and has a rich position regarding streams. This study was carried out in the four creeks (Takaz Creek, Hisardere Creek, Çevlik Creek, Melet Creek) of Malatya province and was aimed to determine of larval Trichoptera fauna in these creeks.

Methods: A total of eleven stations were chosen on the creeks for this study; four stations on the Takaz Creek, two stations on the Hisardere Creek, three stations on the Çevlik Creek and two stations on the Melet Creek. The larval trichopteran samples were gathered from each station by using a Surber net (475 µm mesh, area of base 0.09 m²). The collected material was fixed in formaldehyde (4%) in the field and then kept in 80% ethyl alcohol and sorted in the laboratory and identified to the lowest possible taxonomic level (genus or species) under a stereomicroscope.

Results and Discussion: As a result of the study, 606 individuals and 9 taxa belonging to 5 families were determined in these creeks. The maximum number individuals were collected in Takaz Creek while the fewest individuals were collected in Hisardere Creek. Trichoptera species were belong to Glossosomatidae [*Agapetus fuscipes* Curtis, 1834], Goeridae [*Goera pilosa* Wallengren, 1891], Hydropsychidae [*Hydropsyche angustipennis* (Curtis, 1834), *Hydropsyche fulvipes* Curtis, 1834, *Hydropsyche instabilis* (Curtis, 1834), *Cheumatopsyche lepida* (Pictet, 1834)], Polycentropidae [*Polycentropus irroratus* Curtis, 1835], Sericostomatidae [*Sericostoma* sp., *Sericostoma personatum* (Kirby & Spence, 1826)]. There are several studies about determine of Trichoptera fauna in various regions of Turkey. However, the knowledge of the Trichoptera fauna is still very limited in some parts, particularly in the eastern part of Turkey. It is contributed to close the gap of studies of Trichoptera this area of Turkey and to make a preliminary study that will form the basis for further studies with this study.

Keywords: Trichoptera, Fauna, Creek, Malatya, Turkey

Acknowledgements: This research has been supported by Unit of Scientific Research Projects, Istanbul University (Project No: 51379). We are deeply grateful to them for their financial support.

Detection of Zooplankton Fauna in Downstream of Euphrates**Ahmet Bozkurt, M. Ayçe Genc***Iskenderun Technical University, Marine Sciences and Technology Faculty, 31200, Iskenderun, Hatay, Turkey*

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Objective: Zooplankton samples were taken for determination of the zooplankton fauna of the lower Euphrates basin (between Birecik Dam Lake and Karkamış Dam Lake).**Methods:** The samples of zooplankton were collected from 3 stations in downstream of Euphrates basin (First station 37° 01' 11" N, 37° 58' 16" E; second station 36° 57' 44" N, 38° 00' 23" E; third station 36° 53' 52" N, 38° 01' 48" E) by using a plankton net with 60 µm mesh size. The net was hauled horizontally during 20 minutes in July and September 2015, during routine survey cruises and then samples were replaced into glass jar. The samples were fixed with 4% buffered formaldehyde. The zooplankton species examination was done using an Olympus CH40 microscope. To identify the species, the works of Borutsky (1964), Scourfield and Harding (1966), Dussart (1969), Damian-Georgescu (1970), Ruttner-Kolisko (1974), Smirnov (1974), Koste (1978), Kiefer and Fryer (1978), Negrea (1983), Korinek (1987), Pennak (1989) and Segers (1995) were used.**Results and Discussion:** In the study a total of 41 species were found, including 19, 12 and 10 taxa belonging to Rotifera, Cladocera and Copepoda, respectively. Detected ten families from Rotifera, Lepadellidae was the most species rich family with 4 species followed by Lecanidae and Brachionidae with 3 species each one. While Synchaetidae and Trichocercidae were represented by two species, Dichranophoridae, Asplanchnidae, Mytilinidae, Testudinellidae and Notommatidae were represented one species. Six families were detected from Cladocera, Daphnidae was the most species rich family with 4 species followed by Chydoridae with 3 species. Porcellionidae, Bosminidae and Sididae had the least species followed by Eurycercidae with 2 species. In the Copepoda with four families, Cyclopoidae had 7 species and others, Diaptomidae, Ameiridae and Canthocamptidae had 1 species each one. It was determined that some species with wide spread from Rotifera, *Cephalodella gibba* (Ehrenberg, 1838), *Keratella cochlearis* (Gosse, 1851), *K. tropica* (Apstein, 1907), *Lecane closterocerca* (Schmarda, 1859), *L. luna* (Müller, 1776), *Lepadella ovalis* (Müller, 1786), *L. patella* (Müller, 1786), *Testudinella patina* (Hermann, 1783), from Cladocera *Bosmina longirostris* (Müller, 1785), *Ceriodaphnia pulchella* Sars, 1862, *Alona guttata* Sars, 1862, *Chydorus sphaericus* (Müller, 1776), from Copepoda *Cyclops vicinus* Uljanin, 1875, *Nitocra hibernica* (Brady, 1880) were present at all sampling stations. On the other hand, it was reported that all species found in the study wide spread, common, and cosmopolitan and they were reported from lots of study inland waters of Turkey (Ustaoglu, 2004; Ustaoglu et al., 2012).**Key words:** Euphrates basin, Karkamış Dam Lake, Birecik Dam Lake, Zooplankton

Zooplankton Fauna of Some Temporary Volcanic Lakes in Gaziantep

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Objective: Zooplankton species diversity of four volcanic lakes around Tahtaköprü Dam Lake (Gaziantep) has been determined within the provincial borders of Gaziantep. In the study, it was determined that the contents of zooplankton of lakes were the same species.

Methods: The samples of zooplankton were collected from 4 temporary lakes (36° 50' 37" N, 36° 39' 03" E) in the same freshwater localities by using a plankton net with 60 µm mesh size. The net was hauled vertically from the bottom to the surface in the lakes in March 2007, April 2007, August 2007, January 2008 and December 2016, during routine survey cruises and then samples were replaced into glass jar. The samples were fixed with 4% buffered formaldehyde. The zooplankton species examination was done using an Olympus CH40 microscope. To identify the species the works of Scourfield and Harding (1966), Borutsky (1964), Dussart (1969), Damian-Georgescu (1970), Ruttner-Kolisko (1974), Koste (1978), Kiefer and Fryer (1978), Korinek (1987), Segers (1995), Smirnov (1974), Negrea (1983) and Pennak (1989) were used. The lakes are 377 m above the sea level. They have a maximum depth of 18 m (B), 14 m (A), 7 m (C), 4 m (D), and a surface area of 5000 m², 6250 m², 1250 m² and 2500 m² respectively.

Results and Discussion: A total of 29 taxa were found in the study area, including 18, 8 and 3 taxa belonging to Rotifera, Cladocera and Copepoda, respectively. A total of 5 sampling were made in the study, *Lecane closteracera* (Schmarda, 1859), *Pompholyx sulcata* Hudson, 1885, *Testudinella patina* (Hermann, 1783), *Bosmina longirostris* (Müller, 1785) and *Chydorus sphaericus* (Müller, 1776) were found in 4 sampling period but *Asplanchna sieboldi* (Leydig, 1854), *Brachionus budapestinensis* Daday, 1885, *Keratella tropica* (Apstein, 1907), *K. quadrata* (Müller, 1786), *Lecane ohioensis* (Herrick, 1885), *Lepadella patella* (Müller, 1773), *Trichocerca stylata* (Gosse, 1851), *Ceriodaphnia reticulata* (Jurine, 1820), *C. pulchella* Sars, 1862, *Moina micrura* Kurz, 1874 were found in only one sampling time. Identified five families from Rotifera, Brachionidae was the most species rich family with 8 species followed by Lecanidae with 6 species. Trichocercidae and Asplanchnidae had the least species, followed by Testudinellidae with 2 species. Four family were determined from Cladocera, Daphnidae was the most species rich family with 4 species followed by Chydoridae with 2 species, and Bosminidae and Moinidae families each one had 1 species. In the Copepoda with two families, Cyclopoidae had 2 species and Diaptomidae 1 species. Almost all species detected in the study were cosmopolites with wide distribution. *Brachionus angularis* Gosse, 1851, *B. budapestinensis* Daday, 1885, *B. calyciflorus* Pallas, 1766, *Keratella cochlearis* (Gosse, 1851), *K. quadrata*, *K. tecta* (Gosse, 1851), *K. tropica*, *Lecane bulla* (Gosse, 1851), *Lepadella. patella*, *Testudinella patina* (Hermann, 1783), *Bosmina longirostris*, *Simocephalus vetulus* (Müller, 1776), *Coronatella rectangula* (Sars, 1862), *Chydorus sphaericus*, *Cyclops vicinus* Uljanin, 1875, are reported to be found in many aquatic environment and cosmopolite species and have wide distribution area (Eldredge and Evenhuis, 2003; Hutchinson, 1967; Ruttner-Kolisko, 1974; Braioni and Gelmini, 1983; Ramdani et al., 2001). *Acanthocyclops robustus* (Sars, 1863) and *Cyclops vicinus* appear in lakes, rivers, marshes, littoral zone in all types aquatic environment such as small waters and prefer hot waters (Dussart, 1969). According to Koste (1978), some of *Brachionus* species (*B. angularis*, *B. budapestinensis*, *B. calyciflorus*) prefer warmer zone and are frequent in trophic and subtrophic waters. Distribution of the species was quite closely related to the ecological characteristics of the species and all species in the study could be found in tropical and subtropical climate zones, such as found in the study.

Key words: Gaziantep, volcanic lakes, zooplankton

Assessment of Water Quality Characteristics for Aquaculture in Lake Aktaş (Ardahan, Turkey)

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Objective: The aim of this study is to determine the water quality characteristics for aquaculture Lake Aktaş (Ardahan, Turkey). The suitability of the water quality of the lake for aquaculture has been also investigated.

Methods: Lake Aktaş is located in the province of Ardahan. Half of the lake is within the borders of Georgia. In the study, samplings were conducted monthly at two sampling sites during 8 months in 2013. Temperature, dissolved oxygen, pH, ammonium, nitrite, nitrate, zinc, iron, copper, potassium, sulphate, sulphide, phosphate and free chlorine parameters were analysed in water samples on the field and laboratory. Thus, it was determined water quality of lake and its productivity for aquaculture.

Results and Discussion: Natural fisheries activities in Lake Aktaş constitute an income source for local communities in addition to agriculture. The surface of lake was covered by a sheet of ice approximately 50-70 cm in winter season. Lake Aktaş has properties of mesotrophic lake, when the data of its physical and chemical analysis was evaluated. It is possible the breaking of equivalence of organic materials, accumulation of toxicants in the environment, and observing of intensive fish mortalities, because of creating an additional organic material loading to lake environment due to aquaculture activities in a shallow lake. Therefore, it is thinking that Lake Aktaş does not suitable for aquaculture. In case of, it is recommended that the present status of lake should consider and avoid intensive aquaculture activities.

Keywords: Lake Aktaş, physical and chemical analysis, water quality characteristics

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Lake Köyceğiz: A study on Physico-Chemical Water Quality and Zooplankton Fauna of Meromictic Lake in Turkey

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Objective: The aim of this study is to investigation of how zooplanktonic organisms distribution depending on lake structure in a meromictic lake.

Methods: The present study was conducted to determine some physico-chemical properties and zooplankton fauna of Köyceğiz Lake between the each month of January 2011 – June 2012. Eight sampling point and totally 19 points which are located at the surface and varying depths were determined in the research field. 20 L water samples collected with Nansen water sampler (1 L) and Hydro-Bios plankton net (25cm in diameter, 100 cm in length with a 55 µm mesh size) from each sampling points for zooplankton counting and physico-chemical analysis. Despite the various quality parameters was analyzed, significant water parameters selected for the Redundancy Analysis (RDA). Surface zooplankton samples were taken by horizontally (about 5 minutes) with a plankton net (Hydro-bios Kiel). The proximity between the sampling points was determined using Hierarchical Cluster Analysis and Two Way Indicator Speceis Analysis (TWINSpan) was used to determine and classify bioindicator species. Redundancy Analysis (RDA) was selected to figure out relationships between ecological parameters and species abundances and occurrences.

Results and Discussion: A total of sixty two species were identified, of these fifty-nine belonged to Rotifera, three to Cladocera and three to Copepoda. According to Hierarchical Cluster Analysis, the highest similarity was 0,87 with the sampling point was between 2 and 3 at a depth of 10 meters and the lowest similarity was between 1st sampling point at a depth of 10 meters and 5th surface with the value of 0,07. The number of sampling points is sixteen and they are classified as 7 groups. TWINSpan result showed us, seven major groups divided by *Brachionus angularis* and *Brachionus calyciflorus*. *B. calyciflorus* was grouped with just the sampling point 5 (deep and surface) and the others were belonged to *B. angularis*. As a result of this study, hardness (sulphate), biological oxygen demand, acid binding ability and pH values were found the critical and significant parameters to zooplankton distribution each layer of the sampling stations. It is also found the zooplankton distribution of surface stations were related to biological oxygen demand and dissolved oxygen. Lake Köyceğiz fed by not only with small and large streams but also underground resources and this was also very important for zooplankton distribution.

Keywords: Lake Köyceğiz, zooplankton distribution, meromictic lake, TWINSpan

Ecological and Economical Importance of Asian clam *Corbicula fluminea* (O. F. Müller, 1774)

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Introduction: The Asian clam, *Corbicula fluminea* (Müller, 1774) is the one of the most widespread invasive species in aquatic ecosystems. This species is native to Southeast Asia, China, Korea, south-eastern Russia, the Ussuri Basin, Australia and northern Africa and it rapidly spreads to the America and Europe at the beginning of the 20th century. In Turkey, this species has been identified in Seyhan, Ceyhan, Asi, Tigris River, Çine Stream and in Gavur Lake of Kahramanmaraş city. It is a small infaunal bivalve and found in lakes and streams of all sizes with silt, mud, sand, and gravel substrate. *C. fluminea* could survive in a wide range of habitat conditions due to its high physiological and ecological adaptation capability. Therefore, invasive populations can reach densities of up to several thousand individuals in per square meter. Although *C. fluminea* is an invasive species, it has crucial role in invasive and naturally distributed area both aquatic ecosystem and human efforts.

Ecological benefits: Asian clam is an important organism of aquatic ecosystems. It can affect nutrient dynamics in freshwater systems by removing particles from the water column, excreting nutrients and biodepositing faeces and pseudofaeces. In addition, this species can influence energy flow, phytoplankton depletion, and substrate modification. The other important role is that *C. fluminea* is food source for fish, crustaceans (especially crayfish), birds and mammals in many aquatic systems. At the same time, it can provide habitats to other organisms for example empty shells supply substrate for small crustaceans, gastropods, algae and other benthic species.

Economical value: This species can be used integrated culture due to clearance of water during feeding activity. Therefore, it has economical value for aquaculture activities. On the other hand, many aquarium hobbyists use *C. fluminea* in their aquarium as a bio filter. This species does not be consumed in American or European countries but they used this clam as a fish bait. Actually, *C. fluminea* is an excellent protein source and it is gathered commercially scale for human consumption in the Far East countries as a side dish or additive in soup. Moreover, shell of this species contain lime in high ratio, so after processing their shells are used in poultry feeds.

Conclusion: As a result, *C. fluminea* is very important species in freshwater ecosystem in similar with mussel and oyster. So *C. fluminea* is a promising candidate species for aquaculture and/or other activities in the future.

Keywords: *Corbicula fluminea*, invasive, benthic, freshwater

Stable isotopes analyses of primary producers in Lake Eğirdir (Turkey)**Meral Apaydın Yağcı¹, Şenol Akın², Ahmet Alp³, Mehmet Cesur¹, Rahmi Uysal¹, Abdulkadir Yağcı¹, Fuat Bilgin¹, Vedat Yeğen¹, Fatma Banu Yalım⁴**¹*Fisheries Research Institute, Republic of Turkey Ministry of Food, Agriculture and Livestock, Eğirdir, Isparta, Turkey*²*University of Bozok, Yozgat, Turkey*³*Department of Fisheries, Faculty of Agriculture, University of Kahramanmaraş Sütçü İmam, Kahramanmaraş, Turkey*⁴*Mediterranean Fisheries Research Production and Training Institute, Republic of Turkey Ministry of Food, Agriculture and Livestock, Kepez Area, Antalya, Turkey*

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Objective: The aim of this study is to determine stable carbon ($\delta^{13}\text{C}$) isotope values which show the food source consumed by the individuals (Phytoplankton, terrestrial and aquatic plants, etc.), and nitrogen ($\delta^{15}\text{N}$) isotope values which is used to determine the trophic level of the individuals in the food web, of primary producers in Lake Eğirdir.

Methods: Lake Eğirdir is located in Southern Anatolia and covers a total area of about 457 km², at the 918 m sea level and tectonic feature. The samples from 4 stations in Lake Eğirdir were collected between January 2010 and December 2010. A total of 130 specimens from phytoplankton, epiphyton, sediment, *Ceratophyllum submersum*, *Potamogeton perfoliatus*, *Myriophyllum spicatum*, *Cladophora*, *Phragmites australis*, *Salix alba* and Chlorophyta (green algae) were analyzed as primary producers source in both spring and autumn seasons. The leaves and macroalgae of the plants were collected by hand, placed in a refrigerator bag, and stored in deep freeze. To remove foreign materials (crustaceans) on plants, some plants were treated with a few drops of 0.1 N HCl acid. Phytoplankton specimens were filtered on compost (GF / F filter) (450°C 4 hours). After the filters with phytoplankton were dried in the oven, the phytoplankton on the filter paper was scraped with a clean spatula. All specimens were separately placed in a clean glass petri dish and dried at 60°C for two days then pounded in a mortar into flour was made. Samples were taken in small capsules (approx. 2 mg) made from tin (Sn) and sent to stationary isotope laboratory at Georgia University in the United States. Analyses of carbon and nitrogen stable isotope ratios were made by using a mass spectrometer.

Results and Discussion: Primary producers and food web structure of Lake Eğirdir is situated in almost all organisms. *Cladophora*/ Phytoplankton, *Phragmites australis* and *Salix alba* had more light carbon isotope values. Main primary producers sources were C3 (*Salix alba* and *Phragmites australis*) plants, Phytoplankton / *Cladophora* and partial Epiphyton in Barla station; C3 with Phytoplankton/*Cladophora* in Gelendost station; Phytoplankton, C3 and Chlorophyta in Hoyran/Kayaagzı station; C3, Phytoplankton/*Cladophora* and C4 (*Ceratophyllum submersum*, *Potamogeton perfoliatus* and *Myriophyllum spicatum*) plants in Köprü station. Our staple isotope results revealed the primary producers (C3 plants, Phytoplankton) of Lake Eğirdir.

Keywords: $\delta^{15}\text{N}$, $\delta^{13}\text{C}$, Lake Eğirdir, primary producers, trophic position

Acknowledgements: This study was supported by the Republic of Turkey Ministry of Food, Agriculture and Livestock, General Directorate of Agricultural Research and Policy (TAGEM/ HAYSÜD/ 2010-09-01-01). The authors would like to thank Directorate of Fisheries Research Institute, Eğirdir, Isparta, Turkey and the Agricultural Engineer (MSc.) Hasan Bostan for their administrative and technical support in this study.

Hydroelectric Power Plants in Turkey and Wave Power As An Alternative Energy Source

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Objective: In this study, hydroelectric power plants researched hydroelectric power plants in Turkey were researched and wave energy systems which could be used for their locations were researched.

Methods: In this study, the dam reservoirs of our country are determined according to the regions. Establishing hydroelectric power plants, regulating the flow of rivers by collecting the waters in rainy seasons and releasing them during the dry season. Thus, floods and deluge are prevented and can be used for agricultural irrigation when needed, for supplying drinking water and for fishing purposes. Hydroelectric power plants have an important place among the energy production methods to meet the growing need from the past to the present day. Alternatively, the wave energy is researched.

Results and Discussion: Hydroelectric power plants are some of the advantages of being renewable, not generating harmful waste like fossil fuels, responding quickly to demands and being able to work for a long time. But in the place where it is built, turning into a steady and deep lake with a constantly flowing and shallow watery river is a negative effect on the aquatic ecosystem. The large surface area of the dam lake increases evaporation and can cause salinisation and salinization in agricultural land. Today, in the seas and in the oceans, electricity can be generated by making use of the kinetic energy of the winds, storms and tides of the tides. More sensitive energy production can be provided by the wave production systems that will be installed in the appropriate places by examining the seas. There is no other cost than initial investment and maintenance costs. We think that wave energy systems to be installed as an alternative energy source will be more beneficial to the natural ecosystem. Dam lakes can be used for other reasons but we think that wave energy will be more useful for energy production.

Keywords: Dam Lake, Hydroelectric Power Plant, Wave Energy

Effect of fish passage on fish population in Asi River**Sevil Demirci, Şükran Çakır Arıca, Ayşe Özyılmaz***Iskenderun Technical University, Faculty of Marine Science and Technology, Department of Marine Technologies, Iskenderun/Hatay, TURKEY*

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Objective: Fish passages have gained considerable importance in recent years due to reasons such as European Union harmonization laws and national awareness, and will become increasingly important. These systems that facilitate the passage of migrating fish affect the amount of the population in the Asi River (also called Orontes).

Methods: Asi River which is significant for East Mediterranean is a dynamic system in especially for migrating stocks. To keep this dynamic structure intact is need fish passage. Fish passage has a pool and orifice model in Asi River. Fish are jumping from pool to pool or swim throughout the river.

Results and Discussion: In accordance with the opinion fisherman it is thought that species such as *Capoeta barroisi*, *Capoeta capoeta*, *Anguilla anguilla*, *Clarias lazera*, and *Garra rufa* in the region facilitate migrations by providing vertical connectivity of the river. As a result, this fish transit system must be in a place that can be found by most of the migrating stock. Especially when water level is low (July-August) should allow fish pass easily. Thus the decline in population density can be prevented.

Keywords: Fish transition, migration, Orontes, fish

Lake Amik as an Experience of Draining a Wetland

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Objective: Lake Amik, which was located on the Amik plain of Eastern Mediterranean Region, was drained for agricultural purposes, flood prevention, and mosquito control in 1960s. The aim of this study is to evaluate the effects of Amik Lake drainage on biodiversity, ecosystem and local population and to draw attention to the importance of wetlands.

Methods: Amik Plain is surrounded by Amanos Mountains and Amik Lake was almost at the center, in Hatay. Although Amik was named as a lake, it might have been also in wetland character and was famous of its freshwaters, reedy vegetation and other water plants and migratory birds that had been using the lake during their intercontinental migrations from Europe to Africa. In this study, face-to-face talks were held with the elderly people of the region, who were directly affected by the drainage of the Amik Lake. Their observations and thoughts about the issue were evaluated.

Results and Discussion: Among these threats are illegal hunting in the passageways of the migratory birds, wind turbines to be installed on the migration routes. More than that, the airport has been constructed on drained Amik Lake bed, across the Belen, which is the unique route for migrating birds in Hatay. Of course not only the migrating birds, but also all living things (biodiversity), including human, have been adversely affected over the years from this drying decision.

The decisions on multifactorial effects on the ecosystem should never be taken without the approval of all relevant organizations and communities

Keywords: Lake Amik, Wetlands, Migrating Birds, Ecosystem, Biodiversity

Epilithic Diatom Composition in Madra Stream (Balıkesir)**Haşim Sömek¹, Gülşah Çoşkunışık², Saniye Türk Çulha¹**¹*İzmir Katip Çelebi University, Faculty of Fisheries, İzmir*²*Izmir Katip Çelebi University, Graduate School of Natural and Applied Sciences, İzmir*

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Objective: Turkey has to realize the harmonization of Turkish law with the European Union legislation and put the Water Framework Directive (WFD) into practice in the E.U. membership process. Phytobenthos (especially diatoms) which is defined between essentially biological quality elements and the indices specific to them holds an important place in the WFD (Anonymous, 2000). The aims of this study are to investigate epilithic diatom composition using WFD methods developed by the European Union in Madra Stream. Diatom composition and selected physicochemical parameters of Madra Stream (Balıkesir) have been determined for the first time in the study. This study has an also additional importance in increasing the number of experienced specialists on diatom taxonomy and WFD methods.

Methods: Madra Stream in the North Aegean River Basin of Turkey, is located between 39° 07'-39° 22' N latitudes and 26° 40'-27° 15' longitudes. Epilithic diatoms and water samples were taken from 7 stations in the stream by seasonally (Autumn, Winter, Spring, Summer), between the years of 2015 and 2016. Standard methods for the implementation of the Water Framework Directive were preferred for the collection, cleaning and preparations of diatom samples (Kelly et al., 1998; CEN, 13946:2003). Water temperature, pH, dissolved oxygen, saturation, conductivity, total dissolved solid and salinity were measured with electronic equipment (WTW 3420i SET) in situ. Analyses of dissolved nitrogen forms, total phosphorus, total hardness, calcium and magnesium ions were performed according to standard spectrophotometric methods (APHA, AWWA, WEF, 1999).

Results and Discussion: In Madra Stream, the average values of water temperature, pH, dissolved oxygen, saturation, conductivity, total dissolved solid, salinity, ammonium nitrogen, nitrite nitrogen, nitrate nitrogen, total phosphate, total hardness, calcium and magnesium ions ranged from 12.6 to 22.1 °C, 8.1 to 8.9, 8.5 to 10.7 mg/L, % 90.1 to 107.3, 130.0 to 1602.3 µS/cm, 129.5 to 1597.3 mg/L, 0.0 to 0.8 ppt, 18.9 to 530.7 µg/L, 2.6 to 133.5 µg/L, 10.9 to 225.4 µg/L, 33.3 to 171.5 µg/L, 4.5 to 59.6 oF, 17.4 to 142.3 mg/L and 0.9 to 62.8 mg/L, respectively. During the sampling period, a total of 100 epilithic diatom taxa belonging to 44 genus from division of Bacillariophyta were identified in Madra Stream. As a result of the study, *Navicula* (13 taxa), *Gomphonema* (5 taxa), *Nitzschia* (5 taxa) and *Surirella* (5 taxa) were the most represented genus. All of identified taxa are cosmopolite for Turkish inland waters. Many of these taxa have eutrophic character and the current physicochemical conditions of Madra Stream have influenced on epilithic diatom composition.

Keywords: Madra Stream, Diatoms, Water Quality, WFD

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New Records of Genus *Eunotia* Ehrenberg (Bacillariophyceae) for the Freshwater Diatom Flora of Turkey From Some High Altitude Lakes in Blacksea, Turkey

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Objective: In this study, it is aimed to investigate of diatom flora of some high altitude lakes. The results are being partly revealed by genus level.

Methods: The samples was collected from two high altitude lakes (about 3400 m) and some small streams flowing into the lakes in July-2015. The samples were boiled with H₂O₂ and HCl to remove the organic matter. After repeated washing with distilled water, the material was air-dried on cover glasses and mounted in Naphrax. Observation of the diatoms were performed in Dumlupınar University with Nikon Ci light microscope and Nikon DS-Fi1 camera.

Results and Discussion: As a result, 7 species (*E. borealpina* Lange-Bertalot & Nörpel-Schempp, *E. botuliformis* F.Wild, Nörpel & Lange-Bertalot, *E. crista-galli* Cleve, *E. curtagrunowii* Nörpel-Schempp & Lange-Bertalot, *E. islandica* Østrup, *E. minor* (Kützing) Grunow, and *E. subarcuotoides* Alles, Nörpel & Lange-Bertalot) are new records for “Freshwater Flora of Turkey”.

Keywords: Black Sea Region, Diatom, Eunotia, Oligotrophy, Turkey.

Determination of Some Heavy Metals in Four Fish Species from Karacaören I Dam Lake, Turkey

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Objective: The aim of the present study is to determine concentration of some heavy metals in muscle tissues of four freshwater fish species living Karacören I Dam Lake which is the receiver of the wastewater of Isparta City.

Methods: A total of 106 fish samples (29 *Cyprinus carpio*, 28 *Squalius fellowesii*, 26 *Vimba vimba* and 23 *Carassius gibelio*) were caught seasonally between July 2013 and June 2014 by fishing nets from two different stations in the dam lake. All fish samples were kept at -20°C until analysis.

The fish samples were weighed and measured total body length. To determine the heavy metal concentrations, a piece of muscle tissues from each fish specimens was taken. Samples were measured in ICP-MS after solubilization treatment with HNO₃ in microwave unit. Some heavy metals as arsenic (As), cadmium (Cd), lead (Pb), mercury (Hg), manganese (Mn), nickel (Ni), chromium (Cr), zinc (Zn) and copper (Cu) parameters were analyzed. Metal concentrations were expressed as mg.kg⁻¹ wet weight (ww).

Results and Discussion: Arsenic (As), cadmium (Cd), lead (Pb), mercury (Hg), manganese (Mn), nickel (Ni), chromium (Cr), zinc (Zn) and copper (Cu) parameters were detected different concentrations in muscle tissues of fish species. The highest concentration in the all fish species was recorded for Zn and the lowest concentration for Cd. In *Vimba vimba*, the ordering of metals was found as Zn>Mn>Cu>Cr>Hg>Ni>As>Pb>Cd; in *Cyprinus carpio* as Zn> Mn> Cu> Cr> Hg>As>Ni> Pb>Cd; in *Squalius fellowesii* as Zn> Cu>Mn> Cr> Ni> Hg>As>Pb>Cd; in *Carassius gibelio* as Zn> Cu> Mn>Hg> Cr> Ni>As> Pb>Cd. Most of metal concentrations in *Carassius gibelio* were higher than those for other fish species as followings: Pb 0.0440±0.074, Cd 0.0011±0.001, Hg 0.1443±0.049, Cu 0.4634±0.08, Zn 7.1733±0.998. The maximum concentrations of Cr and Mn were measured in *Vimba vimba* as 0.3036±0.401 and 0.4568±0.3384 respectively. The highest concentrations of Ni (0.0979±0.047) and As (0.0485±0.047) content was determined in *Squalius fellowesii* and *Cyprinus carpio* respectively.

Keywords: Heavy metals, *Cyprinus carpio*, *Squalius fellowesii*, *Vimba vimba*, *Carassius gibelio*, Karacaören I Dam Lake, Turkey.

Investigation of Some Metal Levels in Water and Sediment Samples of Beysehir Lake**Cafer Bulut¹, Kazim Uysal², Soner Savaşer¹, Faruk Pak³, Özgür Aktaş³, Şakir Çınar¹**¹*Fisheries Research Institute, Egirdir-Isparta*²*Department of Biology, Faculty of Arts and Sciences, Dumlupınar University, Kütahya*³*Mediterranean Fisheries Research, Production and Training Institute, Kepez Unit, Döşemealtı, Antalya*

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Objective: In this study, it was aimed to investigate some metal levels in water and sediment samples of Beysehir Lake.**Methods:** This study was carried out seasonally in 2014. Sampling was conducted at 25 stations on the lake. The water samples were collected in 100 milliliter high density polyethylene bottles (precleaned with 10% nitric acid), stabilized with suprapure nitric acid (0.5% HNO₃), preserved in a cool place (about 4°C) for further analysis. Arsenic (As), copper (Cu), nickel (Ni), chromium (Cr), lead (Pb), zinc (Zn), mercury (Hg), cadmium (Cd), manganese (Mn), iron (Fe), aluminum (Al), molybdenum (Mo), tin (Sn), strontium (Sr), lithium (Li), antimony (Sb), rubidium (Rb) and boron (B) parameters have been studied in water samples. Arsenic (As), copper (Cu), nickel (Ni), chromium (Cr), lead (Pb), zinc (Zn), mercury (Hg), cadmium (Cd), manganese (Mn), iron (Fe), aluminum (Al), molybdenum (Mo), tin (Sn), strontium (Sr) parameters have been studied in sediment samples. Complex chemical analyzes of the samples were carried out by Graphite Furnace Atomic Absorption Spectrophotometer (AAS) in the Chemistry Laboratory of Fisheries Research Institute. The obtained data were evaluated on the basis of the existing criteria.**Results and Discussion:** As a result, the specified metal surface water, respectively, B>Sr>Fe>Mn>Mo>Li>Al>Rb>Cr>As>Ni>Cu>Zn>Sb>Pb>Sn>Co>Hg>Cd was found to be as in high level. In the sediment structure, Fe>Al>Mn>Sr>Cr>Ni>Zn>Cu>As>Pb>Co>Mo>Sn>Cd>Hg were found in high level. Metal levels in surface water are listed in the 1st Water Quality Class according to the Regulation on Superior Water Quality Management (2016). Hg, Pb and Cd and Zn levels were found to be below 4 threshold effect values ((LEL (lowest effect value), MET (Minimum impact threshold value), TET (value of toxic effect), SEL (severity level value)) from the parameters specified in the sediment quality criteria determined by MacDonald et al. (2000). The amounts of As, Cu and Ni exceeded the LEL level. The amount of Cr was above the level of TET (toxic effect value).**Keywords:** Beysehir Lake, heavy metal, water, sediment**Acknowledgment:** This work was carried out with the support of the project of TAGEM/2014/A11/P02/6 of the General Directorate of Agricultural Research and Policies of Republic of Turkey Ministry of Food, Agriculture and Livestock.

Estimation of the Nitrogen-Phosphorus Load Caused by Rainbow Trout**(*Oncorhynchus mykiss* Walbaum, 1792) - Kanlıçay Stream (Denizli)****Cafer Bulut¹, Ufuk Akçimen², Soner Savaşer¹**¹*Egirdir Fisheries Research Station, 32500 Egirdir-ISPARTA*²*Isparta Directorate of Provincial Food Agriculture and Livestock, ISPARTA*

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Objective: In our country, trout farming, which started in the 1970s (rainbow trout) farming, with production of over 100000 tons of annual production today, a leader in aquaculture. In recent years, the negative effects of aquaculture have begun to be debated, along with increased plant and production quantities. At land-based aquaculture facilities, wastes are released in different amounts to the water environment. As such, it is important to examine the environmental impacts of aquaculture. In this study, it was aimed to investigate the estimated nitrogen and phosphorus loads of the rainbow trout facilities on the Kanlıçay Stream located in the Denizli borders.

Methods: The estimated nitrogen and phosphorus loads of the facilities were tried to be calculated by considering the total fish production amounts, feed conversion rate, total amount of consumed feed and nitrogen and phosphorus contents of the used trout farms on Kanlıçay Stream as of 2010. In calculating the annual production amount and feed consumption of the enterprises, the statements of the enterprises, the observations of the project team, the results of nitrogen and phosphorus analysis are taken as basis.

Results and Discussion: The annual input of nitrogen input from the enterprises on the Kanlıçay Stream was estimated as 175.2 tons. The amount of nitrogen removed fish was estimated to be 99.6 tonnes annually. However, the estimated nitrogen load entering the creek Kanlıçay year was estimated at 75.66 tons. Boyd and Queiroz (2001) reported that 5.7 kg phosphorus was loaded per 1000 kg feed used in trout production. Phosphorus load per 1000 kg/feed of the facilities on Kanlıçay Stream was estimated as 8.33 to 9.67 kg/feed. The estimated average phosphorus load of the trout facilities was found to be above the value specified by Boyd and Queiroz (2001).

Keywords: Kanlıçay Stream, tainbow trout, *Oncorhynchus mykiss*, estimated nitrogen load, estimated phosphorus load

Comparison of Some Heavy Metal Levels Gill, Muscle and Liver Tissue of Common Carp (*Cyprinus carpio*, Linnaeus 1758) in Egirdir Lake

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Objective: Heavy metals are at the forefront of environmental pollutants. They are freed from the effects of natural roads and industrial wastes, they interfere with underground and surface waters and damage aquatic ecosystems. Heavy metals accumulate at a high level in organs such as liver, kidney and spleen of fish. In this study, accumulation levels of some important metals in carp fish samples in Egirdir Lake were investigated.

Methods: The study was conducted in the spring and autumn of 2013. Fishes were obtained from three different regions of Lake Egirdir (Hoyran, Gelendost, Köprü) with the help of various mesh openings. Analyzes were made on samples of gills, liver and muscle tissues of 30 carp fish. Samples were first subjected to solubilization with HNO₃ and H₂O₂. Measurements were performed on the ICP-OES instrument. In the study, have been examined arsenic (As), cadmium (Cd), lead (Pb), manganese (Mn), nickel (Ni), chromium (Cr) and zinc (Zn).

Results and Discussion: In the gill region of carp fish, most Zn (average: 115,848 mg/kg) and at least As (average: 0,051 mg/kg) accumulation were detected. In the muscle area, most Zn (mean: 19,703 mg/kg) and least As (0,019 mg/kg) were detected. Generally, the most dense Zn element was found in common carp. It followed Cu, Mn respectively. At least As and Cd were detected. When the data obtained were evaluated in the light of other studies made, it was determined that the samples of Lake Egirdir carp were lower than the other studies.

Keywords: Egirdir Lake, common carp, *Cyprinus carpio*, heavy metal

Acknowledgment: In this study was supported by Süleyman Demirel University Scientific Research Projects Unit SDÜ-BAP 3454-D2-13 project.

Phytoplankton Species Diversity of Beysehir Lake**Cafer Bulut¹, Nurhayat Dalkıran²**¹*Egirdir Fisheries Research Station, 32500 Egirdir-ISPARTA*²*Uludag University Faculty of Arts and Sciences, Department of Biology, Görükle-BURSA*

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Objective: Algae are the major primary producers in many aquatic systems and are an important food source for other organisms. Species composition and the seasonal variations of these forms in freshwater are dependent on the interactions between physical and chemical factors. In this study, we aimed to examine phytoplankton composition and their seasonal changes in Beysehir Lake.

Methods: The study was conducted in 2014. During the study, the 15 stations were made from Beysehir Lake seasonal sampling. In the field, the samples were collected/placed in sample containers of 100 ml volume and fixed with 4% formaldehyde solution. For diagnostic, Anagnostidis and Komárek (1999, 2005), Dillard (1993); Huber-Pestalozzi (1941, 1950, 1955, 1961, 1972, 1982, 1983), John et al. (2002), Komárek (2013), Krammer and Lange-Bertalot (1991a, 1991b, 1997a, 1997b, 2000), Patrick and Reimer (1966, 1975), Prescott (1972), Popovsky and Pfister (1990) were used as the sources. Synonyms and systematic categories of taxa are arranged utilizing <http://www.algaebase.org> website.

Results and Discussion: 9 taxa belong to Cyanobacteria, 9 to Euglenozoa, 9 to Dinophyta, 7 to Chrysophyceae class and 1 to Xanthophyceae class of Ochrophyta, 58 to four classes of Bacillariophyta, 9 to Conjugatophyceae class of Charophyta, 34 to Chlorophyceae class and 11 to Trebouxiophyceae class of Chlorophyta have been identified. As a result, a total of 147 taxa were determined. As a result, a total of 147 taxa were determined. Kazancı et al. (2009), they also found toxic species, *Microcystis aeruginosa* and *Anabaena solitaria* as well as another toxic species, *Aphanizomenon flos-aquae*, in the lake. Fakıoğlu ve Demir (2011) found that *Anabaena planctonica*, *A. spiroides*, *M. aeruginosa* and *Planktothrix agardhii* species were toxic species. In this study, *A. planctonica* and *Aphanizomenon sp.* found in the lake. *A. planctonica* only was observed in small quantities in August while *Aphanizomenon sp.* has been observed to be abundant at a high rate. Studies conducted in the lake during the 30-year period (Kazancı et al., 2009; Fakıoğlu and Demir, 2011) show that species diversity increases with the years, while at the same time the dominant species change with the years. The risk of the proliferation of different species with toxic characteristics in the lake, over the years poses a risk. Whether these species produce toxins in the lake should also be investigated.

Key Words: Beysehir Lake, phytoplankton, species diversity

Evaluation of Water Quality Parameters of Gökçekaya Dam Lake**Belgin Yoldaş¹, Ufuk Akçimen², Cafer Bulut¹, Osman Yener³, Vedat Yeğen¹,****Soner Savaşer¹, Ramazan Küçükkara¹***¹Fisheries Research Institute, Eğirdir-İSPARTA**²Isparta Agricultural Provincial Directorate -İSPARTA**³Bahri Dağdaş International Agricultural Research Institute, KONYA*

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Objective: In this study, it is aimed investigation of the monthly and seasonal changes of the water quality parameters, determination of water quality characteristics and pollution problems and also classification of the water quality according to Surface Water Quality Control Regulation in Gökçekaya dam lake.

Methods: The water samples were taken from two sampling sites for analysis and measurements were performed in situ at monthly from June2016 to May2017. Water temperature, dissolved oxygen, oxygen saturation, pH, electrical conductivity and salinity (salinity) were measured by means of WTW Multi field measurement set. Water samples were taken by means of polypropylene bottles and transferred to laboratory. Nitrite, Nitrate, Phosphate, Ammonium, T.Nitrogen, T.Phosphatase, COD and sulfate were measured according to spectrophotometric method with WTW. Chloride, organic matter, calcium, magnesium, alkalinity and total hardness were determined with titrimetric method. The physical and chemical analyzes performed in the laboratory were made according to the methods of APHA 1995, TSE 1989 and WTW 2005.

Results and Discussion: As a result of analyzes, 2 sampling points in Gökçekaya dam lake, average yearly surface water temperature 10.66- 16.38 °C, electrical conductivity 1014.90-1019.78 µS/cm, Ph 8.09-8.41, dissolved oxygen 2.25-8.58 mg/L, nitrite nitrogen 0.06-0.10 mg/L NO₂⁻-N, nitrate nitrogen 2.98-3.77 mg/L NO₃⁻-N, ammonium nitrogen 1.02-0.27 mg/L NH₄⁺-N, orthophosphate 0.62-0.46 mg/L PO₄⁻³-P, chloride 103.78-96.06 mg/L Cl⁻, sulfate 1308.35- 1133.48 mg/L SO₄⁻², calcium 96.79-100.41 mg/L Ca⁺², magnesium 71.01-61.11 mg/L Mg⁺², total hardness 54.51-51.98 °F respectively. According to Surface Water Management Guide-Inland Water Resources Quality Criteria, the studied surface part of Gökçekaya Dam Lake I was determined to have IV. Class (high polluted) water quality with respect to all parameter values.

Keywords: Water Quality Parameters, Gökçekaya Dam Lake

Water Quality Characteristics of Rivers Feeding into Sariyar Dam

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Objective: In this study, it is aimed investigation of the monthly and seasonal changes of the water quality parameters, determination of water quality characteristics and pollution problems and also classification of the water quality according to Surface Water Quality Control Regulation in Ankara, Porsuk, Kirmir and Sakarya rivers.

Methods: Sampling process were conducted on four different sampling station at monthly period from June-2016 to May-2017 and some of measurements were performed in situ. Water temperature, dissolved oxygen, oxygen saturation, pH, electrical conductivity and salinity (salinity) were measured with WTW Multi field measurement set. Water samples were taken by means of polypropylene bottles and transferred to laboratory. Nitrite, Nitrate, Phosphate, Ammonium, T.Nitrogen, T.Phosphatase, COD and sulfate were measured according to spectrophotometric method with WTW. Chloride, organic matter, calcium, magnesium, alkalinity and total hardness were determined with titrimetric method. The physical and chemical analyzes performed in the laboratory were made according to the methods of APHA 1995, TSE 1989 and WTW 2005.

Results and Discussion: As a result of analyzes, amount of dissolved oxygen of the Ankara river is 2,29. And this value is well below the limit values. And for other rivers, the average amount of dissolved oxygen is 14.88. Other measured parameters are variable on a monthly basis. And these parameters are well above the limit values. According to this results, because four rivers that flowed into the Sariyar dam brought serious pollution loads, the cleaning of these rivers will contribute to improve of the Sariyar dam lake.

Keywords: Water Quality Parameters, Ankara River, Porsuk River, Kirmir River, Sakarya River

Acute Toxicity on Fish Meager (*Argyrosomus regius*, Asso, 1801) of Cadmium (Cd²⁺)**Faruk Pak¹, M. Rüstü Özen², Özgür Aktaş¹, Yılmaz Emre³**¹*Mediterranean Fisheries Research, Production And Training Institute, Antalya, Turkey*²*Süleyman Demirel University, Faculty of Fisheries, Isparta, Turkey*³*Akdeniz University, Faculty of Science, Department of Biology Antalya, Turkey*

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Objective: Rapid industrial development, urbanization and intensive agricultural drug applications have brought about the problem of environmental pollution. Especially today, the heavy metal pollution in the aquatic environment has reached the dimensions that seriously threaten human health through the food chain. Cadmium, which is highly toxic in heavy metals, is not essential for aquatic organisms and is an increasing element in the natural environment due to ongoing anthropogenic and industrial activities. The cadmium ion (Cd²⁺) is a metal widely studied in water pollution studies due to its toxic effect, its widespread distribution in the environment and its side effects in organisms even at low levels. In this study, acute effects of cadmium exposure on meager (*Argyrosomus regius*), a new aquaculture species with a commercial value were investigated.

Methods: In the experiments were used meager which have average length of 12.08±0.81 cm and weights 23.08±3.06 g. The test fish were exposed to following concentrations of copper (0.1, 0.5, 1, 2, 5, 10, 20 and 40 mg/L) for 24-96 hours. In preparations of test solutions cadmium chloride and sea water which has salinity 37‰, temperature 20 °C, pH 8.45, and oxygen saturations 85%. Test fish were placed in glass containers to replications experimental groups as hourly and daily morphological observations were made and recorded time of death in acute toxicity test. Data obtained from the cadmium acute toxicity tests were evaluated using the Probit Analysis to LC₅₀.

Results and Discussion: No deaths were observed in the control, 0.1 mg/L, 0.5 mg/L, 1 mg/L and 2 mg/L experimental groups for 4 days during which the experiment was conducted and no adverse effects were observed in the morphological observations of the fish. At higher concentrations (10-40 mg/L) as time progresses, the surface concentrations of fish depending on the movements of assembly and also the opposite effect and side swims away from a fast-moving, uncontrolled swimming, to escape out of the water movement, perpendicular to the water, swimming, broathing movements are observed approaching the surface of the water. For *Argyrosomus regius* median lethal concentration at 24, 48, 72 and 96 h (LC₅₀) were calculated as 18.645, 10.171, 8.049, 6.699 mg Cd²⁺/L, respectively. These values were found to be 4 times higher for copper in the same fish.

Keywords: Acute toxicity, *Argyrosomus regius*, Meager, Cadmium, LC₅₀

Evaluation of shell pigmentation of freshwater crayfish (*Astacus leptodactylus*) in Çıldır Lake

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Objective: Freshwater crayfish (*Astacus leptodactylus*) are colored a greenish brown. In rare cases, shell color is influenced by diet, sunlight, bottom type and genetic factors. The aim of this study was to evaluate the shell pigmentation of freshwater crayfish (*A. leptodactylus*) in Çıldır Lake.

Methods: *A. leptodactylus* (n: 531, mean weight: 37.72 ± 15.30 g, mean carapace length: 52.46 ± 7.43 mm) were obtained from Çıldır Lake. Different color (colormorph) appearances (blue, blue-mottled, honey color, honey color-mottled, petrol color, petrol color-mottled, bright greenish brown and bright greenish brown-mottled were determined in freshwater crayfish samples.

Results and Discussion: Our results indicated that percentage of brown, brown-mottled, honey color, honey color-mottled, petrol color, petrol color-mottled, bright greenish brown and bright greenish brown-mottled were 1.88%, 0.37%, 2.63%, 0.37%, 37.09%, 9.41%, 29.37% and 19.77%, respectively. In Çıldır Lake, there are highly structured water plants reaching the light at the bottom of the lake and the substratum structure is covered with dense mud in the other parts although the sediment structures and vegetation of the lake have not been examined in detail. In addition, Çıldır Lake is a set lake, which is formed as a result of volcanic eruptions. For this reason, volcanic rocks are likely to be found at the bottom of the lake. It is thought that reasons possible impacted the pigmentation may be habitat structure and vegetation. In conclusion, the differences in pigmentation may be due to habitat structure and vegetation.

Keywords: freshwater crayfish, *Astacus leptodactylus*, pigmentation, Çıldır Lake.

Fish Fauna of Side Arms of Karasu River, Erzurum**Osman Serdar, Ebru Ifakat Özcan***Munzur University, Faculty of Fisheries, Tunceli, Turkey*

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Objective: In this study, it is aimed to fish fauna side arms of Karasu River, Erzurum**Methods:** Fish samples were collected from 8 locations in Karasu River, during October 2014 to September 2015 by electroshocker. The samples were immediately preserved with ice and fixed with 5% formaldehyd on arrival in the laboratory. All individuals were measured for total length (TL, in cm), fork length (FL, in cm), standard length (SL, in cm) to the nearest mm and weighted (W, total weight in g) to the nearest 0.01 g. Metric measurements were carried out with 0.01 mm sensitive calipers. Meristic characters such as number of gill rakers, pharyngeal teeth, dorsal and anal fin rays, lateral line scales and vertebrae were counted under a stereomicroscope. Geldiay and Balik (1996), were referred to for the determination and definition of the genera and species of the fish samples.**Results and Discussion:** In this study; in order to fish fauna of Karasu River side arms of Erzurum, fishes were caught from 8 different side arms of Karasu (Yeşildağ Stream, Yeşildere Stream, Köşk Stream, Ağasuyu Stream, Sincan Stream, Çiğdemli Stream, Han Stream and Taşağıl Stream). 11 species have been identified from region of research (*Salmo trutta macrostigma* (Dumeril, 1858), *Acanthobrama marmid* (Heckel, 1843), *Alburnoides bipunctatus* (Bloch, 1782), *Barbus lacerta* (Heckel, 1843), *Capoeta trutta* (Heckel, 1843), *Capoeta umbla* (Heckel, 1843), *Chondrostoma regium* (Heckel, 1843), *Squalius cephalus* (Linnaeus, 1758), *Glyptothorax kurdistanicus* (Berg, 1931), *Chalcarburnus mossulensis* (Heckel 1843), *Paracobitis tigris* (Heckel, 1843)).**Keywords:** Erzurum, fish fauna, Karasu River, taxonomy

Length-weight and length-length relationships of *Chondrostoma regium* in Karasu River, Turkey

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Objective: In this study, it is aimed to estimate of length-weight and length-length relationships of *Chondrostoma regium* (Heckel, 1843) in Karasu River.

Methods: The study area, which is in the tributary of Karasu River (Yeşildere, Köşk, Ağasuyu, Sincan, Poik, Çiğdemli, Han, Karahasan, Taşağıl, Karataş, Büyükgöze, Deli, Eriç, Kırık, Karnı streams) in the East Anatolia region of Turkey. Specimens (232 individuals) were collected during October 2014 to September 2015 by electroshocker from Karasu River. The samples were immediately preserved with ice and fixed with 4% formaldehyd on arrival in the laboratory. All individuals were measured for total length (TL, in cm), fork length (FL, in cm), standard length (SL, in cm) to the nearest mm and weighted (W, total weight in g) to the nearest 0.01 g insitu. The length-weight relationship was calculated using the expression: $W = aL^b$ (Sparre and Venema, 1998), where the W is the total weight (g), (TL) the total length (cm), “a” intercept and “b” is the regression coefficient. The student’s t-test used to test whether the slope (b) was importantly different from 3, indicate the growth type: isometric (b = 3), positive allometric (b > 3) or negative allometric (b < 3). Additionally, standard error of the parameter b and the statistical significance level of (r) were estimated. Length-lengthrelationships (LLR) were calculated using linear regression analysis. LLRs were measured as $FL = a + bSL$, $SL = a + bTL$ and $TL = a + bFL$ equations in all individuals.

Results and Discussion: The total length and weight of the sampled ranged between 7.5-31.0 cm and 5.7-289 g. The length-weight relationships were determined as $W = 0.0191L^{2.79}$ ($r^2 = 0.98$) for females, $W = 0.0219L^{2.74}$ ($r^2 = 0.96$) for males and $W = 0.0202L^{2.77}$ ($r^2 = 0.98$) for all individuals. The types of growth for all individuals were negative allometric for *Chondrostoma regium*. Length-length relationships were determined as $TL = 0.869 + 1.017FL$, $FL = -0.126 + 1.092SL$ and $SL = -0.348 + 0.884TL$ for all individuals.

Keywords: Length-weight relationships, length-length relationships, *Chondrostoma regium*, Karasu River, Turkey

Diet Overlap of two Cyprinids Caught with Local Fishing Gears in River Asi**Sevil Demirci, Ayşe Özyılmaz***Iskenderun Technical University, Faculty of Marine Science and Technology, Department of Marine Technologies, Iskenderun/Hatay, TURKEY*

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Objective: Feeding habits of two cyprinids living in the same environment were studied in Asi River. The aim of this study explains interspecies feeding relations between *Capoeta barroisi* and *Capoeta damascina* in the River Asi.

Methods: In this study, a total of 137 *Capoeta barroisi* and 167 *Capoeta damascina* species were caught, electroshocking, fyke net, traps and cast net. Their gut contents were analyzed. In the study, gut contents were identified to the lowest taxa. Food items were identified and counted with stereo microscope (magnification 100x). The counting was made using Thoma slide square. Diet overlap, emphasizing the percentage similarity both species between of the diets, was calculated according to the index of Shorygin (Shorygin, 1952)

Results and Discussion: Based on the data of this present study, both species have herbivour diet features. The volumetric diet composition of *C. barroisi* and *C. damascina* were mainly found Chrysophyta, Cyanophyta and Chlorophyta. *Cyclotella*, *Nitzschia*, *Navicula*, *Scenedesmus*, *Dactylococcopsis* were dominant organisms in both fish gut systems. *Nitzschia* and *Navicula* were especially selected by both species from the environment (SI of *Nitzschia*: 67 %; SI of *Navicula*: 61%). It was considered that especially like a *Dactylococcopsis* other food organism was preferred not intentionally but due to its abundance in the medium. (SI of *Dactylococcopsis*: 11%).

Keywords: Diet Overlap, *C. barroisi*, *C. damascina*, Shorygin Index

Feeding Habits of *Capoeta damascina* (Valenciennes, 1842) in the Asi River, Turkey**Sevil Demirci, Ayşe Özyılmaz**

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Objective: In present study, intestine contents of *Capoeta damascina* (Valenciennes, 1842) were studied in order to determine its position in food chain. The aim of this study is to define preliminary information on the most common preferred food species and the dietary preferences in algae species in the Asi River.

Methods: In this study, a total of 167 *C. damascina* individual samples were collected by electroshocking, trap, fyke net and cast net. The gut contents of the fish were investigated by using percent of total number (N), percent of frequency of occurrence (F), method of Geometric Index of Importance (GII) and Index of Relative Importance (IRI).

Results and Discussion: The results of intestine system of volumetric analysis showed that *C. damascina* mostly consumed phytoplankton origin food organism. Chrysophyta, Chlorophyta and Cyanophyta are main food groups for *C. damascina*. Especially, members of Chrysophyta were dominant species according to the values of IRI and GII. The diets of this species consist of only 4 zooplankton origin food items which are Copepoda, Cladocera, Nematoda, and Euglenophyta. They were observed in a very few amount in the gut system (Less than 5%).

Keywords: *Capoeta damascina*; Asi River; Feeding Habits; IRI indices; GII indices

Endemic Species of the Genus *Pseudophoxinus* (Teleostei: Cyprinidae) in Anatolia and Distribution Areas

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Objective: Spring minnows of the cyprinid genus *Pseudophoxinus* are distributed from Central Anatolia east to Azerbaijan and south to Israel. Most species have very small distribution areas and are often restricted to a few streams or springs making them one of the most challenging group of fishes for conservation in the strongly impacted Middle East landscape. Recent studies have shown that *Pseudophoxinus* is comprised of two well-separated phylogenetic lineages (central Anatolia and Levant-the upper Euphrates groups), which correspond to different geographic distribution patterns. Several authors have underlined the role of past isolated endorheic inland systems of Anatolia on the speciation process of the genus, and suggested the lake basins in central and southwestern Anatolia as the center of origin. In our study, the endemic species of *Pseudophoxinus*, which has a very high endemism rate in Anatolia, habitat characteristics, distribution areas, threats and IUCN situations are discussed.

Methods: In the study, Süleyman Demirel University Eğirdir Fisheries Faculty Collection (IFC-ESUF) samples were used. Taxonomic properties of the samples were determined according to Kottelat and Freyhof (2007). The habitat preferences and threats of the species are based on observations of about 20 years.

Results and Discussion: In the taxonomic studies carried out in Anatolia: *P.alii*, *P.anatolicus*, *P.antalyae*, *P.battalgilae*, *P.burduricus*, *P.crassus*, *P.egridiri*, *P.elizavetae*, *P.evliya*, *P.fahrettini*, *P.firati*, *P.handlirschi*, *P.hittitorum*, *P.iconii*, *P.kervillei*, *P.maeandri*, *P.maeandricus*, *P.mehmeti*, *P.ninae*, *P.turani*, *P.zekayi* and *P.zeregi*, 22 species were identified. From these species, *P.handlirschi* (Eğirdir Lake endemic) was extinct in the early 1970s (EX). All of the taxa of *Pseudophoxinus* (except *P.kervillei* and *P.zeregi*), which have an important place in inland water fishes in Anatolia, are endemic.

Keywords: Anatolia, spring minnows, morphology, zoogeography

The Effects of Environmental Factors on Freshwater Fish Species

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Objective: In this study, it is aimed to review the effects of environmental factors on freshwater fish species, the determination of contamination sources, the toxic level of contaminants and the control of these contaminants.

Methods: There have been many environmental factors that affect the life and quality of freshwater species such as technological, ecological, industrial, agricultural etc. If freshwater species are contaminated with these environmental pollutants, these pollutions can not only be risk for freshwater fish species but also they can be problem for human health when these freshwater fish are consumed. For this purpose; environmental factors that affect the life and quality of freshwater fish species such as the climate change risks by increasing temperatures, many environmental contaminants such as heavy metals (zinc, aluminum, manganese, copper, arsenic, chromium etc.), the sources of contaminants, the type of contaminants, the determination of these contaminants by using different methods, the toxic level of these contaminants, harmful concentrations to freshwater organisms, the accumulation of these contaminants in freshwater fish species, the effects of these products to human health when they are consumed, the elimination and control of environmental pollutions such as industrial, agricultural, technological, ecological etc. were explained by using different literatures.

Results and Discussion: In this review; the effects of environmental factors on freshwater fish species were explained. Environmental factors effecting the life of freshwater fish species such as increasing the temperature of freshwater, pollution, diversity, invasive fish species etc., factors effecting the quality of freshwater fish species and also human health such as pollutions (technological, ecological, industrial, agricultural etc.), the chemical and microbiological contaminants of fresh water fish species were discussed. Toxic levels of these chemical and microbiological contaminants on freshwater fish species, determination of these contaminants on freshwater fish species by using different methods were also cleared according to literatures.

As a result; the incidence, distribution and bioaccumulation of these chemical and microbiological contaminants in freshwater should be controlled. Samples of fish species, freshwater and soil should be taken and controlled regularly. The industrial, technological, agricultural waste waters and sewage wastes can't be flowed into the freshwater because of being avoided the chemical and microbiological contaminants. Safety regulations, obligations, new control plans should be applied on freshwaters for preventing diseases to contaminate freshwater species and humans.

Keywords: Environmental factors, freshwater, freshwater fish species, human health, diseases

Some Population Parameters of *Salmo trutta macrostigma* (Dumeril, 1858) in Munzur River (Turkey)

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Objective: This study was carried out to determine the some population parameters of *Salmo trutta macrostigma* (Dumeril, 1858) whose economic value is quite high and living in Munzur River. It was aimed to provide the necessary data to protection of this species in its natural environment.

Methods: A total of 165 fish sample examined in the study was caught by using fishing line, cover net, gill net and electro-shocker between January 2015 and December 2015 in the Munzur River (Turkey). After the length and weight of fish samples was measured in the laboratory, age of the fish was determined by using scale. Some population characters were confirmed by means of standard methods. FAO-ICLARM FISAT II Pocket Program was used to determine the von Bertalanffy growth parameters.

Results and Discussion: The female-male ratio of population consisting of I-VIII age groups was found as 1:0.96. The regression coefficient (b) in the length-weight relationship was determined as 2.9854 (isometric) for females, as 2.7251 (allometric) for males and as 2.8509 (allometric) for all population. The total lengths and weights of examined fish samples were varied from 12 cm to 36 cm and from 22.9 g to 490 g, respectively. Mean condition factor of all age groups of populations was calculated as 1.19. The highest relative growth rate (31.41%) was occurred between II and III age groups. von Bertalanffy growth parameters of population were calculated as $L_{\infty}=55.8$ cm, $K=0.10$ year⁻¹, $t_0=-1.61$ year, $W_{\infty}=1949.6$ g for female, as $L_{\infty}=56.58$ cm, $K=0.08$ year⁻¹, $t_0=-2.06$ year, $W_{\infty}=1696.3$ g for male and as $L_{\infty}=55.5$ cm, $K=0.09$ year⁻¹, $t_0=-1.89$ year, $W_{\infty}=1756.5$ for all population. Growth performance index (Φ') used to compare of growth parameters obtained from different studies was calculated as 2.49 for female, 2.41 for male and 2.44 for all population.

Keywords: Munzur River, *Salmo trutta macrostigma*, Population, Age, Growth

The Investigation of Some Meristic and Morphometric Characteristics of *Salmo trutta macrostigma* (Dumeril, 1858) in Munzur River

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Objective: There have been difficulties in subspecies identification of brown trout in our country. The most important reason for this, species becomes different as morphologically in time depending on its home region. Although genetic methods in species identification have come into the forefront in recent years, the investigation of morphological characters has maintained its importance. In the study, all morphological characters of *Salmo trutta macrostigma* (Dumeril,1858) in the Munzur River were determined and were compared with other studies.

Methods: A total of 40 fish sample examined in the study was caught by using fishing line, cover net, gill net and electro-shocker between January 2015 and December 2015 in the Munzur River. Measurement of 24 morphometric characters and count of 30 meristic characters were carried out in the laboratory.

Results and Discussion: The regression coefficient (b) in the length-weight relationship was determined as 2.8378 (negative allometric growth). The regression equation of correlation between total length and weight was detected as $SB=0.9428TB-1.0041$. The rates among the body parts of fish samples were determined and this data were compared with other studies. In the samples examined, the number of lateral line scale was ranged from 107 to 146; the number of transversal scale was ranged from 20 to 31; the number of vertebrae was ranged from 54 to 59 and the number of gill rakers was ranged from 18 to 22. The number of dorsal, ventral, pectoral, anal and caudal fin spines and rays were determined to be D: III-IV 10-12, V: I-II 7-12, P: I-II 8-14, A: I-IV 7-11 ve C: VIII 17-25, respectively. It was determined that the numbers of red and black spots on the body were changed from individual to individual.

Keywords: Munzur River, *Salmo trutta macrostigma*, Morphometric, Meristic

Length-Weight Relationship and Relative Condition Factor of Caucasian Goby, *Ponticola constructor* (Nordmann, 1840) Inhabiting Terme Stream, Samsun, Turkey

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Objective: This study describes the length-weight relationship and relative condition factor of Caucasian goby, *Ponticola constructor* (Nordmann, 1840) from Terme Stream, Samsun, Turkey. The relationship between total length and standard length was also determined.

Methods: Fish were collected between June 2015 and August 2016. The specimens were caught using an electro-shocker. All samples were measured to the nearest 0.01 mm for total length (TL) and standard length (SL), and weighed to the nearest 0.01 g. Sex was determined from gonad examination. The chi-squared test was used to show whether the sex ratios deviated significantly from 1:1. The length-weight relationship (LWR) was estimated using the equation $W = aTL^b$. LWR was obtained separately females, males and all individuals. The slopes of LWRs of females and males were compared for significant difference by analysis of covariance (ANCOVA). The student's *t*-test employed to test whether the slopes (*b*) were significantly different from 3, indicating the growth type: isometric ($b = 3$), positive allometric ($b > 3$) or negative allometric ($b < 3$). The relative condition factor (K_r) was computed using the equation $K_r = W / aTL^b$. K_r values were separately determined according to sexes. Differences between K_r values of females and males were tested by the student's *t*-test. All length-length relationships were established using linear regression analysis.

Results and Discussion: From the total of 232 specimens were captured, 140 (60.34%) were females, 74 (34.90%) were males, and 18 (7.76%) were undetermined sexes. The overall sex ratio of females to males was 1:0.52, which did deviate from 1:1 ($\chi^2 = 20.355$, $df = 1$, $P < 0.001$). The LWRs were highly significant ($P < 0.001$, $r^2 > 0.974$). The coefficient *b* of LWR was calculated as 2.856 for females, 2.847 for males, and 2.879 for all individuals. No significant difference was observed in slopes of LWRs of females and males (ANCOVA, $F = 0.02$, $P > 0.05$). The variations in estimated *b* values from 3 were statistically significant ($P < 0.05$). This result showed negative allometric growth for *P. constructor*. The mean K_r values of females, males, and all samples were computed as 1.001, 1.005, and 1.004, respectively. There was no significant difference in mean K_r between sexes ($P > 0.05$). The relationship between total length and standard length was found as $TL = 2.617 + 1.157 SL$ ($r^2 = 0.998$) for females, $TL = 0.538 + 1.202 SL$ ($r^2 = 0.994$) for males, and $TL = 1.116 + 1.186 SL$ ($r^2 = 0.992$) for all specimens. In conclusion, this study is the first reference on the LWR and K_r of *P. constructor*. According to the findings of the present study, it is suggested that the growth of this species is satisfactory in Terme stream.

Keywords: Length-weight relationship, relative condition, *Ponticola constructor*, Terme stream

Basic Stem Cell Culture Techniques in Fish

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Objective: In this study, it is aimed to give basic information on fish cell culture laboratory environment and to briefly introduce the fundamental concepts and techniques of fish stem cell culture.

Methods: There are four basic requirements for successful stem cell culture. The first one is a well-established and good equipped cell culture laboratory (Laminar-Flow Hood, Inverted Microscopes, Fluorescent, Clinical centrifuge, Water bath, refrigerator and Freezers, Biohazard Waste Containers, cell culture vessels, pipettes). The second requirement for successful stem cell culture is the practice of aseptic technique. The third necessity is appropriate, quality controlled reagents, biochemical and supplies (L-15, DMEM, Cell culture dishes, multi-well plates, typan blue..). The final one is the knowledge and practice of the fundamental techniques involved in the growth of the cell type of interest. However, currently there is no globally accepted definition and standardization regarding to good stem cell growth techniques.

Results and Discussion: Teleost fishes represent 48% of all living vertebrate species (Nelson, 2006). They represent an enormous resource for the development of vertebrate and mammalian cell and tissue models for use in biomedical sciences. The physiology, genetic and blood plasma constituents of teleost fish are similar to those of terrestrial vertebrates. Teleost fish are also extremely important models for human biology, health and disease (Gehrke et al., 2015; Bhandari, 2016; Brugman, 2016 and Davis et al., 2016). Therefore, the techniques for stem cell culture are also similar. Nevertheless, fish stem cell culture differs from mammalian stem cell culture, in temperature, in osmolality in culture media. There is no one single methodology in culturing stem cells of different organs and different animal species (Lakra, 2011). However, fish stem cell culture environment and laboratory safety regulations can be standardized. Basic and standard principles regarding to cell culture can be used in order to compare data between laboratories and experimentation performed at different times. The most globally accepted problems in stem cell culture experiments are contamination and microbial infection (Pamies et al., 2017). Recent significant advances in stem cell culture decreased the contamination problem significantly.

Keywords: Cell culture, fish, laboratory, safety

Length-Weight And Length-Length Relationships For Mullet (*Liza abu* Heckel, 1843) In Devegeçidi Dam Lake, South-Eastern Turkey

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Objective: *Liza abu* specimens are economically important as food eaten fresh, smoked or canned, as bait, and as cultured fish in ponds. The objective of this study was investigated the length-weight relationships and the length-length relationships of *Liza abu* H., 1843 inhabiting in Devegeçidi Dam Lake, (Southeastern Turkey). First study was for *Liza abu* in the this lake.

Methods: *Liza abu* specimens were obtained by using gillnets with 18 mm mesh size between January and May 2017 from Devegeçidi Dam Lake region in Turkey. The total length (TL), standard length (SL) and fork length (FL) of fish were measured (± 0.1 cm), weighted (± 1 g) with an electronic balance, and the sex was assigned by examining the gonads. The length-weight relationships for weight were calculated using the equation, $W=aL^b$, where 'a' is a coefficient related to body form and 'b' is an exponent indicating isometric growth when equal to 3. The length-weight relationship between males and females were calculated separately. The length-length relationships, TL vs. FL, FL vs. SL, and SL vs. TL relations were estimated with linear regression. All statistical analyses were evaluated at $p < 0.05$ significance level.

Results and Discussion: In this study were used *Liza abu* specimens in total 255 (161 female and 92 male) in Devegeçidi Dam Lake in 2017. Length-weight relationships were found as $W = 0.011 \times TL^{3.01}$ ($r^2 = 0.92$) for females and $W = 0.017 \times TL^{3.05}$ ($r^2 = 0.91$) for males. The b values of both sexes were $b \geq 3$, which represents isometric growth (Student's t-test; $P < 0.05$). The length-length relationships between total length (TL), fork length (FL) and standard length (SL) for *Liza abu* were found to be highly significant ($r^2 > 0.96$, $p < 0.05$).

Keywords: *Liza abu*, Length-weight relationship, Length-length relationship, Devegeçidi Dam Lake, Turkey.

Some Population Parameters of *Capoeta umbla* (Heckel, 1843) in the Boztepe Recai Kutan Dam Lake (Malatya)

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Objective: In this study, it is aimed to determine some biological properties of *Capoeta umbla* population and this is the first study in the Boztepe Recai Kutan Dam Lake.

Methods: The fish samples were collected using the gill nets with mesh sizes between 36 and 100 mm in February, March, and April 2014. Total length and weight of the each fish sample were measured and their ages were determined from the otolith. To determine the gender of the fish, the abdominal areas were opened and the gonads were examined. Condition factor was calculated from $CF = (W \cdot 100) / L^3$ equation. The length-weight relationship was determined with Le Cren's $W = a \cdot L^b$ equation and the age-length relationship was estimated with the von Bertalanffy's $L_t = L_{\infty} \cdot (1 - e^{-K \cdot (t - t_0)})$ equation.

Results and Discussion: A total of 318 *C. umbla* samples (131 males and 187 females) were investigated and age distribution of the population were confirmed between I and X years old. The mean total length values were determined between 10.2-45.2 cm in male individuals; between 11.10-46.83 cm in female individuals, and the mean weight values were determined between 11.20-602.00 g in male individuals; between 23.00-678.00 g in female individuals. The equation of total length-weight relationship were found as $W = 0.010TL^{2.8375}$ for all individuals. Fish age-total length relationship were found as $L_t = 51.29 \cdot (1 - e^{-0.15 \cdot (t + 1.99)})$ for all individuals. The mean condition factor values were determined between 0.845-0.968 in male individuals; between 0.703-0.998 in female individuals. As a result, it is thought that these data should be taken into consideration for the sustainable fishing of the *C. umbla* population inhabiting Dam Lake.

Keywords: Boztepe Recai Kutan Dam Lake, *Capoeta umbla*, age, growth

A Comparison of the Size-Composition of the Turkish Crayfish (*Astacus leptodactylus* Eschscholtz, 1823) Inhabiting Eğirdir Lake vs Keban Dam Lake

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Objective: Turkish (Narrow-clawed) Crayfish (*Astacus leptodactylus* Eschscholtz, 1823) is the most important shellfish in Turkey in both economic and ecological sense. It is an important export product with high commercial value and is also an important source of revenue for fishermen. Although it is an important species a lot of bio-ecological features of it remain unknown. In this study, some morphometric features of two important *A. leptodactylus* population of Turkey have been compared on length to length relation for each length category.

Methods: In this study, the sizes of total length (*TL*), carapace length (*CL*), carapace width (*CW*), abdomen length (*AL*), abdomen width (*AW*), chela length (*ChL*), and chela width (*ChW*) were compared separately for each length category obtained from two different habitats. In calculations, a total of 1328 crayfish from Lake Eğirdir (♀:555, ♂:773) and 2045 from Keban Dam Lake (♀:868, ♂:1177) were used. The field studies in Lake Eğirdir were carried out in three different stations, in a period of July-2010 and June-2011 with monthly period. Field works in Keban Dam Lake were carried out in 6 different stations in a period of January-2012 and December-2012. In the comparing body section of crayfish that in different sex groups and same length category in each catching ground the t-test was used. Statistical calculations were made on significance of $P < 0.05$ and $P < 0.001$. For all statistical calculations R Studio (V.0.99.463) computer software was used.

Results and Discussion: . The correlation relations between compared parameters were so high. According to linear regression analysis while the highest relation was between *TL* and *AL* ($R^2=0.987$) of the female in Eğirdir Lake and the weakest relation was between *AW* and *ChL*'s ($R^2=0.084$) of male+female in Keban Dam Lake. As a result, it was determined that the biometric features of *A. leptodactylus* populations in Eğirdir Lake and Keban Dam Lake were different and while these differences were insignificant in small and larger lengths, it was significant in mid- length groups.

Keywords: Narrow-clawed crayfish, *Astacus leptodactylus*, morphometric characters

Complement System and Functions in Teleost Fishes**Gülşen Uluköy¹, Ayşegül Kubilay², Esin Baba¹**¹*Department of Aquaculture, Fisheries Faculty, Muğla Sıtkı Koçman University, Kötekli-MUĞLA*²*Department of Aquaculture, Fisheries Faculty, Süleyman Demirel University, Çünür-İSPARTA*

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Objective: The aim of this study is to provide a review of the complement system in teleost which have important duties in immune response. The complements are a major humoral system of innate immunity.

The complement system occurs a set of plasma proteins which circulates in blood. They play key roles in innate and adaptive immunity. It consists of 35 individual soluble proteins, respectively. They work together to remove pathogens and damaged cells from the host. It is also a part of the immune system that enhances the ability of antibodies and phagocytic cells to clear microorganisms by covering the pathogen from an organism, The activation of complement can develop in different routes;

Activation of complement system;

The Classical Pathway (CCP) : activation occur when antigen-antibody (Ag-Ab) binding occur in the host.

The Alternative Pathway (ACP) : activation occur when the bacterial endotoxin released in the host.

Lectin Pathway (LCP) : activation occur when the mannose binding the lectin.

The complement system is one of the key mechanisms of the humoral components of the immune system which enhances the ability of phagocytosis. The system plays an essential role in alerting the host of the presence of potential pathogens, as well as killing or inactivating. These routes lead to the activation of C3 into C3b and C3a. Result of the cascade complement gain activation and binds to surfaces of pathogen. Complements could active in teleost fish a very wide range of temperatures even if low temperatures. This makes the complement has a very powerful defense mechanism in fish. The complements involve in opsonization, phagocytosis, chemotaxis, lysis and inflammation in immune response.

In conclusion; This review will provide information on the functions of complement system in fish and the roles the each soluble proteins, including the various forms, play in host defence, is important for developing a new strategies in fish health management.

Keywords: Complement, C3, cascade, pathway, humoral immunity, innate and adaptive immunity

Fuzzy Logic Method in Forecasting Length Weight Relation

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Objective: It is aimed to evaluate that the fuzzy logic approach can be used in calculating the length-weight relation. In fisheries study, estimation can also be made by fuzzy logic method of length weight relation.

Methods: In the literature, many authors talked about the importance of length weight relation and the interpretation of the parameters that define it. The concept of fuzzy logic was first proposed by Zadeh (1965). A fuzzy logic model is also known as a fuzzy inference system or fuzzy-rule-based system. Basically, any fuzzy logic model consists of three parts: the fuzzy membership functions, the fuzzy decision rules, and the fuzzy reasoning. The length-weight relationships were estimated from the formula, $W = aL^b$, where W is total body weight (g), L the total length (mm), a and b are the coefficients of the functional regression between W and L (Ricker, 1973).

Results and Discussion: The values of the fisheries products such as fish and crayfish can be estimated by using the fuzzy logic method. Fuzzy logic method and estimation methods and length-weight relation calculations are investigated. The results on the trial data are examined and predicted by fuzzy logic method. Studies have been initiated to obtain fish or crayfish samples for fuzzy logic method.

Keywords: Fuzzy Logic approach, Length-Weight Relationships, fisheries

Otolith Shape Analyses of The European Bitterling (*Rhodeus amarus* Bloch, 1782) sampled from Terme and Terice Streams (Samsun, Turkey)

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Objective: Otolith analysis is an important marker in the studies of fish populations. Otolith shape analyses have been shown to be promising tools for stock identification. The aim of this study is to determine the shape index values of *Rhodeus amarus* Bloch, 1782. European bitterling were sampled from Terme and Terice Streams in Samsun Province and detected the regional differences between the localities.

Methods: *R. amarus* samples were obtained from Terme and Terice Streams. The measurements for the Terme Stream (56 individuals) and Terice Stream (60 individuals) samples were taken separately. All captured fish were measured (± 0.1 cm) for total length (TL) and weighted (± 0.01 g). Utricular and lagenar otoliths were removed by making left and right distinctions. All otoliths were photographed on distal side. Otolith breadth (OB), length (OL), perimeter (P) and area (A) (± 0.001 mm) were determined by Imaging Software. Form Factor, Circularity, Roundness, Rectangularity, Aspect Ratio and Ellipticity were used for otolith shape analyses. These shape indices were calculated for the utricular and lagenar otolith pairs of *Rhodeus amarus* by separating right and left. SPSS 20, Minitab 15.0 and the Excel software were employed in the statistical analyses.

Results and Discussion: The average total lengths and weights of the individuals sampled from the Terme and Terice Streams determined as 6.809 ± 0.108 , 5.463 ± 0.102 cm and 4.454 ± 0.248 , 1.828 ± 0.164 g, respectively. According to the statistical analyses there is differences in terms of total length and weight between localities ($P < 0.001$). For Terme and Terice populations, there is no differences between right and left otolith pairs in terms of otolith shape analyses ($P > 0.05$). Form Factor, Circularity, Roundness values of asteriscus otoliths and Rectangularity, Aspect Ratio, Ellipticity of lapillus otoliths are different between localities ($P < 0.001$). According the results of this study, index values were determined statistically significant difference between the two populations and otolith shape indeces can be utilized for the seperation of stocks for bitterling in following studies. Otolith shape analysis is based on the principle that the shape of the otolith varies geographically, even within a species. This is the first study in which the otolith shape analysis of *R. amarus* was performed.

Keywords: *Rhodeus amarus*, Samsun, otolith, stock separation

Otolith Shape Analyses of The Chub (*Squalius cephalus*, L., 1758) Inhabiting Inland Waters of Samsun Province

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Objective: Cyprinidae is the family that has the most species in freshwater fish fauna. *Squalius cephalus* is an opportunistic species and is common in almost all running waters in Turkey. There are limited studies about otolith shape indices of chub. Otolith analysis is an important marker in the studies of fish populations. The aim of this study is to determine the shape index values of *Squalius cephalus*, L., 1758, sampled from Akçay Stream, Terme Stream and Yedikır Dam Lake in Samsun Province and detect the regional differences between the localities.

Methods: The chub samples were obtained from Akçay (57 individuals), Terme (55 individuals) and Yedikır Dam Lake (62 individuals). All captured fish were measured (± 0.1 cm) for total length (TL) and weighted (± 0.01 g). Utricular and lagenar otoliths were removed by making left and right distinctions. All otoliths were photographed on distal side. Otoliths were weighted (± 0.0001 g). Otolith breadth (OB), length (OL), perimeter (P) and area (A) (± 0.001 mm) were determined by Imaging Software. Form Factor, Circularity, Roundness, Rectangularity, Aspect Ratio and Ellipticity were used for otolith shape analyses. These shape indices were calculated for the utricular and lagenar otolith pairs of *S. cephalus* by separating right and left SPSS 20, Minitab 15.0 and the Excel software were employed in the statistical analyses.

Results and Discussion: The average total length of individuals sampled from Akçay, Terme and Yedikır varies between 10.31 ± 0.518 , 10.33 ± 0.289 and 11.11 ± 0.327 , respectively. There is no difference in terms of OB, OL and OW between Akçay and Terme samples ($P > 0.05$). For Terme population, the Form Factor, Circularity and Rectangularity values are found different from other localities ($P < 0.001$). Also, Ellipticity and Aspect Ratio of Yedikır Dam Lake individuals are different from other localities ($P < 0.001$). Roundness value is similar between all localities ($P > 0.05$). Consequently, Form Factor, Circularity, Rectangularity, Aspect Ratio and Ellipticity can be used for stock separation. The otolith shapes have been evaluated based on morphometric measurements and the mathematical computation of shape indices. The results obtained from this study can be utilized for the separation of stocks in chub populations using otolith shape indices mentioned inland waters of Samsun Province.

Keywords: *Squalius cephalus*, Samsun, shape analyses, stock separation

Population Dynamics of European Pond Turtle *Emys orbicularis* from Lake Gölhisar (Burdur/Turkey)

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Objective: The objectives of our study were to establish the population size, density, body size, and sex ratio of a population of *E. orbicularis* from western Anatolia.

Methods: 12 field studies were conducted in Gölhisar Lake between years 2011 – 2013. In order to catch turtles, cage like fykes made from nets were used. The fykes were located at optimum distance at the reeds at night and they were collected in the early morning. The captured turtles were marked individually by notching marginal scutes according to Ernst *et al.* (1974).

As the sampling period covered a time span of three years, it was reasonable to regard the population is open (where there are individuals which enter the population by birth and immigration and others which leave the population by death and emigration). With the data set formed from the captured individuals, POPAN (Schwarz, Arnason 1996) and MARK (Lebreton *et al.* 1992, Cooch, White 2016) programs used for generate models and *Akaike's information criteria* (AICc) was used to determine the most suitable model. With the suitable model, the capture rate (p), survival rate (ϕ), annual change rate (λ), annual population size (N) and the super population size (\check{N}) were estimated.

Results and Discussion: As result of field studies, 160 (64 ♂♂, 82 ♀♀, 14 juvenile) samples in total was captured and marked, and 65 of them were recaptured. According to POPAN program, the 3 years super population size was estimated as 188, mean capture rate was calculated as 0.24 and mean survival rate was calculated as 0.65. It has been observed that the sex ratio is female biased (male: female = 0.78).

Keywords: *Emys orbicularis*, population size, sex ratio, Lake Gölhisar, Turkey

A Preliminary Study on Freshwater Amphipods (Crustacea) of Kütahya Province**Mehmet İpek¹, Murat Özbek², Ümit Şirin¹**¹*Eskişehir Osmangazi University, Faculty of Science and Art, Eskişehir, Turkey*²*Ege University, Faculty of Fisheries, 35100, İzmir, Turkey*

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Objective: A preliminary study on freshwater amphipod species inhabited Kütahya province (Turkey) were studied.

Methods: Specimens were collected from 10 different freshwater resources which are 5 running waters and 5 fountains between 25 July 2015 – 12 May 2016. A scoop net having 0.5 mm mesh size was used to sampling the benthic materials. Specimens were fixed in 96% ethyl alcohol in the field, then also kept in the same solution in laboratory. All examinations and photographing were made with the help of a monitoring system being from a dissection microscope (Olympus SZ61) and a compound digital camera. Karaman and Pinkster (1977, 1987) and Özbek and Balık (2009) were followed for the taxonomic identification. All specimens are deposited in the Entomology Laboratory of Biology Department, Faculty of Science and Art, Eskişehir Osmangazi University, Eskişehir, Turkey.

Results and Discussion: As a result of the study, totally 454 specimens were investigated. There are seven amphipod species [*Gammarus anatoliensis* Schellenberg 1937, *G. balcanicus* Schäferna 1923, *G. pulex pulex* (L. 1758), *G. gonensis* Özbek 2016, *G. uludagi* G. Karaman 1975, *G. katagani* Özbek, 2012 and *Niphargus* sp.] inhabited the freshwaters of Kütahya province. *G. pulex pulex* is the most diverse species among the determined ones with 5 localities. Photos and short descriptions of the determined species are presented in addition to a key comprising the Amphipod species inhabited the freshwaters of Kütahya province.

Keywords: *Gammarus*, distribution, freshwater, Kütahya, Turkey

Relationships between Fish Length and Otolith Dimensions of Wels Catfish, *Silurus glanis* L., 1758 Inhabiting Sıddıklı Küçükboğaz Dam Lake

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Objective: The biometric relations were important for fisheries biology. Also, they supply crucial information identification species from otolith size, estimation of fish length from otoliths coming out of the stomach of predator fishes. Therefore, we aimed determination to these relations of wels catfish inhabiting Sıddıklı Küçükboğaz Dam Lake.

Methods: 203 specimens were caught between September 2015 and August 2016. Total length (TL) of each fish was measured to the nearest 0.1 cm and sexes were determined through macroscopic examination of the gonad. The lagenar (lapillus) and utricular (asteriscus) otoliths were removed, cleaned, and preserved in Eppendorf tubes. For lagenar otolith, Otolith length (OL) and width (OW), for utricular otoliths Otolith length (OL) and height (OH) were measured to the nearest 0.001 mm. The relationships between otolith dimensions and fish size were established using nonlinear regression models. Paired t-test was conducted for determining the difference in measurements of left and right otolith and between male and female were tested by t-test. Differences between coefficients (b) of regressions generated separately for male and female otoliths were tested by analysis of covariance (ANCOVA).

Results and Discussion: Both lapillus and asteriscus, no significant differences were observed between left otolith dimension and right otolith dimension. Therefore, right otolith was chosen for analyses. As between sexes was not determined significant differences, regressions between fish length and otolith measurements were established according to entire samples. Regression equations were determined as $OW = 0.0402 \cdot TL - 0.607$ $r^2 = 0.74$, $OL = 0.0516 \cdot TL - 0.635$ $r^2 = 0.78$ in lapillus, $OH = 0.049 \cdot TL - 0.594$ $r^2 = 0.83$ and $OL = 0.0578 \cdot TL - 0.573$ $r^2 = 0.81$ in asteriscus. Also, significant differences were not observed in b values of male and female.

Keywords: Lapillus, asteriscus, biometry, biostatistics, Kırşehir.

Acknowledgements: This work was financially supported by Ahi Evran University (Project No: TBY. A4.17.003).

Determination of the Population Size of the Western Caspian Turtle, *Mauremys rivulata* (Valenciennes in Bory de Saint-Vincent, 1833) (*Testudines: Geoemydidae*) in the Vicinity of Troy Historical National Park

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Objective: In this study, it is purposed to estimate of population size, body size and body mass of *Mauremys rivulata* in the vicinity of Troy Historical National Park.

Methods: Between May 2016 and May 2017, fieldwork was conducted in three different stations. Turtles were caught by net, hand or using fish traps set. Straight carapace length (SCL) and plastron (PL) of specimens were measured to the nearest 0.1 mm using a caliper and body mass (BM) was recorded to nearest 10 g using 1,5 kg Percision scale. In addition turtles were marked by notching marginal scutes before release. Population size was estimated with capture-recapture method, according to *Lincon Index*. A *t-test* was applied to examine differences in straight carapace length (SCL), plastron length (PL) and body mass (BM) between sexes.

Results and Discussion: We marked totally 76 (45♂♂ 22♀♀ 9 juvenil) and 13 indivudials were recaptured. According to the Lincoln Index, the mean of population size is 72 for *Mauremys rivulata*. The mean of straight carapace length (SCL) was 113 mm in males and 141 mm in females. The mean plastron lenght (PL) was 93 mm in males and 118 mm in females. Mean of body mass (BM) was 192 g in males and 364 g in females. The females were larger and heavier than males (t-test, for SCL: $t = 6.40$, $df = 65$, $P < 0.05$; for PL: $t = 11.90$, $df = 65$, $P < 0.05$; for BM: $t = 6.21$, $df = 65$, $P < 0.05$). As a result, although there are many faunistic studies on turtle specimens in the region and its vicinity, no population studies have been found. According to the IUCN (World Nature and Natural Resources Conservation Association) Red List 2004 the population trend of *M. rivulata* is stable and also category of risk has given as LC (Least Concern), have been identified in the region. As a result of this study, *M. rivulata* was found to be abundant in the region.

Keywords: *Mauremys rivulata*; freshwater turtle; population ; body size; Troy

Contribution to the Determination of Morphometric and Meristic Characters of *Squalius cii* and *Squalius pursakensis* Species

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Objective: In this study, it is aimed to compare morphometric and meristic characteristics of species belonging to *Squalius* genus distributed in Sakarya and Susurluk basins.

Methods: This study was carried out between the years of 2016-2017, the species of *Squalius pursakensis* distributed in Sakarya and the species *Squalius cii* distributed in the Susurluk basin. Sakarya basin fish samples were obtained from Porsuk Stream, Seydisuyu, Yeniköy and Göksu Streams. Susurluk basin fish samples were obtained from Nilüfer Stream and Emet Stream. For this purpose, a total of 175 samples were obtained from the Susurluk basin and the Sakarya Basin. A total of 26 morphometric characters and 9 meristic characters were evaluated. The morphometric value of each individual was regressed to the standard length and this ratio was used to perform discriminant analysis (DCA). Discriminant analysis was done with PAST Paleontological Statistics Version 3.15 version.

Results and Discussion: As a result of the study, *S. cii* and *S. pursakensis* species were differentiated in terms of morphometric and meristic characteristics. The number of scales in the lateral line of *S. pursakensis* is in the range of 42-45 and in the *S. cii* species is in the range of 44-47. The most important morphological feature that can be used to distinguish *S. cii* and *S. pursakensis* species is the shape of the anal fin. Last point of anal fin in *S. cii*, it is 4 or 5 branched ray and the last point of the anal fin of *S. pursakensis* is the seventh and eighth branched rays. The presence of alien species and typological influences have led to a wider range of metric and morphometric characters of fish. This has led to the necessity of taking samples from different lokalites in order to determine a reaction norm while ichthyofaunistic studies are carried out.

Keywords: Emet Stream, Nilüfer Stream, Morfometry, Susurluk basin, Sakarya basin

Acknowledgments: This work was supported by Anadolu University, 1605F330 ANABAP project and thanks to Anadolu University for their support of writers.

Distribution Areas of *Squalius* Genus in Turkey

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Objective: Cyprinids are most important freshwater species which are rich vertebrate family diversity. The classification of Leuciscinae, (which is subfamily of Cyprinids) requires knowledge of biological properties and their relationship to environmental factors. Some of the species belonging to this genus have been classified under the genus *Squalius*. Its distribution areas are very widespread from Europe, North and West Asia, North America, Azov, Black Sea, Hazar Sea regions. Some species of *Squalius* have been reported from Dicle, Euphrates, Kesik, Asi and Beyşehir drainages. Very few populations in Anatolia and nearby basins have been studied with sufficient detail. There are some species identified from Anatolia later became synonymous with *Squalius cephalus* and some of these species are thought to have spread all over Europe. There are many rivers, lakes and dam lake in Anatolia. They usually live in slow current waters. This study was carried out the distribution areas of the *Squalius* from species and subspecies of the Cyprinidae family.

Methods: The distribution of regional freshwater *Squalius* in our country has been examined. In this study, literature survey method was used.

Results and Discussion: In this study living areas of *Squalius* species, and distribution areas and other biological studies have been prepared with the thought that it is a reference. It is reported that *Squalius* genus is found in many parts of dam lakes and reservoirs our country such as central and western Anatolia, Mediterranean, Marmara and eastern Anatolia.

Keywords: Chub, *Squalius*, Cyprinidae, habitat, Turkey

Distribution areas of *Vimba vimba* L. 1758 in Turkey**Ramazan İkiz, Hamdi Deniz Erol***Akdeniz University, Fisheries Faculty, ANTALYA*

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Objective: *V. vimba* fish, a member of Cyprinidae family, is a common species of Central Europe, Black Sea and Azov Sea basins and has been included in Thrace through the inland waters of our country. North and Northwest Anatolia, Central Anatolia and the Mediterranean region in this part of the distribution, especially during the reproductive period, this species can fishing abundantly. This work was carried out to reveal the distribution areas of *V. vimba* in our country.

Methods: Literature studies have been carried out and the living areas of *V. vimba* in our country have been reviewed and updated according to the regions.

Results and Discussion: Some researchers were studied the growth and reproduction characteristics, meat quality and age determination of *V. vimba* in the waters of our country. With this study, this compilation was prepared by considering the fact that when *V. vimba* is treated on the basis of regions in our inland waters, the basic information about the latest status and abundance of the populations in the rivers, lakes and teas is reached and it will form the basis for future biological studies.

Keywords: Population, Freshwater, Anatolia, Biological

Biological Properties of Ankara Barbell *Luciobarbus escherichii* (Steindachner, 1897) in Kirmir Stream**Semra Benzer¹, Mehmet Yılmaz², Ali Gül²**¹ *Gazi University, Education Faculty, Science Education Department, Ankara*² *Gazi University, Education Faculty, Biology Education Department, Ankara*

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Objective: The present study was reported that length–weight relationships (LWR) and condition factor of Ankara barbell *Luciobarbus escherichii* (Steindachner, 1897) in Kirmir Stream.

Methods: The 160 *L. escherichii* specimens were caught between 2015 and 2016. The fork length (FL), standard length (SL), total length (TL) and body weight (BW) of each specimen were measured with a digital caliper to the nearest 0.1 mm, weighted to the nearest 0.01 g, and each specimen was sexed. LWR were estimated from the formula, $W = a L^b$, where W is total body weight (g), L the total length (mm), a and b are the coefficients of the functional regression between W and L.

Results and Discussion: The present study, fork lengths (min-max), standard length (min-max), total length (min-max) and weight (min-max) of specimens were varied between mm; 42-119 mm; 39-105 mm; 46-132 mm and 1.002-19.97 g, respectively. Length-weight relationship (LWR) and condition factor (K) of *L. escherichii* were determined. Length weight relationships were found as $W=0.0000195 FL^{2.9184}$ ($r^2= 0.967$), $W=0.00002417 SL^{2.9354}$ ($r^2= 0.966$) and $W=0.00001683 TL^{2.8918}$ ($r^2= 0.966$) for all specimens. The condition factor was calculated as 1.1765 and 1.6311(min and max) for *L. escherichii*. The present study indicates structural data of population of *Luciobarbus escherichii*. The data of this study are very important for *L. escherichii* population in Kirmir Stream. Results obtained from this study may be useful in the future to obtain information about population structure of *L. escherichii*.

Keywords: Biological properties, *Luciobarbus escherichii*, length-weight relation, Condition factor, Kirmir Stream

Some Morphometric Characters of *Capoeta baliki* (Turan, Kottelat, Ekmekçi & Imamoglu, 2006) in The From at Kayaagzı Creek

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Objective: In this study was investigated some morphometric characters of the of *Capoeta baliki* (Turan, Kottelat, Ekmekçi & Imamoglu 2006) at Kayaagzı Creek (Kirmir Stream). A variety of morphological, are used to identify and classify fishes, it is more common to use morphometric measurements.

Methods: The 44 *C. baliki* specimens were caught between 2015 and 2016. Some morphometric characters were measured with a digital caliper to the nearest 0.1 mm of each specimen. These characteristics were the fork length (FL), standard length (SL), total length (TL) head length, preorbital length, eye diameter, inter-orbital length, body depth, anal distance, anal fin base length, anal fin length, pectoral fin length, pectoral fin base length, ventral fin length, ventral fin base length, caudal peduncle depth, caudal peduncle length. These parameters were determined with statistically. Body weight (BW) of each specimen were weighted to the nearest 0.01 g, and each specimen. Differences of between morphometric characters were observed statistically significant by the regression analysis ($p < 0.05$). The aim of this was to quantify morphometric characteristic of *C. baliki* at Kayaagzı Creek (Kirmir Stream)

Results and Discussion: The present study, fork lengths (min-max), standard length (min-max), total length (min-max) and weight (min-max) of specimens were varied between 39-120 mm; 36-115 mm; 44-135 mm and 1.175-25.777 g, respectively. The present study indicates some morphometric characters of *C. baliki*. The data of this study are very important for *C. baliki* population in at Kayaagzı Creek (Kirmir Stream). Results obtained from this study may be useful in the future to obtain information about population structure of *C. baliki*.

Keywords: *Capoeta baliki*, morphometric characters, Kayaagzı creek,

The Morphometric Properties of the Sand Smelt (*Atherina boyeri* Risso, 1810) in Hirfanlı Dam Lake

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Objective: Sand smelt (*Atherina boyeri*) is a member of Atherinidae family which have large adaptation talent and shows regional differentiation for morphological and biological characteristic. In this study was investigated some biometric properties of the sand smelt population in Hirfanlı Dam Lake.

Methods: The samples were collected from Hirfanlı Dam Lake at April 2016. Fish specimens were captured by nets from Hirfanlı Dam Lake. The samples were preserved in %4 formaldehyde solution. Body weight of each specimen were weighted to the nearest 0.01g. Some morphometric characters were measured with digital caliper to the nearest 0.1mm of each specimens. The mean, standard deviation, minimum and maximum values of standart length, fork length, total length, head length, head depth, body depth, eye diameter, preorbital length, interorbital distance, predorsal length from I dorsal fin, interorbital distance, predorsal length from II dorsal fin, caudal peduncle depth, gill cover length, preanal distance, prepectoral distance, preventral distance, dorsal fin length I, dorsal fin length II, anal fin length, pectoral fin length, ventral fin length, body weight parameters were calculated.

Results and Discussion: The study presents some morphometric characters of *A. boyeri*. It was found difference even between population from other water systems. The data of this study are very important for fisheries.

Keywords: *A. boyeri*, sand smelt, morphometric properties, Hirfanlı Dam Lake.

Food items and Seasonal Feeding Habits of Pike, *Esox lucius* L., 1758 Inhabiting Sıddıklı Küçükboğaz Dam Lake, Kırşehir/Turkey

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Objective: Food and feeding habit of fish are important biological factors for both effective lake fisheries management and conservation biology in an aquatic environment. In this study, it is aimed to describe food items and determine seasonal feeding habits of pike in Sıddıklı Küçükboğaz Dam Lake, Kırşehir.

Methods: A total of 133 specimens of pike were collected from September 2015 to August 2016. The total length (TL) of each specimen was measured to the nearest 1 mm. The diet was assessed using numerical percentage (N%), occurrence percentage (O%), and percentage by weight (W%). The relative importance index (IRI) was computed for each prey item in diet: $\%IRI = (N\% + W\%) \times O\%$. Stomach fullness index (FI%) was estimated to determine feeding intensity. Feeding habit and intensity were examined as seasonally. Also, the vacuity index (VI%) that express the percentage of empty stomach was calculated between seasons.

Results and Discussion: A total of 133 stomachs were investigated. The total length of samples ranged from 234 mm to 866 mm with a mean value of 538 mm. The number of fish with empty stomach was 60 (45.1%). The mean FI was the highest during summer (1.59%), while it was the lowest during winter (0.51%). Prey items comprised only prey fish belonging to *Tinca tinca*, *Atherina boyeri*, *Cyprinus carpio*, *Squalius* sp., and *Alburnus* sp. The diet of 73 samples included 116 prey items, comprising 52 *T. tinca*, 40 *A. boyeri*, 8 *C. carpio* and *Squalius* sp., 5 *Alburnus* sp. and 3 unidentified fish. The dominant prey item by numbers in diet was *T. tinca* (N%= 44.83), followed by *A. boyeri* (N%= 34.48). The occurrence percentage of *T. tinca* was the largest (56.16%), followed by *A. boyeri* (27.4%). Unidentified fish was found in the stomachs of three pike (4.11%). Total weight of 116 prey items was 675.88 g. The dominant prey items by weight was *T. tinca* (66.68%), followed by *Squalius* sp. (15.7%). According to the relative importance index (IRI), the most important food items was *T. tinca* (79.51%), followed by *A. boyeri* (14.8%). The most consumed food item was *T. tinca* in all seasons (IRI% > 70.0), followed by *Squalius* sp. in spring, *A. boyeri* in summer and winter, and *Alburnus* sp. in autumn.

Keywords: Food item, feeding habit, the relative importance index, Sıddıklı Küçükboğaz Dam Lake, Kırşehir

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First Report On Introduction Of Medicinal Leech To The Wildlife

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Objective: Medicinal leeches are being increasingly important organisms because of their ability to treat certain diseases. Intensive use of them in health and pharmaceutical sectors led to collection pressure on their populations in the wild. Habitat destruction, anthropogenic activities, and reduction of hosts in wild affect negatively the medicinal leech populations. Because of all these effects, the medicinal leech populations inhabiting European and Turkish wetlands have decreased day by day. Therefore, some precautions are needed to prevent the decline of these populations. It is aimed to announce the introduction of leech to a wetland around Lake Eğirdir with this study, which is expected to contribute to increase of the medicinal leech populations.

Methods: The leeches (*Hirudo verbana* Carena, 1820) were produced in Medicinal Leech Research Laboratory founded in Fisheries Research Institute - Eğirdir (Turkey). A total of 2,300 leeches, 1,000 of them are in mature size, were collected from Aşağı Tırtar, Gelendost, Kayaağzı wetlands around Lake Eğirdir in September, 2015. The leeches were kept into pet jars half filled with non-chlorinated water and they fed periodically by fresh cattle blood. Reproduction period was started in January, 2016 and lasted through year. Leeches mated and gravid ones were transferred to pet jars filled with moist peat. Cocoons were kept in moist peat during 30 days, and then they were opened.

Results and Discussion: Approximately 30,000 hatchlings were obtained through reproduction period. The excessive cannibalistic behaviors were observed after each feeding, and this led to dense mortality. Approximately 3,200 young leeches reaching an average of 0.4 g were released in Gelendost wetland around Lake Eğirdir on 15 March 2017.

Because of decreasing of the medicinal leech populations, they should be supported by effective ways, including the introduction of leech in habitats. Considering that a mature leech can produce up to 100 hatchling during a reproduction season, this will make a significant contribution to medicinal leech populations. Similar activities, which first one was applied by this study, should be made in the wetlands, where medicinal leech populations are found, under a fisheries policy. In order for these studies to be effective, medicinal leech populations should be allowed to safely reproduce in wild in accordance with the close season and for this, control activities should be applied more effectively.

Keywords: leech populations, mature leech, reproduction, cocoon, hatchling.

Reproduction Ecology of Medicinal Leech, *Hirudo verbana* in Wetlands Around Lake Eğirdir, Turkey

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Objective: The trade of medicinal leech collected from the wild is mostly based on *Hirudo verbana* populations in Turkey and the Krasnodar Territory of Russia. However, because of confusing with *Hirudo medicinalis*, ecology of *H. verbana* is not known enough. Sustainable management of any population requires enough knowledge on their reproduction ecology. For this purpose, the reproduction ecology of *H. verbana* populations inhabiting wetlands around Lake Eğirdir, Turkey was investigated with this study.

Methods: The study was conducted in five distinct wetlands around Lake Eğirdir in 2013 and 2014. Leeches were analyzed for gravidity using discolouration and swelling symptoms of the clitellum region and cocoons were searched in habitats to determine reproduction period of the populations. The weight, length and diameter of cocoons were determined. Hatchling numbers per cocoon and participation of them in the population was investigated.

Results and Discussion: The first copulation was observed in April-May. The gravid leeches varied between 1.69 g and 15.26 g, intensively in 2-3 g class with 28%. Gravidity was observed from June to September. Cocoons were laid between July and September when water temperature is 25.2 ± 2.42 °C and 19.93 ± 2.15 °C, respectively. The intensive cocoon laying period was the first 20 days of August. A total of 139 cocoons were sampled in the field. 136 of them were found in moist substrates (humus, clayey, sandy, macrophyte parts etc.) outside the water up to a depth of 10 cm from the surface with density of 10 cocoons per m². Three of them were found in inactive waterfowl nests. Some cocoons were sampled as partly destroyed before hatching. Length and diameter of cocoons varied between 14.00–30.91 mm and 10.36–17.80 mm, respectively. Weight of full and empty cocoons varied between 0.11–1.90 g and 0.06–0.46 g, respectively. There were 15.20 ± 3.94 hatchlings which weighed 25.10 ± 7.06 mg in the cocoons. Approximately 1% malformation was observed in the hatchlings. The hatchlings develop in the cocoon within about one month; however, some of them may leave the cocoons sooner, while others may wait longer. The offspring are beginning to be sampled in the water with November, when the water level of the lake begins to rise. The offspring may have to wait at outside the water to join to the population in the water until May (for 9-10 months) depending on the rise in water level of the lake.

The close season for medicinal leech collection is implemented between 1 March to 30 June according to “Notification No. 4/1 Regulating Commercial Fisheries” in Turkey. It is thought that sampling of young leeches in water mostly in spring, depending on the rise in water level of lake, might be guided on this regulation. It is recommended that the close season of medicinal leech, *H. verbana* should be rearranged as “15 May-30 September” more accurately reproduction period, according to the findings of this study. Climatic differences among regions and the time required for mating was also taken into account to determine the close season. This regulation will provide a reproduction period without collection pressure and prevent to some extent decrease of medicinal leech populations.

Keywords: gravidity, cocoon, hatchling, malformation, water level elevation, close season, collection pressure.

Acknowledgement: This study was supported by Süleyman Demirel University, Scientific Research Projects Coordination Unit (SDU-BAP 3341-D2-12). The authors are grateful to Eğirdir Fisheries Research Institute for laboratory support.

Condition Index of Narrow-Clawed Crayfish (*Astacus leptodactylus*, Eschscholtz 1823) in Turkey

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Objective: The goal of this study is determining of the Condition Index (Fulton's Condition Factor & Crayfish Constant) of *Astacus leptodactylus* in Turkey.

Methods: Crayfish were collected from seven-teen different fishing area to represent of all of the Turkey in 2015. Total length (*TL*), carapace length (*CL*) and carapace width (*CW*) were measured nearest 0.01 mm by digital calipers and total weight (*TW*) was gaged nearest 0.01 g by digital scales. Sexual differences were determinate as morphologically. Two condition indices were used in calculation; Fulton's Condition Factor ($FCF=W/TL^3$) and the Crayfish Constant ($CC = W/(TL*CL*CW)$). The value of *FCF* and *CC* were compared by sex, locality and length class. In the statistical calculations, independent samples *t-test* and One-way analysis of variance (*ANOVA*) with *Tukey*^{HSD} were used.

Results and Discussion: Total of 402 individuals were used in the study length range between 61.01-185.86 mm and total weight range between 4.60-218.55 g. While 171 of sample were female, 331 were male. Mean *FCF* were calculated as 0.0256±0.0003 for female and 0.0302±0.0003 for male (p<0.001). Mean *CC* were founded as 0.2243±0.0103 for female and 0.2265±0.0023 for male as well (p>0.05). Lowest mean *FCF* value was determinate for Mamasın Dam Lake (0.0259±0.008), while highest was founded Suğla Lake (0.0324±0.0005). Mean *FCF* value showed differences between locality (p<0.001). Lowest mean *CC* value was calculated for Lake Terkos (0.1952±0.0054) on the contrary it was founded as highest for İznik Lake (0.2494±0.0068). Mean *CC* value has showed differences between locality (p<0.001). Both *FCF* and *CC* value have showed differences by locality (p<0.001). It is thought that, differences of *FCF* and *CC* values streaming from feeding status of crayfish in the habitat and fishing pressure.

Keywords: Fulton's condition factor, Crayfish constant, *Astacus leptodactylus*, Condition index

Share of in Fishery Production of Crustacean in Turkey and World

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Objective: In this study was aimed to reveal the contribution of the crustaceans to total fishery production in Turkey and world.

Methods In this study, the relevant literature has been examined for general information about economically important crustaceans in the world and in our country. This review including fishery production (capture-aquaculture) and Crustacean production (capture-aquaculture) in our country and world by years and their distributions by species groups were prepared by using data from FAO 2015 Statistic, TÜİK 2016 statistics and BSGM 2016 database.

Results and Discussion: The crustaceans is a group of animals that belong to the class crustacea and 25 000 species of crustacean have been identified to date (Demirsoy 1998). Shrimp, crab, lobster and crayfish can be listed the top of the most economically important crustaceans with capture or aquaculture in the world and in our country. According to FAO statistics, total world fisheries production in 2015 was 169.3 million tonnes, of which about 92.6 million tonnes of capture and 76.6 million tonnes of acuaculture in 2015, the world total crustacean production was 13.9 million tons. This production are composed of 8.3 million tonnes (60 %) of shrimp, of which is 3.4 million tonnes of capture and 4.9 million tonnes of aquaculture. This is followed by freshwater crustaceans with the production of 2.5 million tonnes (FAO 2015). Aquaculture production is gradually becoming important and increasing in world.

Crustacean production in our country is still depends on capturing. The total fish production of our country has been 588 715 tons in 2016 of which 335 320 tonnes by capture and 253 395 tonnes by aquaculture. Total production decreased by 12.4 % compared to the previous year. 70.6 % percent of the total production is marine fishes. This is followed by freshwater fish (23 %), mollusks and others (5.6 %), crustaceans (0.8 %). In 2016, the total crustacean production by capturing was 5055,6 tonnes, of which was 4501 tonnes of shrimps (89 %). This was followed by crayfish with the production of 544 tonnes (TÜİK 2016). In 2016, total fishery export amounted to approximately 145 thousand tonnes in our country. The income of this export was 2 398 269 090 ₺, which amounted to 33 435 365 ₺ (1 257 tons) of crustacean exports (BSGM 2016).

As a result; It can be said that the production obtained by hunting in parallel with the deterioration of the natural resources is decreasing every year and that the aquaculture is increasingly gaining importance and the production made by this way is increasing gradually.

Keywords: Crustacea, production, capture, aquaculture

Cast Nets; Technical Characteristics and Catch Composition from Muğla Freshwaters Fisheries, Turkey

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Objective: Cast nets are widely used by freshwater fishermen in Muğla province. In this study, we aimed to determine the type of cast nets that are used in Muğla freshwater fisheries. In addition, their technical characteristics were given and drawn by FAO mode.

Methods: Cast nets were collected from net sellers and scientists who make samplings in freshwaters. Mesh sizes, mesh numbers (row and height), rope diameters and lead weights were measured. Photoshop CS6 was used for technical plans' drawings. Also species composition is obtained from scientific studies which were realized in Muğla province with cast nets before.

Results and Discussion: Totally, 3 types of cast nets were sampled. Mesh sizes, heights, weights and bottom shapes are varies. Two type of the cast nets have pouches and one type has no pouch. Total weights are between 4.5 kg and 5.0 kg. Stretched mesh sizes differ between 20mm and 36mm. According to scientific studies, 20 fish species were (*Onchorynchus mykiss*, *Squalus cephalus*, *Petroleuciscus borysthenicus*, *Luciobarbus escherichii*, *Luciobarbus capito*, *Capoeta bergamae*, *Carassius gibelio*, *Alburnus escherichii*, *Acanthobrama mirabilis*, *Chelon labrosus*, *Liza ramada*, *Mugil cephalus*, *Chonrostoma meandrense*, *Cyprinus carpio*, *Sparus aurata*, *Lepomis gibbosus*, *Knipowitschia caucasica*, *Anguilla anguilla* and *Capoeta capoeta*) constituted the catch composition.

Keywords: Freshwater fisheries, cast nets, catch composition,

Fishing Gears and Technical Features Used in Demirköprü Dam Lake (Manisa) Fisheries

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Objective: Description of the structural characteristics of fishing gears used in fisheries to describe according to international standards is important. This study aimed to determine fishing gears and technical features used by commercial fishermen in Demirköprü Dam Lake (Manisa Province) which is one of the most important fishing area and the largest surface area in the Aegean Region.

Methods: Studies were carried out between June 2015 and December 2016. Data were obtained by observations, measurements and meeting with fishermen at the fish landing area of fishery cooperative (S.S. Köprübaşı Su Ürünleri Kooperatifi). Measurements of fishing gears were made with tape measure and Omega mesh gauge. The technical drawing of the fishing gears were made with Microsoft Visio 10.0 program according to FAO standards.

Results and Discussion: A total of seventeen varieties of gillnets were identified in the study area eleven of them for common carp (*Cyprinus carpio* Linnaeus, 1758) fishery and three for silver crucian carp (*Carassius gibelio* Bloch, 1782) and three for Danube bleak (*Alburnus chalcoides* Güldenstädt, 1772). Two longlines using with different baits and six fyke nets were defined for European catfish (*Silurus glanis* Linnaeus, 1758) fishery.

It has been found that fishermen use different fishing gears for their target species in Demirköprü Dam Lake. Three gillnets (20, 25, 28 mm bar length) and a trammel net (70 mm bar length) which was used by fishermen in the previous years were not found in this study. Identification of fishing gears used in fishery resources and determination of changes in fishing gears are important tools to determine fishing effort and fisheries pressure.

Keywords: Fishing gears, Gillnet, Trammel net, Longline, Fyke net, Demirköprü Dam Lake

Acknowledgement: The study was sponsored by Izmir Katip Çelebi University Scientific Research Projects (2015-ÖDL-SUÜF-0003 Numbered Project) and TUBITAK (214O632 Numbered Project).

The Current State of Fishing Boats Belonging to the Cooperative Members in Keban Reservoir (Elazığ)

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Objective: In this study was aimed to determine the structure of fishing boats in the Keban Dam Lake fishery cooperatives.

Methods: This study was carried out in 15 fisheries cooperative in Keban Dam Lake between 2013 and 2014. This study was focused on fishery cooperatives in Keban Dam Lake and were obtained face to face interviews with fisherman and cooperative heads measurements were made using steel meters (5 m) of boat lengths and were using cooperative records, boat engine brands, boat engine powers.

Results and Discussion: There are 184 registered fishing boats in the study area. While 181 boats (98.37%) were made from steel, 3 bots (1.63%) were made from wood. But the fishing boat were made of fiberglass also we can't found it to use it in catching. The boat length must be used 7- 8 m (50.545). The cooperative Cemisgezek uses the most are fisherman's. At least 9-10m long bots used (0,54) the length of the boat is used only Kemaliye region. The most commonly brand of engine was beet engine with 84.24 in the fishing boat. The least used brand engine with 0.54. the most engine horse power used to 7-9.99 hp (111 units) . The least used to 19 - 21.99 hp (1 unit). At high engine power ranging from 30-60.99 hp (2.18%), was determined to Cemisgezek, Keban, Uzunova, Yolustu Cooperative. As a result; The choice of boat is important to increase of production of Keban Dam Lake. The suitable a model boat to be developed for the region.

Keywords: Keban Dam Lake, Fishing Cooperative, Fishing boat, Fisherman

Fishing Tackle and Fishing Methods Used in Carp, Catfish and Pike Fisheries in The Lower Sakarya River, Turkey

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Objective: Sakarya river is one of the most important angling fisheries areas in Turkey because it contains fish species which are important for sports purposes such as carp, catfish and pike. In this study, the technical characteristics and methods of fishing were investigated for carp, catfish and pike fish in Lower Sakarya River.

Methods: This study was conducted between January 2017 and June 2017 by examining the fishing gear of amateur angling fishers in the Lower Sakarya River. As a result of the face-to-face interviews and examinations, the technical characteristics of the fishing lines, hooks, floats and sinkers used in fishing gears, baits used in fishing and fishing methods are recorded. Photoshop CS6 was used for technical plans' drawings.

Results and Discussion: A total of 118 amateur anglers were interviewed in the study. 3 to 4 meter long telescopic fishing rod are used in carp and pike fishing. However catfish fishing is rarely done by fishing rod. Fishing is usually done with bottom fishing tackle but buoy fishing tackle is also used in lower Sakarya River. 0.35-0.80 mm fishing line is used in the main body and 0.25-0.40 mm in the surfcasting rigs of fishing tackle used in carp, spring and pike fishery. In the catfish fishing, surfcasting rigs are made with steel wire, are also used. Used sinkers varies between 50-200 grams according to current in the fishing area. While vegetable baits (corn, broad bean, wheat) are used in carp fishing, live baits (bait fish, frog, bloodsucker) are preferred in catfish and pike fishing.

Keywords: angling, fishing tackle, carp, catfish, pike,

Structural Improvements of Fishing Gears Used in The Beydağ Dam Reservoir (Izmir-Turkey)

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Objective: The Beydağ Dam Reservoir was built on 760 hectares in 2008 and has been restocking every year by State Hydraulic Works. The people of the region, who had never experienced fishery before, learned from fishermen in the nearby surrounding districts and supplied fishing gear from them. In the study, the structural improvements of the fishing gears used in Beydağ Dam Lake between 2011-2017 was investigated and technical details were revealed.

Methods: The study was carried out in Beydağ Dam Reservoir in 2017. Data for fishing gears present and before (gill net, trammel net and fishing line) were gathered in situ investigations and survey studies with fishermen face to face. For drawing technical plans, FAO's Fishing Gears Catalogues were taken into account as references and the fishing gears were drawn in scale. Some details of these gears have been schematized as in FAO catalogues without using scale. Microsoft Visio 2010 software was used in technical and structural drawings.

Results and Discussion: In 2011, the Beydağ Fishery Cooperative was established and the lake was leased for 5 years to this cooperative in 2014. A total of 50 members are registered in the cooperative and 12-15 members are active in fishing with 3 boats. Common carp (*Cyprinus carpio*), Perch (*Perca fluviatilis*) and Prussian carp (*Carassius gibelio*) are caught by fishing line, trammel and gill nets in the lake. At the beginning, these fishing gears were bought as rigged from fishermen in the surrounding area or by internet. Almost all of these nets were made of monofilament with a twine thickness of 0.23 mm. 160 mm and 600 mm mesh sizes were used in the inner and outer net panels, respectively. Nowadays, the fishermen and their wives in the region are taking a course about fishing gear design and construction by an experienced instructor. So they have made some structural changes in the fishing gears. These changes have occurred in hanging ratio (E), material of these nets, and especially amount of the weight used in the fishing gears. They are planning to use 210d/6 and 400 mm mesh size in outer nets for new trammel nets and also more lead weight. Fishing gears used previously fairly light and easily drifted by the fish, causing more damage and reducing the fishing area of the net. Advantages and disadvantages of these changes in fishing gears should be monitored for sustainable fisheries.

Keywords: Trammel net, gill net, common carp, hanging ratio.

Monthly Catching Efficiency of Gillnet Fishery for Common Carp (*Cyprinus carpio*) in Marmara Lake (Manisa)

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Objective: Marmara Lake (Manisa Province), one of the most important inland fishing areas in the Aegean Region. Commercial fishers in the lake are used intensively gillnets for Common Carp (*Cyprinus carpio* Linnaeus, 1758). This study aimed to determine monthly catching efficiency changes of gillnet fishery for common carp in the Marmara Lake.

Methods: Samplings were carried out between June 2015 and December 2016 as monthly. 70, 75, 80, 90 and 100 mm bar length and 210d/2 and 210d/3 number twine thickness multifilament gillnets were used as in preferred by commercial fishers. Weight of carp is measured with 1 mm precision electronic scale. The catch per unit (CPU) was calculated to assess of catching efficiency. The difference in CPU between the months is statistically tested (Kruskal-wallis test). In addition, monthly changes between the fisheries statistics (monthly fisheries statistics for the years 2011-2016 were obtained from the Manisa Provincial Directorate of Food, Agriculture and Livestock) and experimental samplings for the period between June 2015 and December 2016 were compared. The differences between monthly averages catching efficiency for the years 2011-2016 tested statistically (Kruskal-wallis test).

Results and Discussion: A total of 390 carps (total of 942.5 kg) ranging in weight from 170 to 18200 g were caught. The highest catching efficiency was found at 20.9 ± 3.44 g/m.operation⁻¹ in August 2016 and the lowest at 2.70 ± 1.37 g/m.operation⁻¹ in December 2015. It was determined that the difference in catching efficiency between months is significantly important (P: 0.000; P < 0.05). Highest catch was presented in October 2016 (16207 kg) and as lowest in June 2015 (1847 kg) in the fisheries statistics between June 2015 and December 2016. On the other hand, the highest averages catch given for August (13565 ± 2541.4 kg) and the lowest for January (4039 ± 1590.9 kg) in the statistics. In fisheries statistics, monthly average catches differences were statistically significant (P: 0.010; P < 0.05). Also differences between the monthly distribution of catching efficiency in experimental samplings and fisheries statistics were observed.

In conclusion, the catching efficiency of Marmara Lake gillnet fishery for carp is changes throughout the year. To reveal this difference, fishing behavior and environmental parameters changes affected on fishing powers needs to be investigated.

Keywords: Marmara Lake, Catching efficiency, Gillnet, Common Carp (*Cyprinus carpio*), Monthly change

Acknowledgement: This research was financially supported by the Izmir Katip Celebi University Scientific Research Projects (2014-GAP-SUÜF-0007 Numbered Project).

History, present status and future perspectives of crayfish (*Astacus leptodactylus*, Eschscholtz, 1823) production in Turkey

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Objective: In this study, it was aimed to reveal the past, present situation and future perspectives of the production of crayfish (*Astacus leptodactylus*) which is distributed in the inland waters of Turkey.

Methods: In this review, fisheries statistical data's from Turkish Statistical Institutes were used. The most important crayfish species distributed in the world belong to 3 different families. Members of *Cambaridae* and *Astacidae* of these were distributed in the northern hemisphere, but members of *Parasacidae* were distributed in the southern hemisphere (Huner, 1989). In Turkey, there are two different crayfish species are distributed naturally. Stone crayfish (*Austropotamobius torrentium*) was reported only from Velika Creek in Thrace Region of Turkey. *Astacus leptodactylus* species, called narrow clawed crayfish or Turkish crayfish, are distributed in all of Turkish Lakes (Köksal, G,1988; Harlıoğlu and Güner, 2006-2007-2010; Akhan et al., 2014).

Results and Discussion: Turkish crayfish production is supplied from narrow clawed crayfish (*Astacus leptodactylus*). The Narrow clawed crayfish production is based on crayfish fisheries in Turkey. Besides production from natural stocks, some cultivation trial have been performed in Turkey in recent years. By the 1960s, crayfish fisheries started to increase due to intense demand of European countries. The amount of crayfish production had increased up to 8000 tons/year in 1984. After 1985, crayfish production was decreased dramatically because of crayfish plaque disease which was caused by *Aphanomyces astaci* in most of Turkish Lakes (Harlıoğlu, 2004). In order to increase crayfish production, existing stocks should be given a chance to recover, and capturing crayfish should be restricted in low-stock populations. The results of our scientific studies on crayfish cultivation should be transferred to the aquaculture sector in order to spread crayfish culture.

Keywords: Crayfish, production, *Astacus leptodactylus*,

History and Current Status of Marmara Lake (Manisa) Fishery**Hakkı Dereli¹, Turhan Kebapçioğlu², Yusuf Şen³**¹*Izmir Katip Çelebi University, Faculty of Fisheries, Department of Fisheries and Fish Processing Technology, İzmir*²*Akdeniz University, Manavgat Tourism Faculty, Department of Recreation Management, Antalya*³*Izmir Katip Çelebi University, Graduate School of Natural and Applied Sciences, İzmir*

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Objective: Marmara Lake located in Gediz River Basin is largest freshwater lake and one of the important fishing areas in Aegean Region. In this study, it is aimed to reveal of development Marmara Lake and fishery from ancient times to present.

Methods: Information related to development Marmara Lake and fishery was obtained by literature review. In addition to the literature, face-to-face interviews with fishermen and observations (during 2014-GAP-SUÜF-0007 Numbered Project) were also used for the period 1950-2016 and current situation.

Results and Discussion: The Marmara Lake has been converted into an irrigation reservoir since 1953, while located in an enclosed basin, slightly salty alluvial set lake, fed by small rivers and ground waters. With this arrangement, Kum Stream and Gediz River have also added to feeding the lake.

The abundance and large size of fish in the Marmara Lake known as “Gygaea” in antiquity have been mentioned in historical sources. The abundance of fish was also emphasized in the early 19th century. While only fishing line having bone or stone hooks was used in ancient times, fishing was developed with the nutritional needs of human and nets were used in the last century. Fish production of Marmara Lake fishery varied between 19 and 967 tonnes/year in 1932-1996. Carp was the main target species during this period in the lake. In 1950-1975, the lake was leased a person and beach seine fishery was carried out with boat by the seasonal workers from other provinces. Right to lease has been transferred to the fisheries cooperative established by local people in 1977 and gillnet have intensively used since 1978.

Because of the rainfall regime and the use of agricultural water in the region, the lake water level is quite variable. The droughts in 1989-1994 and 2006-2008 years affected the lake’s water level and fisheries. After the drought observed in large part of the Lake Marmara, said by the Lydians to be never dry, in 1992, the European eel and crayfish, abundantly caught in 1986-1990, could not caught in the lake. During the droughts and following periods (1991-1993 and 2009-2010 years) fishing was prohibited. 82 licensed fishermen carry out commercial fisheries with 38 boats in the lake in current status. An average of 62 tons/year fish caught during 2011-2016 years. In addition to carp, pikeperch, European catfish, silver crucian carp and danube bleak were caught. Increasing macrophytes due to eutrophication in recent years causes difficulties for fishing operations with gillnets and fyke net in the lake.

Keywords: Marmara Lake, Fisheries, Gygaea

Acknowledgement: This research was financially supported by the Izmir Katip Celebi University Scientific Research Projects (2014-GAP-SUÜF-0007 Numbered Project).

New Approach for Codend Selectivity of Coastal Beach Seine for Big-scale Sand Smelt (*Atherina boyeri* Risso 1810) Fishery in İznik Lake, Turkey

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Objective This study was aimed to determine big-scale sand smelt (*Atherina boyeri* Risso 1810) codend selectivity parameters in coastal beach seine fishery in İznik Lake, Turkey.

Methods: The study was conducted on İznik Lake where one of the most important big-scale sand smelt production areas of Turkey. Monthly experiments were done during 2014 years in four different stations in the lake. In order to calculate 3 different meshes selectivity parameters at same time, beach seine codend was specially designed. The codend, which have 6 mm mesh size, total length was 16 m. Three rectangular panels (2*10 m) which have 14 mm, 12 mm and 9 mm mesh size were attached from the beginning of codends at the distance of 4 m, 8 m and 12 m, respectively. Selectivity data were collected by the covered codend method and analysed by means of a logistic equation with the maximum likelihood method. It was assumed that codend and covers specimens as; in front of the 14 mm mesh panel's specimens as codend and the others (in front and aft part of the 12 mm and 9 mm specimen) as cover for 14 mm meshes. In front of the 12 and 14 mm specimens as codends and in front (12 mm aft) and aft part of the 9 mm panels as cover specimens for 12 mm mesh. Finally, in front of the 14, 12 and 9 mm mesh panel's specimens as codend and aft part of the 9 mm mesh panel as covers for 9 mm mesh. Pooled selectivity parameters were estimated by using the CC2000. One-way analysis of variance (*ANOVA*) were used to compare mean length and *TUKEY^{HSD}* test was utilized determined differences between length class obtained difference mesh size codend.

Results and Discussion: Forty-eight successful hauls were performed. A totally 3053 individuals were caught length ranged from 2.6-11.2 cm and weight ranged from 0.11-11.02 g. The mean L_{50} values (50% retention length) of 14, 12 and 9 mm panels were determined as 5.27 ± 0.12 , 4.17 ± 0.06 and 3.09 ± 0.05 cm total length, respectively. Significant differences were found between length class of 14, 12, and 9 mm mesh panels ($p < 0.001$). It is concluded that 14 mm mesh panels are suitable for sustainable big-scale sand smelt fishery by beach seine net when considered given by length at first maturity size (4.96 for female and 4.52 cm male).

Keywords: Beach seine, selectivity, *Atherina boyeri*, İznik Lake,

Acknowledgement: This study was supported by Republic of Turkey, Ministry of Food Agriculture and Livestock, General Directorate of Agricultural Research and Policies.

The Status of Inland Fishery Cooperatives in The Aegean Region (Turkey): A Descriptive Study After Five Years

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Objective: This study is to reveal the current status of the inland fishery cooperatives in the Aegean comparing their current characteristics to the five years ago.

Methods: Telephone survey was conducted with the heads of inland fishery cooperatives (22) which are located in Aegean Region (İzmir, Manisa, Muğla, Afyonkarahisar, Denizli, Aydın and Kütahya) to put forward the potential of inland fishery cooperatives via analyzing their main characteristics and activities.

Results and Discussion: Findings show the changes in inland fishery cooperatives in terms of problems, number of members, socio-economic conditions of their members during the last 5 years. The results of the study will provide up-to-date information on how the inland fishery cooperatives in the Aegean region have changed in recent years and will help decision-makers to take necessary measures and develop policies.

Keywords: Inland fishery cooperatives, inland fishing, cooperatives, Aegean fisheries.

Current State of Inland Capture Fisheries and Aquaculture in Middle East Countries and Expectations for the Future

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Objective: In this study, it is aimed to evaluate the present and future situation of fisheries and aquaculture production in inland waters in the Middle East Countries (MEC) including Turkey.

Methods: The main materials of this study are data and reports from Turkish Statistical Institute (TUIK) and Food and Agriculture Organization of the United Nations (FAO). The obtained statistical data were evaluated in Excel and SPSS program. As a result of the evaluation, the place of MEC and Turkey inland fishery production in the world, inland capture and aquaculture production by years, major inland aquaculture and fisheries species, estimated inland fishery production for the next five years were revealed. Estimates of the future production were made by trend analysis using the last 20 years of inland fishery production data. In addition, it has also benefited from previous research results and publications on the subject.

Results and Discussion: In 2015, 30.2% of the world's fishery production was carried out in the inland waters. In the MEC, inland aquaculture and capture production has an important place because it constitutes about 53% of the total fishery production. In the MEC, leading countries in the inland aquaculture and fisheries are Egypt, Iran and Turkey, respectively. Egypt ranks seventh in world inland fishery production, while Turkey ranks twenty-sixth places. In the last 10 years, fishery production in inland waters has increased by 63.8%. As a result of the trend analysis, it is predicted that total fisheries and aquaculture production in inland water will be approximately 2 435 000 tons for 2020 ($R^2 = 0.972$), which is about 2 050 000 in 2015. In 2015, 81% of MEC inland fishery was aquaculture and 19% was capture fisheries. Nil Tilapia (*Oreochromis niloticus*) is the most cultivated and captured species. Rainbow Trout (*Oncorhynchus mykiss*) is the second most cultivated species. The biggest producers of Rainbow Trout are Iran and Turkey. Approximately 20% of total fisheries and aquaculture production in Turkey is obtained from inland waters. By 2016, the share of fisheries production obtained from inland waters has been 10.1% of the total fisheries production and the share of inland aquaculture has been 40.1% of total aquaculture. For this reason, inland aquaculture is important for Turkey. It is found that inland aquaculture production expectation in Turkey for the year 2020 is 133 061 tons ($R^2 = 0,881$). As a result, inland capture fisheries and aquaculture in the MEC is important to meet the world's seafood demand and to increase the socio-economic development in the Middle East.

Keywords: Fisheries, Aquaculture, Middle East Country, Turkey, Inland Waters

Amateur Fishing License Status in Turkish Inland Amateur Fishery by Interactive Survey

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Objective: In this study, it was investigated whether amateur fishermen had the amateur fishing certificate which is regulated according to the Communiqué on the Arrangement of Amateur Fisheries Fleet No. 4/2.

Methods: Fishers were surveyed using an online questionnaire. The survey comprised 32 questions. The first set of questions collected demographic data and was compatible with other major recreational fisher surveys. A total of 2045 surveys were conducted between March 2017 and July 2017 for the amateur fishermen in the social media.

Results and Discussion: Amateur fishers who participated in the survey have 45.3% of the fisheries documents whereas 54.7% do not have any fisheries documents. Amateur fishermen of young age groups (14-35) have higher rates of having amateur fishing document than middle and advanced age group ($X^2=156.802$; $p<0.001$). The level of education is increasing, the rate of being an amateur fishing document increases. ($X^2=24.382$; $p<0.001$). The rate of having an amateur fishing document is widespread among students (76.19%). This ratio is the lowest among retirement amateur fishermen (30.90) ($X^2=80.107$; $p<0.001$). None of the amateur fishers participating in the survey have been inspected by any institutions or organizations (%71.9). Only 20.4% were gendarmerie and 5.7% were controlled by the staff of the Ministry of Food, Agriculture and Livestock. It is not possible to say that any amateur fishing document which is not legally obligatory and demanding without any training is currently an effective instrument in fisheries management.

Keywords: Amateur fishing license, Fisheries controlling, Amateur Fisheries

Catch Efficiency of Medicinal Leech in Turkish Lake Region

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Objective: The intensive using in health and pharmaceutical sectors, destruction of their habitats and over collecting have decreased of medicinal leech populations inhabiting European and Turkish wetlands. They even have completely disappeared in some wetlands. International trade of *Hirudo medicinalis* and *Hirudo verbana* was regulated by CITES. Conservation and management of any population may be possible by conservation policies based on regular monitoring studies. It was aimed to determine catch efficiency of medicinal leech in Lakes Region where the biggest freshwater lakes of Turkey are located.

Methods: This study was conducted in wetlands in Lakes Region (Turkey) between 2011-2014. A total of 232 habitats (lake, pond, dam, marsh, river, canal, pool and trough) found in the cities of Afyonkarahisar, Burdur, Denizli, Isparta and Konya were sampled for medicinal leech. The catch efficiency was determined by using a semi-quantitative method based on collected leech number per collector during one hour in habitats, where medical leeches were found.

Results and Discussion: Medicinal leeches were sampled from distinct 25 habitats. First medicinal leech record is reported in 12 of these habitats with this study. All sampled specimens were identified as *Hirudo verbana* Carena, 1820. Catch efficiency was highest in Lake Gavur, Lake Eğirdir and Lake Kovalı with 106 leeches/hour/collector (l/h/c), 97 l/h/c and 84 l/h/c, and lowest in Lake Akşehir, Büyükçay Stream and Lake Suğla with 1 l/h/c, 4 l/h/c and 8 l/h/c, respectively.

Considering the findings of a previous study conducted by Kasperek et al. (2000), catch efficiency has increased only in Acıgöl spring waters by 110%, not changed in Lake Akşehir and Lake Eğirdir, and dramatically decreased of about 70% in five wetlands. The most important problems for medicinal leech populations in studied wetlands are habitat destruction, introduction of fish into habitats, and illegal over leech collecting without any collection limit. Therefore, the habitats should be protected against anthropogenic effects and the introduction of fish should be controlled. Additionally, the populations of medicinal leech should be managed by certain quotas under more effective control activities.

Keywords: *Hirudo verbana*, CITES, semi-quantitative method, habitat destruction, introduction of fish, over-collecting, quota.

Acknowledgement: The authors gratefully acknowledge the research grant (TAGEM/HAYSUD/2011/A01/P-03/1) from Republic of Turkey, Ministry of Food Agriculture and Livestock, General Directorate of Agricultural Research and Policies.

Intestine Villi Morphology of Black Sea Trout (*Salmo trutta labrax* Pallas, 1811): Age**Osman Tolga Ozel¹, Isa Coskun², Eyup Cakmak¹**¹Central Fisheries Research Institute, TRABZON²Ahi Evran University, Faculty of Agriculture, Department of Animal Science, KIRŞEHİR

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Objective: This study was conducted to determine the effect of age on the mid-intestine villi morphology of Black Sea trout (*Salmo trutta labrax* Pallas, 1811).

Methods: One to 5 years old, fifth-generation (F5) Black Sea trout were used in this study. Between May-November 2016, the fish were kept in the freshwater ponds (0.5-18.5°C) fed by stream. After that, the fish were transferred to the sea cages (6.9-7.6°C; salinity ‰18) in November 2016 where fish were kept for 2 months. Of twenty fish from each group, mid-intestine tissues were taken at in January 2017 in seawater (7.6°C), and analyzed by placing the samples into 10% formalin then into the tissue cassettes for dehydration process and embedded in paraffin blocks, and subsequently cut 5-µ thickness and placed on a slide. Each sample were stained with hematoxylin and eosin solution by using standard paraffin-embedding procedure. After embedding process, villi length (VL), villi width (VW) and villi length to villi width (VL/VW) were evaluated by using an image processing and analysis system. Data were analyzed by one-way analysis of variance. Differences between means were compared using Duncan's multiple range test. Statistical analyses were computed using SPSS 15.0.

Results and Discussion: Weights of the 1, 2, 3, 4 and 5 years old fish were found as 80.83±9.09g, 819.82±189.59g, 2548.5±681.14g, 3064.65±979.33g and 3598.88±928.85g respectively. The lowest VL (315.39±92.62 µm), VW (65.18±13.40 µm) and VL/VW (4.94±1.42) were obtained in 1 years old fish. This was followed by 2 years old fish (VL; 713.98±73.44 µm, VW; 147.06±35.54 µm and VL/VW; 5.20±1.60). The highest VL (1160.52±90.74 µm) and VW (174.76±36.56 µm) were obtained in 3 years old fish. VL (1092.50±121.29 µm and 1046.11±140.00 µm) of the 4 and 5 years old fish were similar to each other, respectively. Also, VW (147.06±35.54 µm, 152.64±47.89 µm and 157.59±33.07 µm) of the 2, 4 and 5 years old fish were similar to each other, respectively. Furthermore, VL/VW (6.92±1.51, 7.80±2.39 and 6.99±2.06) of the 3, 4 and 5 years old fish were similar to each other, respectively. The intestine is an important organ that responsible for the digestion and absorption of nutrients, and it's histological structure may be influenced by nutritional and non-nutritional factors. This study demonstrated that fish growth rate and middle intestine villi length and width were increasingly increased from 1 to 3 years old, but were diminished after 3 years old. We may say that middle intestine villi development were proportional to the growth rate, and changed depending on age. For better understanding of intestine villi morphology changed depend on age of fish, other sections (proximal and distal) of the intestine should be examined.

Acknowledgements: This research was done as a preliminary study for the project named "Possibilities of using some phytobiotic added diets in nutrition of Black Sea trout (*Salmo trutta labrax* Pallas, 1811)" supported by General Directorate of Agricultural Research And Policies.

Keywords: Black Sea trout, *Salmo trutta labrax*, intestine, villi morphology, age

Effect of L-tryptophan on sperm quality of endangered Anatolian trout *Salmo rizeensis***Filiz Kutluyer¹, Mehmet Kocabaş²**¹*Munzur University, Fisheries Faculty, 62000, Tunceli, Turkey.*²*Karadeniz Technical University Faculty of Forestry, Department of Wildlife Ecology & Management 61080, Trabzon, Turkey.*

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Objective: The present study focused on the usefulness of L-tryptophan for Anatolian trout *Salmo rizeensis* sperm**Methods:** Different activation media (NaCl, 0.3%; NaHCO₃, 1%) were supplemented with L-tryptophan [Control (0), 0.5, 1, 2, 3, 4 and 5 mM]. Sperm motility and duration were determined in sperm samples.**Results and Discussion:** The results from the present study indicated that addition of L-tryptophan to activation medium was increased motility rate and duration in *S. rizeensis* compared to control group. Differences in the motility rate and duration of *S. rizeensis* sperm were significant among the treatments ($p < 0.05$). Highest motility rate (98%) and duration (60 s) were at concentration 5 mM in activation medium (NaCl). Highest motility (98%) and duration (47 s) were at concentration 5 mM in activation medium (NaHCO₃). In conclusion, sperm quality was positively affected by quantitative changes different concentrations of L-tryptophan. In addition, L-tryptophan can be used in activation medium for *S. rizeensis*.**Keywords:** *Salmo rizeensis*, Anatolian trout, L-tryptophan.

Does L-tryptophan affect to sperm quality of *Salmo coruhensis*?

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Objective: The present study focused on the usefulness of L-tryptophan for improvement of sperm quality in *Salmo coruhensis*.

Methods: Different activation media (NaCl, 0.3%; NaHCO₃, 1%) were supplemented with L-tryptophan (0.5, 1, 2, 3, 4 and 5 mM). Sperm motility and duration were determined in sperm samples.

Results and Discussion: The data in this study indicated that highest motility (90.00%) and duration of motility (80.33 s) were at concentration 1 mM in activation medium (NaCl). Highest motility (94.05%) and duration of motility (84.07 s) were at concentration 2 mM in activation medium (NaHCO₃). In conclusion, sperm quality was positively affected by quantitative changes different concentrations of L-tryptophan. In addition, L-tryptophan can be used in activation medium for *S. coruhensis*.

Keywords: endangered species, *Salmo coruhensis*, sperm quality, L-tryptophan.

Biofilm Formation In Bacterial Fish Pathogens

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Objective: The aim of this review was to investigate the production of biofilm formation in bacterial fish pathogens. Bacteria in nature often exist as sessile communities called biofilms. These communities develop structures that are morphologically and physiologically differentiated from freelifving bacteria.

In this review, biofilm is an association of micro-organisms in which microbial cells adhere to each other on a living or non-living surfaces within a self-produced matrix of extracellular polymeric substance (EPS). Quorum sensing (QS) is used to coordinately control gene expression and therefore particular behaviors under conditions of high cell density. It is important for bacterial survival such as biofilm formation, bacteria to synchronize, virulence factor secretion, bioluminescence, antibiotic production, sporulation and competence for DNA uptake. The matrix, which is composed of polysaccharides, proteins, nucleic acids and water, enables the biofilms to attach to the surfaces. One of the most important functions of the matrix is to protect the bacteria from various stress factors such as UV radiation, extreme pH values, osmotic pressure, dehydration and antibiotics. Biofilms can also cause fish diseases widely.

Bacteria in the biofilm may undergo physiological, metabolic and phenotypic changes leading to a biofilm-specific phenotype. In biofilms, poor antibiotic penetration, nutrient limitation, slow growth and adaptive stress responses constitute a multi-layered defense. Resistance to antimicrobial agents in the biofilm matrix may be attributed to the emergence of phenotypic variants within the biofilm population, induction of the general stress response, activation of efflux pumps and quorum-sensing systems.

Biofilm, EPS and adhesion in bacterial fish pathogens; *Aeromonas hydrophila*, *Tenacibaculum maritimum*, *Flavobacterium columnare*, *Vibrio cholerae*, *Flavobacterium psychrophilum*, *Yersinia ruckeri*, *Vibrio alginolyticus*, *Vibrio cholerae*, *Vibrio parahaemolyticus*, *Vibrio fischeri*, *Vibrio vulnificus*, *Edwardsiella tarda*, *Mycobacterium marinum*, *Staphylococcus aureus*, *Vibrio parahaemolyticus* were described in this review.

In conclusion, As researchers develop better model systems for use in evaluating more reliable techniques and control strategies for the measurement of biofilms, more efficient biofilm control strategies are expected to emerge. The role of biofilms in antimicrobial drug resistance is investigated and the linkage between biofilm contamination and fish infection is better established. The importance of biofilms in the aquaculture for fish health will arise.

Keywords: Bacterial fish pathogens, biofilm, virulence factors, quorum sensing.

Antibiotic Usage; Aquaculture Awareness**Ercüment Genç, Doğukan Kaya**

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Objective: In this study, it is aimed to evaluate of necessity of antibiotic use in aquaculture. For this purpose, Antibiotics which are used extensively in aquaculture are handled at important points.

Antibiotic use in aquaculture: Antibiotic use in both humans and animals is contributing to enhance of resistant bacteria resulting in some serious health problems. The specification and amount of use of antibiotics in aquaculture depends on farming practices, different local and national regulations. Some countries have recently introduced strong regulations in response to the global threat of antimicrobial resistance and consumer awareness about residues in their food. The majority of aquaculture farms production have produced fish as a food with insufficient monitoring such as culture of environment and process. The large part of the discussion on antibiotic resistance focuses on three specific issues; firstly the practice of antibiotics in small sub therapeutic doses in feed as a growth factor or preventative control in fish. In Europe, this kind of non-therapeutic use of antibiotics was banned in 2006 in an effort to hold over-use. Secondly, only a few antibiotics are approved for aquaculture against the high risks. Thirdly, only five per cent of marine culture farm has currently certified and this type of certifications is evaluated as responsible aquaculture. Responsible aquaculture products have created some positive effects on market demands analyzed by environmental friendly consumer organizations.

Conclusion: An international approach has been developed to reduce the use of antibiotics in aquaculture for food additive purposes. The suggestions at this point every country should developed own national policies. If fish farmers improve a more responsible management approach of the harmful effects of antibiotics, public demands on sustainable and safe food will be taken into consideration.

Keywords: Aquaculture, antibiotic, food safety

Sympathoadrenal System and Stress in Fish

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Objective: The aim of this review is to inform about stress and tyrosine hydroxylase (TH) activity in fish.

Introduction: Stress is present in the lives of all living things and is the force that brings about physical change and adjustment. Small amounts of stress can be harmless or even beneficial, but high levels of stress or prolonged periods of stress can create severe health problems. Short-term stress will cause an increase in heart rate, blood pressure, and respiration. The fish is reacting much as we do with the fight or flight mode. The fish can only maintain these altered states for a short period of time and then they will adapt or the stress will become chronic. Stress is accompanied by the release of the hormone cortisol, which is responsible for many of the negative health effects associated with stress. In addition to having a negative effect on growth, reproduction, and digestion, chronic stress will also lower the ability of the immune system to respond effectively and fully. This lowered immune response is what allows parasites, bacteria, and fungi to infect a stressed fish and cause disease and death. TH is an enzyme which plays a central role in neurotransmission and hormonal function of catecholamines. TH is the rate-limiting enzyme in the synthesis of the catecholamines (dopamine, epinephrine and norepinephrine). Therefore, the regulation of TH represents the central means for controlling the synthesis of these important catecholamines. TH has a large molecular diversity, resulting from differential splicing of its mRNA, which is tissue specific and can result in long-term changes in the activity of the enzyme. In addition, it affects the availability of neurotransmitter substances at various synapses. 3,4-dihydroxy-phenylalanine (DOPA), dopamine, norepinephrine and epinephrine are synthesized in the catecholamine pathway. Chromaffin cells in the adrenal medulla release catecholamines. Both synthesis and release of catecholamines rise in these cells as a result of the increase in TH activity and TH mRNA.

Conclusion: Tyrosine-derived catecholamines, including DOPA, dopamine and norepinephrine are important stress hormones. Stress increases TH activity and biosynthesis, which is known to affect the adrenergic nervous system. Therefore, it would be important to research TH activity in fish for the stress conditions.

Keywords: Fish, sympathoadrenal system, stress, catecholamines, tyrosine hydroxylase.

Effect of Medicinal Plants of *Origanum onites* and *Origanum vulgare* Essential Oil on the Lysozyme Activity

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Objective: Infectious diseases represent the main problem for the development and sustainability of the aquaculture industry as they cause significant economic losses as they restrict productivity and require the use of control measures that are often very expensive. However, the indiscriminate administration of antibiotics or other drugs in fish leads to the selection of antibiotic-resistant bacterial strains as well as to the accumulation of chemical residues in water and fish tissues, which may prove damaging to the environment and be potentially dangerous for consumers. The research was aimed to determine the effect of different increasing levels of *Origanum onites* and *Origanum vulgare* essential oil as feed additives in rainbow trout diets in order to observe their influence in serum lysozyme activity.

Methods: Fish were fed the experimental diets supplemented with four different concentrations (0.125, 1.5, 2.5, 3.0 ml kg⁻¹) of *O. vulgare* and *O. onites* essential oil for 60 days. Lysozyme activity was determined using a modification of the method described by Ellis (1996). The method is based on lysis of 0.12% the standard bacterium *Micrococcus lysodeikticus* in 0.5% agarose prepared in sodium phosphate buffer. The diameters of the lysed zone were measured.

Results and Discussion: Results showed that the levels of lysozyme activity in different experimental concentrations, 1.5, 2.5, 3.0 ml essential oil per kg of diet, had significantly higher compared to control in *O. vulgare* after 60 days ($p < 0.05$). Lysozyme activity was significantly higher in rainbow trout fed diet containing 3.0 ml essential oil per kg of diet than other treatments and control after 60 days in *O. onites* ($p < 0.05$). These results suggested that the essential oil of *O. onites* and *O. vulgare* increase lysozyme activity and also may improve disease resistance to pathogens when added to rainbow trout feed.

Keywords: *Origanum onites*, *Origanum vulgare*, rainbow trout, lysozyme activity

Acute Toxication of Deltamethrin Results in Activation of iNOS, 8-OHdG and Up-Regulation of Caspase 3, iNOS Gene Expression in Common Carp (*Cyprinus carpio* L)

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Objective: Deltamethrin is a widely used synthetic pyrethroid pesticide that protects agricultural yields, including crops, fruits, and vegetables from insect-pests. It is known that deltamethrin toxication leads to metabolic disorders and has detrimental effects on the brain and liver in different organisms. However, the harmful effects of deltamethrin toxication on aquatic animals remain unclear. In the present study, we aimed to evaluate the adverse effects of deltamethrin toxication by performing a histopathological examination, an immunofluorescence assay, and a qRT-PCR on common carp.

Methods: Fish were divided into six groups. There was two aquarium for each group. Each aquarium contained ten fish and totally 60 fish were used in the present study. The fish in groups I and II were the control. The fish in groups III and IV were given dose of 0,08 µM (1/5 LD50), V and VI were given dose of 0,04 µM (1/10 LD50) concentration of deltamethrin. First, we assessed the pathological alterations by using a histopathological examination and an activation of iNOS and 8-OHdG by using an immunofluorescence assay (IF) as a result of DLM toxication on the gills, liver, and brain of common carp. Thereafter, qRT-PCR was used to determine whether or not the DLM toxication changes the caspase-3 and iNOS mRNA expression levels in the brain.

Results and Discussion: We observed that a low-dose (0.04 µM) and a high-dose (0.08 µM) of deltamethrin exposure caused lamellar cells hyperplasia and inflammatory cells infiltration in the gills, hyperemia, diffuse hydropic degenerations and focal necrosis in the hepatocytes, necrotic changes in the neurons, and also induced activation of inducible Nitric Oxide Synthase (iNOS) and 8-hydroxy-2-deoxyguanosine (8-OHdG) in the gills, liver, and brain depending on the exposure time (24 h, 48 h, 72 h and 96 h). In addition, deltamethrin toxication caused the up-regulation of caspase-3 and the inducible Nitric Oxide Synthase (iNOS) of the gene expression depending on the dose (0.04 µM and 0.08 µM) and the exposure time in the brain ($p < 0.05$, $p < 0.01$, $p < 0.001$). Our results indicated that long-term deltamethrin exposure could lead to inflammation, oxidative stress, DNA damage, and apoptosis on the different organs in common carp. Thus, deltamethrin toxication is dangerous for common carp populations, and the usage of deltamethrin should be controlled and restricted in agricultural areas.

Keywords: Deltamethrin; iNOS; 8-OHdG; Caspase 3; Immunofluorescence assay; Pesticides; Toxicity; Inflammation; Oxidative stress; DNA damage; Apoptosis.

Antibacterial Activity of Some Essential Oils against *Vagococcus salmoninarum***Seçil Metin, Zühre Işıl Biçer***Suleyman Demirel University Egirdir Fisheries Faculty, ISPARTA*

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Objective: In this work, essential oils of thyme (*Origanum vulgare*), melissa (*Melissa oleum*), St. John's Wort (*Hypericum perforatum*), rosemary oil (*Rosmarinus officinalis*), ginger (*Zingiber officinale*), clove (*Eugenia caryophyllata*), peppermint (*Menta piperita*), lavender (*Lavandula hybrida*) and black cumin (*Nigella sativa*) were screened for its chemical composition and *in vitro* antibacterial activity against *Vagococcus salmoninarum*.

Methods: The composition of oils were analysed using GC/MS. Antibacterial effects of essential oils against *Vagococcus salmoninarum* were detected by agar diffusion and tube dilution assays.

Results and Discussion: As a result of this study, clove and thyme essential oils were shown to possess strong antibacterial activity against *V. salmoninarum*. The main components of effective essential oils were carvacrol (63.57 %) and eugenol (85.99%), respectively. In the further studies, *in vivo* antibacterial activities against vagococcosis of thyme and clove essential oils should be explored.

Keywords: Antibacterial activity, *Vagococcus salmoninarum*, Essential oil, Agar diffusion, Minimal inhibitory concentration (MIC)

Effects of Fermented Sunflower Meal with *Bacillus subtilis* on Growth Parameters, Digestibility and Body Composition in Carp (*Cyprinus carpio*)

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Objective: The objective of this study was to determine effects of dietary inclusion of fermented sunflower meal (FSM) and unfermented sunflower meal (UFSM) with *Bacillus subtilis* on growth parameters, digestibility and body composition of carp (*Cyprinus carpio*).

Methods: Five isonitrogenic and isocaloric experimental diets were prepared by adding 10% and 20% FSM and UFSM to diets of common carp. Control diet did not contain FSM and UFSM. A total of 375 carp (initial weight 5.17±0.01 g) were distributed into 5 experimental groups with 3 replicates. Fish were fed ad libitum for 90 days. In digestibility trial was used chromic oxide as the inert indicator. At the end of the trial, five fish from each tank were sampled, homogenized in a blender, and stored at -20°C for chemical analysis. One-way ANOVA was used to compare growth parameters, FCR, body composition and somatic indices among the treatments.

Results and Discussion: At the end of the experiment, growth performance of fish fed fermented sunflower meal was similar to those fed unfermented sunflower meal. However, carp fed fermented sunflower meal showed a slight decrease in growth parameters. Body composition, hepatosomatic index, survival rate, lipid and protein digestibility of fish were not significantly affected with addition of FSM and UFSM to diets. However, protein digestibility of fish fed 20 % UFSM and 20 % FSM were statistically lower than those fed by the control diet (P<0.05). Results of this study indicate that using FSM by *Bacillus subtilis* in carp diet had no a beneficial effect in terms of growth parameters and nutrient digestibility. In future studies, sunflower meals can be tested by fermenting with different bacteria.

Keywords: Sunflower, *Bacillus subtilis*, fermented, carp, growth, digestibility

Effect of Extender Compositions, Glycerol Levels and Thawing Rates on Motility and Fertility of Cryopreserved Wild African Catfish (*Clarias gariepinus*) Sperm

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Objective: The aim of this study was to determine the effect of different extenders, glycerol levels and thawing rates on post-thaw sperm motility and fertilization ability of cryopreserved African catfish (*Clarias gariepinus*) sperm.

Methods: Having determined the main spermatological properties (volume, motility, motility duration, spermatozoa concentration and pH), the pooled ejaculates were diluted with 3 different extenders containing different glycerol levels (5, 10 and 15%) individually. Dilution ratio was 1:10 and the diluted sperm was packaged in 0.25 ml straws and left for 10 min equilibration at 4°C. Following equilibration, the straws were exposed to liquid nitrogen vapour for 10 min and plunged into the liquid nitrogen (-196°C) and then exposed to different thawing rates (30°C/20s and 40°C/20s) to determine sperm motility and post-thaw motility duration.

Results and Discussion: The highest post-thaw sperm motility, motility duration and fertilization rate was determined as 85%, 81s and 95% respectively when sperm was frozen with the extender (ACSE 3) containing 15% glycerol (p<0.05). The protocol reported in this study can be successfully used for cryopreservation of African catfish sperm.

Keywords: African catfish, *Clarias gariepinus*, sperm, cryopreservation, glycerol, fertilization

New Trends in Aquaculture: Aquaponic Systems

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Objective: Aquaponic system is a special form of recirculating aquaculture system consisting of fish tanks and plants that are farmed in the same water. The main goal of the aquaponic systems is reusing of the nutrients released by fishes to cultivate plants.

Methods: The essential elements of aquaponic system includes fish rearing tank, suspended solid removal component, bio-filter, hydroponic component and a sump. Aquaponic systems stabilizes nutrient production from fish waste with nutrient uptake by plants to achieve proper water quality. Plants perform as biofilter and eliminate the need for a separate bio-filter.

Results and Discussion: Aquaponic systems create a mini ecosystem where both plants and fish can flourish. These systems also maximizes production and uses less water than is used to produce the same quantity of fish and vegetables in traditional practices.

Keywords: aquaponic, aquaculture, soilless agriculture, sustainability

Organic Aquaculture

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Objective: Aquaculture constitute one of the four sub-sectors of agriculture with crop production, livestock production and forestry. On the other hand, aquaculture sector has an special economical importance because of its relationship with health and environmental sectors.

Methods: Organic aquaculture is an overall system of farm management and food production that combines best environmental practices such as preservation of natural resources and application of high animal welfare standards. The main challenges for organic aquaculture are improving the coordination between production and market and also achieving an appropriate framework to drive further development. Priorities for research include organic feeds and fish nutrition, consumers' needs, food safety, environmental concerns and trade issues. In organically cultured fish, differences in feeds and nutrition compared to conventional systems results in differences in the quality of the flesh. Organic production is an overall system of farm management and food production that combines best environmental practices, a high level of biodiversity, the preservation of natural resources, the application of high animal welfare standards Organic production is an overall system of farm management and food production that combines best environmental practices, a high level of biodiversity, the preservation of natural resources, the application of high animal welfare standards

Organic production is an overall system of farm management and food production that combines best environmental practices, a high level of biodiversity, the preservation of natural resources, the application of high animal welfare standards

Results and Discussion: There is a future for the development of organic aquaculture but its success depends on new knowledge and technical development to meet consumers' growing interest.

Keywords: aquaculture, extensive production, organic agriculture, sustainable production

Intestine Villi Morphology of Black Sea Trout (*Salmo trutta labrax* Pallas, 1811): Different Weight of Similar Ages

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Objective: This study was conducted to determine the effect of two different weights of similar ages on the mid-intestine villi morphology in Black Sea trout (*Salmo trutta labrax* Pallas, 1811) at the end of the 16-months growing period.

Methods: Fifth-generation (F5) Black Sea trout were used in this study. Between January-November 2016, the fish (from larvae to smolt stage) kept in the freshwater ponds (10.1-12.5°C) fed by spring water. After that, the fish (18.63±3.84g) were transferred to seawater (6.9-16.6°C; salinity ‰18) in November 2016 where fish were kept for 6 months. Fish were selected as two groups according to their live weight: Low weighted group (LW=151.86±12.65g) and high weighted group (HW=372.83±15.92g). Of twenty fish from each group, mid-intestine tissues were taken at in May 2017 in seawater (16.6°C), and analyzed by placing the samples into 10% formalin then into the tissue cassettes for dehydration process and embedded in paraffin blocks, and subsequently cut 5-µ thickness and placed on a slide. Each sample were stained with hematoxylin and eosin solution by using standard paraffin-embedding procedure. After embedding process, villi length (VL), villi width (VW) and villi length to villi width (VL/VW) were evaluated by using an image processing and analysis system. Data were analyzed by independent samples t test. Statistical analyses were computed using SPSS 15.0.

Results and Discussion: There was significantly difference between groups (LW and HW) in terms of both fish weight and mid-intestine villi morphology (VL, VW and VL/VW). Weights of low weighted fish and high weighted fish were recorded as 151.86±12.65g and 372.83±15.92g, respectively. While VL (µm), VW (µm) and VL/VW of low weighted group were 473.38±76.07, 114.18±22.36 and 4.29±1.05, VL (µm), VW (µm) and VL/VW of high weighted group were 605.96±97.54, 130.28±22.76 and 4.78±1.10, respectively. For a profitable aquaculture, Black Sea trout are grown in freshwater ponds or dam cages until smolt stage, and then smoltified in seawater when they reach nearly 12 cm of length and 15 g of weight. In sea cages, fish are grown during the periods allowed by the water temperature. The fish are harvested at the end of the season. This species is an opportunistic ecotype, and there is competition among their individuals in terms of nutrition. This situation can lead to different weight in the fish in the similar ages. Although the fish used in this study were kept same environmental conditions and were fed with the same feed, fish with different weights were observed. This is reflected in the mid-intestine villi morphology. We may say that VL, VW and VL/VW values increased depending on live weight gain. In addition, special feeding (feed additives etc.) programmes can be applied to improve the intestine villi morphology of low weighted fish.

Acknowledgements: This research was done as a preliminary study for the project named “Possibilities of using some phytobiotic added diets in nutrition of Black Sea trout (*Salmo trutta labrax* Pallas, 1811)” supported by General Directorate of Agricultural Research And Policies.

Keywords: Black Sea trout, *Salmo trutta labrax*, intestine, villi morphology, weight

Investigation of Trout Establishments in the Elazig Province in terms of Health Expenditures and Diseases

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Objective: In this study, it was aimed to Investigate of Trout Establishments in the Elazig Province in terms of Health Expenditures and Diseases.

Methods: The study was carried out within the aquaculture period of 2013- 2014 in trout enterprises in Elazig. It started with the stage of studying, setting up the businesses and preparing the questionnaire forms. The trout farms in operation were selected in the form and number to fully represent the existing regions. The information on the work was recorded on the basis of the statement given by the business owners. In the survey, questions related to information about businesses, capacity, number of net cages, stock density, cleaning net cages, water circulation, feeding frequency, hatchery, tools and equipment, diseases seen in the field, vitamin-mineral used in business, vaccine, medicines and their costs were directed. By visiting the establishments, the diseases, indicators, measures taken for the disease, what drugs were used, vitamins, vaccines and their costs were recorded. After the completion of the filling of the questionnaire forms, the questionnaire was recorded to the computer environment.

Results and Discussion: Within the scope of Elazig Trout Enterprise's Health Expenditure and Disease Investigation study, a total of 60 trout farms were examined. Diseases in businesses, 28% are Redmouth Disease (Yersiniosis), Bacterial Coldwater Disease and Coccus; 27%, Bacterial Gill Diseases, Redmouth Disease and Ulcer Disease; 18% are only Redmouth Disease; 12% are Redmouth Disease, Bacterial Coldwater Disease, Vibriosis and 3% are fungal diseases. Any disease is not seen in 12% of fish farms. It was determined that the diseases seen in the establishments were found in 21 provinces of puppies and puppies-adult, and 10 of them were found only in the adult period. No signs of disease were found in 8 of the trout farms. In the vast majority of fish farms (87%), medicines are being used and 30% of them have drug costs between 1000-5000 TL. The total drug cost of drug-using enterprises is 350.000 TL on average. The medication fee for a 25-ton company is about 450 TL, the medication fee for a 50-ton company is about 900 TL, and the medication fee for a 100-ton company is about 1800 TL. The biggest operating expenses in aquaculture enterprises are feed, fingerling fish, medicines, vitamins and vaccines. As seen in our study, drug, vaccine and vitamin expenditures constitute an important amount in total expenditures. Pre-disease protective measures should be taken in trout farming enterprises. In addition, antibiotics should be used regularly and consciously.

Keywords: Trout Farms, fish disease, healt cost, Elazığ

The Effect of Daylight Extension on Growth Parameters of Carp (*Cyprinus carpio*, Linnaeus, 1758)

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Objective: In this study, it was aimed to estimate growth parameters of common carp (*Cyprinus carpio*) that were raised on varying daylight lengths in the net cages.

Methods: The trial was carried out in a commercial aquaculture farm in Demirkopru Dam of Lake, Manisa, Turkey. The net cages used had a volume of 1000 m³. The illumination was provided by underwater lamps with 300 W. The study was conducted in two size groups; large (15.58±2.62 cm, 66.32±31.19 g, n=300) and small (10.07±1.59 cm, 18.72±8.2 g, n=300). Photoperiod regimens used were 18 light(L):6 Dark (D) and 24 L: 0 D and normal daylight (DL). The trial lasted for 196 days. Fish were fed *ad-libitum* in varying frequencies (3, 4 and 5 times) depending on the treatments times in a day. 18 L:6D group were fed 4 times. For 24L/0D period group fish were fed 5 times and the control 3 times a day. A commercial diet containing 43.5 % protein and 18% crude fat was used. The results were evaluated using the statistical program (SPSS 15 version).

Results and Discussion: End of trial, big fish group reached mean weights of 2462.35±9.4 g in the control group, 2686.88±37.01 g in 18L:6D and 2955.11±37.93 g in 24L:0D with feed conversion rates (FCR) 1.52, 1.86, 2.01 and specific growth rates (SGR) 1.86±0.05, 1.89±0.04 and 1.94±0.03, respectively. Small fish group reached 1234.79±82.33 g in the control, 1748.84±22.02 g in 18L:6D and 1905.71±43.92 g in 24L:0D with FCRs 1.33, 1.44 and 1.61 and SGRs 2.14±0.02, 2.31±0.02 and 2.36±0.02, respectively. The results suggest that 18L:6D treatment appears to be more effective for growing carp in net cages.

Keywords: growth parameter carp, *Cyprinus carpio*, net cage, photoperiod

The Effect of the Daylight Extension Period on rainbow trout (*Oncorhynchus mykiss*) Growth Parameters

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Objective: In this study, it was aimed to determine the effects of prolonged daylight on growth parameters of rainbow trout in the net cage.

Methods: The trial was carried in a commercial aquaculture farm in Burdur. Three cages with 15x2,9x1 m were separated to 3 segments each of which had 14,5 m³. 300 fish with mean weight 31,39 ± 0,26 gr were stocked to experimental units. Totally 2700 fish were used. The illumination was provided by spiral lamps with 100 W power. Fish were fed every 6 hours. 18 L:6D group were fed 3 times at 08:00- 14:00 and 20:00. Fish on 24L/0D period group were fed 4 times at 08:00, 14:00, 20:00 and 02:00. Control group (11L: 13D) were fed 2 times a day at 08:00 and 14:00. All experimental groups were fed libitium with a commercial diet including 45% protein and 20% crude fat. 30 fish were selected randomly from each replicate every month and their weight and length were measured. The trial lasted for 125 days. The results were evaluated in the statistical program (SPSS 15 version).

Results and Discussion: 18L/6D and 24L/0D groups weight were significant different from the control group without significant difference between themselves. 18L/6D group showed higher performance than other groups in survival rate. The best photoperiod treatment appeared to be 18L/6D when profitability is considered. As a result, it can be concluded that photoperiod regimens are effective methods to increase the fish weight.

Keywords: growth parameters, photoperiod, rainbow trout, *Oncorhynchus mykiss*

In vitro* Antibacterial activities of Pomegranate, *Punica granatum*, Vinegar Against *Flavobacterium psychrophilum

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Objective: The aim of this study was to assess the antibacterial activity of pomegranate vinegar against *F. psychrophilum*.

Methods: Pathogens F1 and F2 isolates (during outbreak from rainbow trout/Fethiye-Turkey) were refreshed from our collection in Suleyman Demirel University. The antibacterial activity was determined by using agar well diffusion assays (NCCLS, 1999). The test was performed on tryptone yeast extract salts (TYES) agar. The bacterial inoculum was adjusted so as to deliver a final inoculum of approximately 10^8 colony-forming units (CFU)/ml. The vinegars were diluted in phosphate buffered saline. It was added to 25 μ l of the vinegars in well. The plates were incubated at 15°C for 72 hours. The antibacterial activity was evaluated measuring the diameter of the inhibition zone. All tests were performed in triplicate. It was used to PBS as negative control and florfenicol as positive control.

Results and Discussion: Pomegranate vinegar showed that remarkable antibacterial activity against *F. psychrophilum* with a diameter of inhibition zone ranging between 40 mm and 54 mm. Antibacterial and immunostimulant features of these vinegars are known to be therapeutic for human health in many diseases. Pomegranate vinegar which are a natural substance have a good antibacterial activity for *Flavobacterium psychrophilum*. The results confirmed the possible use of pomegranate vinegar as a source of antimicrobial agents which could be used in aquaculture for the control of the bacterial infection.

Keywords: *Flavobacterium psychrophilum*, pomegranate, vinegar, antibacterial activity.

Investigation of Levels Lysozyme Activity, Cortisol and Serum Glucose in Pike Perch (*Sander lucioperca* L., 1758)

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Objective: In this study, lysozyme activity, cortisol and serum glucose levels were investigated in pike perch blood samples of Egirdir Lake.

Methods: Study 2013 was conducted in the spring and fall. Pike perch samples in this study were obtained through their fishing-net. Blood samples were taken at the 2 and 5 ml syringe. Cortisol was measured by electrochemiluminescence method. Lysozyme activity was determined by agar diffusion method. Serum glucose analysis was performed by spectrophotometric method with hexokinase. The obtained data were analyzed in the light of existing criteria and literature.

Results and Discussion: Pike perch cortisol values ranged from 9,16 to 63,44 µg/dL with a mean of 22.86 µg/dL. The average was determined as 15.75 µg/dL in the spring and 31.39 µg/dL in the autumn. Serum glucose values ranged from 66 to 502 mg/dL, with a mean of 242 mg/dL. The average of 248 mg/dL was determined in the spring and 236 mg/dL in the autumn. Lysozyme activity values ranged from 0.570 to 1.140 mg/mL, with an average of 0.944 mg/mL. It was determined as 0.946 mg/mL in the spring and 0.941 mg/mL in the autumn. In the statistical analyzes, it was seen that the difference of the regions was not statistically significant. The difference between the seasons was statistically significant in cortisol values ($p>0,05$). The resulting data were higher compared with other studies. The species live in this situation, it was concluded that the cause of effects such as habitat.

Keywords: *Sander lucioperca*, pike perch, lysozyme activity, cortisol, serum glucose

Acknowledgment: In this study was supported by Suleyman Demirel University Scientific Research Projects Unit SDÜ-BAP 3454-D2-13 project.

**The histology of Invasive Species Stone moroko (*Pseudorasbora parva*
(Temminck & Schlegel, 1846))**

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Objective: In this study, histological appearance of Stone moroko (*Pseudorasbora parva*), invasive species were studied after collected from Mogan Lake, Central Anatolia.

Methods: Fish samples were collected from Mogan Lake. After collected from the Lake, fish samples were sacrificed on ice anesthesia for histologic investigations. Fixation was done by 10% buffered formalin. Routine histologic procedures (dehydration in alcohol series, cleared in xylene, embedded in parafin) were carried out. and The parafin blocks were sectioned with ThermoShandon 325 Finnesse rotary Microtome and stained with H&E. The examination of the slides was done under a light microscope.

Results and Discussion: The gills, liver, gonads, muscle, digestive system and intestine were investigated and evaluated. Eastern Asia originated invasive species were accidentally introduced to Mogan Lake. It effects the ecosystem and become one of the threaten to natural fauna of the eutrophic lake. So it is important to know the histology and biology of *P. parva* at the Mogan Lake for future monitoring and implementations.

Keywords: Histology, invasive species, *Pseudorasbora parva*, Mogan Lake

Activating Solutions versus Hatchery Water for Artificial Insemination of Rainbow Trout (*Oncorhynchus mykiss*)

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Objective: The aim of the present study was to assess comparisons of the effects of two lab- made activating solutions and hatchery water on sperm motility and fertilization success in artificial insemination of rainbow trout (*Oncorhynchus mykiss*).

Methods: An activating solution (A1) containing 60 mM NaHCO₃, 50 mM Tris pH=9.0 and another activating solution (A2) containing 20 mM Tris, 30 mM glycine, 125 mM NaCl, pH=9.0, and also hatchery water (HW) were used for activation of spermatozoa and fertilization. Gametes were collected during the spawning in December from six rainbow trout males (two years of age) while eggs were collected from three females (three years of age) by gentle abdominal massage, avoiding any contamination. Both sperm and eggs samples were mixed and pooled samples obtained for each before the experiments. Percentages of progressive motility (%) and durations of progressive motility (s) were determine under a phase-contrast microscope at 200× magnification immediately while fertilization rates were calculated using a stereomicroscope at 20× magnification eighth days after the insemination. The sperm motility percentages were estimated as the percentage of cells that exhibited progressive forward movement, and the durations of motility were determined as the times until forward movement stopped and circular movement began. Three aliquots of each sample were determined, and the average motility characteristics were then calculated and sperm samples were diluted 1:400 with A1, A2 and HW during motility measurements. Mean sperm concentration of pooled sample was $10.46 \pm 0.50 \times 10^9$ spermatozoa/ml. Fertilization was performed at approximately 300.000:1 sperm-to-egg ratios. A1, A2 and HW were added to the eggs in plastic cups (350 ± 20 eggs). Next, the sperm sample was immediately added and the gametes were mixed. After 5 min, the eggs were rinsed with hatchery water and incubated for 15 min to water-harden the eggs, and then incubated. Fertilization tests were carried out in triplicate for each for each activating solutions.

Results and Discussion: Motility percentages were observed >90% with all A1, A2 and HW, while the durations of progressive motility were 22.5 ± 0.7 s, 30.0 ± 1.4 s and 30.5 ± 0.7 s respectively. The lowest average fertilization rate (64.6 ± 1.4 %) was obtained using HW, while those values were 89.4 ± 5.1 and 91.3 ± 0.6 % using A1 and A2 respectively. Consequently, both motility durations and fertilization rates obtained by using A1 and A2 were significantly higher than those values of obtained by HW.

Keywords: Activating solutions, hatchery water, artificial insemination, rainbow trout

Effects of Sugar Beet Leaf Extracts Obtained by Different Methods on Growth Performance of Goldfish (*Carassius auratus*)

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Objective: It is evaluated that the effects of sugar beet leaf extracts obtained by three different methods aiming to extractions of proteins, carbohydrates, and fatty acids on goldfish (*Carassius auratus*) growth performance in recirculating aquaculture system in this study.

Methods: In a 60-day feeding trial, healthy cultured *C. auratus* (mean weight \pm SD = 6.02 \pm 0.40 g) were stocked in 21 aquariums (50–L) with 12 fish each. Extractions of proteins (P), carbohydrates (C), and fatty acids (F) from sugar beet leaves were added to the feed at a rate of 0.5 and 20 g/kg, referring to P5, P20, C5, C20, F5, F20 as feed treatments. To extract proteins, sodium phosphate buffer (100 mM, pH 7.5) containing 3 mM EDTA was used, while carbohydrates extracted in deionized water at 95°C. Fatty acids from sugar beet leaf were obtained with ether and methanol combination. The Fish were hand-fed with experimental diets (in triplicates) to apparent satiation, twice a day at a rate of 2 % of fish biomass for 60 days. Growth performance and feed utilization were calculated using following equations;

FCR (Feed conversion ratio) = feed consumed / weight gain

RGR (Relatively growth rate %) = [(final wet weight - initial wet weight) / initial wet weight] \times 100

SGR (Specific growth rate %/day) = [(ln final wet weight – ln initial wet weight) / days] \times 100

Results and Discussion: The Supplementation of sugar beet leaf extracts were not influenced the growth performance of fish ($P < 0.05$). There were a slightly increase in P20 and F20 groups but not statically different from the control. Although it is estimated that most alternative supplements are influenced by microbiota directly or indirectly to improved fish growth performance, the sugar beet leaf extracts has not shown this impact in goldfish. Further studies should be encouraged to determine the effects of sugar beet leaf extracts on fish health status or reproductive status.

Keywords: Sugar beet, growth performance, different extraction methods, aquaculture

Sublethal Effects of Etofenprox on Plasma Parameters of Common carp (*Cyprinus carpio*)

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Objective: In the present study, sublethal effects of synthetic pyrethroid etofenprox on plasma parameters of common carp (*Cyprinus carpio*) was investigated.

Methods: Juvenile carp, *Cyprinus carpio* were obtained from Turkish Ministry of Food, Agriculture and Live Stock, Mediterranean Fisheries Research Institute, Antalya. Mean weight and length of the fish were 54.85 ± 10.05 g and 14.75 ± 0.45 cm, respectively. Before the experiments, fish were kept acclimation period for two weeks in aerated dechlorinated tap water at $23 \pm 1^\circ\text{C}$ and fed daily with commercial trout feed (45% crude protein) at a rate of 2% of their body weights. Fish were not fed for 48 hour prior to and during the experiments. Experiments were conducted under static conditions in aquaria containing 100 L of dechlorinated tap water in which approximately 30 fish were stocked in each. Two sublethal etofenprox concentrations (5 and 50 $\mu\text{g/L}$) were carried out with two control groups. After 96 h exposure, blood samples were taken by cardiac puncture under ice anesthesia. Heparin was used to slow blood clotting since fish blood clots very fast. Plasma glucose (mg/dL), total protein (g/dL), cholesterol (mg/dL), triglycerides (mg/dL), sodium (mEq/L), potassium (mEq/L), calcium (mg/dL), chloride (mEq/L), phosphorous (mg/dL) ALT (SGPT; U/L) and AST (SGOT; U/L) levels were determined with a Roche P800 Module and commercial kits. Statistical evaluation was done by Kruskal Wallis test.

Results and Discussion: After exposure to etofenprox plasma glucose, ALT, AST and potassium levels were significantly increased when compared to control group ($p < 0.05$). Plasma total protein cholesterol, triglycerides, sodium, calcium, chloride, phosphorous levels did not change. Like other pesticides, etofenprox can enter water bodies directly by pest control programs or indirectly through rain water and surface run off. Etofenprox has a similar mode of action to other pyrethroids, disrupting the sodium channel function in the nervous system. Exposure to sublethal concentrations for 96 h effects the stress parameters of non-target organism, common carp.

Keywords: Sublethal effects, etofenprox, plasma parameters, common carp (*Cyprinus carpio*)

The Histopathological Effects of Sublethal Fenitrothion on Narrow Clawed Crayfish (*Astacus leptodactylus* Esch. 1823)

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Objective: Organophosphorus fenitrothion [O,O-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate; CAS Number: 122-14-5] are widely used insecticides in agricultural areas in Turkey. In this study, the effects of 1.5 µg/L (1/10 of 96 h LC₅₀) fenitrothion on crayfish histology and biochemical parameters were examined.

Methods: Intermoult stage narrow clawed crayfish (*Astacus leptodactylus* Eschscholtz, 1823) were obtained from a local breeder. Their average weight and average total length were 27.32±0.57 g and 9.85±0.07 cm, respectively. 250 live crayfish were transported to the laboratory in transferred to 4 different 100 L capacity aquariums (100x45x35cm) for acclimatization during 15 days. The studies were conducted at semi-static test procedures in two series. After 7 day exposure to fenitrothion, hemolymph was taken for biochemical analysis and then crayfish were sacrificed on ice anesthesia for histologic investigations. Crayfish tissues (gills, hepatopancreas, antennal gland, muscle and gonads) were fixed in Davidson's fixative. After 24 h fixation, tissues were placed into 70% ethylalcohol and routine histologic procedures (dehydration in alcohol series, cleared in xylene, embedded in paraffin) were carried out. The paraffin blocks were sectioned with ThermoShandon 325 Finesse rotary microtome and stained with H&E. Biochemical parameters were determined with a Roche P800 Module and commercial kits. Non parametric Kruskal Wallis test was performed for statistical evaluation of hemolymph biochemical parameters.

Results and Discussion: No histopathological findings were found in the control group and acetone added control group at the end of the experiments. After 7 days 1.5 µg/L fenitrothion exposure, hepatopancreas tissues of crayfish were showed structure like hyperemia, focal tubule epithelial cell necrosis, degeneration on the tubule lumen, multifocal necrosis, melanization. Structure like hyperemia and capsule, hemocytic congestion, congestion at afferent and efferent canals, branchitis were observed in the gill tissues. Enlargement of antennal gland lumen and structure like hyperemia were recorded in the antennal gland. Some hemolymph biochemical parameter significantly changed. The results of the study were showed that even low concentrations of pesticides in the water were affected crayfish tissues seriously and narrow clawed crayfish (*Astacus leptodactylus*) can be a good model organism for toxicological studies.

Keywords: Fenitrothion, organophosphorus pesticide, histopathology, *Astacus leptodactylus*

Sublethal Effects of Ammonia on Plasma Parameters of Nile tilapia (*Oreochromis niloticus*)

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Objective: The objective of the present study was to investigate sublethal effects of ammonia on plasma parameters of Nile tilapia (*Oreochromis niloticus*).

Methods: This study was conducted using Nile tilapia (*Oreochromis niloticus* L.) (n=200) weighing 65.93±4.13 g obtained from artificial reproduction in Ankara University Fisheries Research Centre. Fish were taken from the tanks 210 L where they were usually stocked and put into the experimental system at least two weeks before the beginning of the experiment (20 fish/tank). During this acclimatization period, the tank was supplied with running de-chlorinated and continuously aerated tap water. The experiments were conducted during 6 weeks and four different ammonia concentrations (control, 1, 2, 5, 10 mg/L TA-N) were used. After 24 h and 6 weeks exposure, blood samples were taken by cardiac puncture under ice anesthesia. Heparin was used to slow blood clotting since fish blood clots very fast. Hematocrit, plasma ammonia (µg/L), glucose (mg/dL), total protein (g/dL), sodium (mEq/L), potassium (mEq/L), calcium (mg/dL), chloride (mEq/L) were analyzed by commercial kits. Statistical evaluation was done by Bonferroni test.

Results and Discussion: The blood parameters effected differently from ammonia concentrations, water temperature and sampling time. Total plasma protein, magnesium (Mg⁺⁺), sodium (Na⁺) reduced at the end of the experiment (p<0.05), plasma glucose and ammonia levels increased linearly with water ammonia levels (p<0.05), plasma chloride (Cl⁻), potassium (K⁺) and hematocrit fluctuated unsteadily and calcium (Ca⁺⁺) levels were remained same. Ammonia is an environmental toxicant that is especially problematic for aquatic organisms. Its level in water systems can raise due to agricultural run-off and decomposition of biological waste. In addition, in intensive fish culture, high stocking densities and feeding rates also increased the probability of exposure of the animals to elevated concentrations of nitrogenous wastes, particularly to ammonia and nitrite.

Keywords: Sublethal effects, ammonia, plasma parameters, Nile tilapia (*Oreochromis niloticus*)

The Development of Fish Feed Industry in Turkey

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Objective: In this study, it is aimed to examine the historical development of fish feed industry in Turkey and demonstrate the current situation of the industry.

Methods: Secondary data of the study were taken from the relevant institutions, local and foreign publications, and relevant reports that contain statistical data. It was found that there are 22 fish feed facilities in Turkey according to the records of Republic of Turkey Ministry of Food, Agriculture and Livestock. Phone calls were conducted with the officers of the mentioned facilities. Production amounts of the facilities were noted. In accordance with the information gathered, population of the study were determined as the facilities that produce 30.000 tons and below per year, and that amount to 70% of 22 facilities. The original data were determined with a phone questionnaire survey carried out with 15 producers based on complete inventory method. The data obtained were interpreted with tables and graphics.

Results and Discussion: In Turkey, fish feed industry has developed in parallel with aquaculture activities. The first fish feed was produced in 1977 by BİLYEM-TAŞ in Bilecik. In 1988, the number of factories that produced fish feed reached to four, and the amount of total fish feed production was 4.000 tons. In 2000, while aquaculture production was 79.031 tons per year, fish feed production was 40.646 tons per year. In addition, in 2015, while aquaculture production 240.334 tons per year, fish feed production increased to 375.476 tons per year (GKGM, 2017; TÜİK, 2016). These figures indicate that aquaculture production and fish feed industry have been developing at a significant pace. Today, there are 22 fish feed production facilities in Turkey, and 70% of these facilities are comprised of facilities that produce 30.000 tons and below per year. As a result of the survey conducted with mentioned facilities, it is found that their annual production amount is between 10.000 and 30.000 tons, that 56% of them produce only fish feed, and that 100% of them expect that fish feed industry is going to further develop in Turkey.

Keywords: Fishmeal, Factory, Aquaculture, Production

Molecular identification of burn spot diseases (*Fusarium sp.*) from Turkish crayfish stocks by PCR method

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Objective: In this study, molecular identification of the fungal pathogen, *Fusarium sp.* which causes burn spot disease in freshwater crayfish (*Astacus leptodactylus*) distributed in the Turkish inland waters was aimed by using Polymerase Chain Reaction (PCR) method.

Methods: Crayfish samples were obtained from 40 different water bodies in Turkey. Crayfish tissue samples were taken from symptomatic region of crayfish and inoculated to PDA media (1000 ml / L filtered lake water, 39 g / L Potato Dextrose Agar, 100 mg / L penicillin G and 10 mg / L oxolinic acid). Genomic DNA isolation was performed using a commercial DNA isolation kit (Qiagen DNeasy Blood & Tissue Kit), harvested *Fusarium* hyphae which was morphologically diagnosed by microscopy examination after sporulation. Polymerase Chain Reaction (PCR) was performed for molecular diagnostic with the DNA of the obtained fungi. PCR was carried out as described in Mishra et al. (2003) on *Fusarium sp.* FAF1 (5'-AACATACCTTAATGTTGC-CTCGG-3') and FAR (5'-ATCCCCAACACCAAACCCGAG-3') primers designed for the ITS region of the nrDNA for the molecular diagnosis of this species. The PCR products were visualized on an agarose gel. The PCR products of the fungi strains were checked in agarose gel and then sent to sequence analysis. Obtained sequences were blasted to GenBank® and their validity were checked.

Results and Discussion: At the end of the study, *Fusarium avenaceum* were isolated and diagnosed from 3 different localities. This is the first molecular study which has been carried on burn spot diseases pathogen (*Fusarium avenaceum*). Burn spot disease pathogen was defined and reported at the species level for the first time in Turkey from three crayfish population supplied from three lakes (Bayramşah Dam Lake- Tekirdağ, Karaidemir Dam Lake-Tekirdağ, Keban Dam Lake- Elazığ).

Keywords: Burn spot diseases, *Fusarium avenaceum*, crayfish, PCR,

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A Magic Piece of Aquarium Filtration Equipment; Protein Skimmer, How Do They Work?

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Objective: The subject of this study is to give information about a magic piece of aquarium equipment called, protein skimmers, foam fractionators, foam separators, air strippers etc.

The number of aquarium hobbyist and professional aquarist have been in increase in our country and in the world in recent years. As parallel to world trend public aquariums in our main cities are opening their doors to visitors, that creates public awareness and curiosity about underwater and aquarium World.

Nowadays developing technology makes easy to maintain successful aquariums for anyone, which is especially true for marine aquarium maintenance.

What is protein skimmers? Protein skimmer is very important piece of aquarium filtration equipment which removes the proteins and other organic wastes from the aquarium before they have a chance to break down into more harmful elements, such as ammonia and nitrite. Removing these wastes also helps prevent algae build up, as does the reduction in phosphates. Protein skimmer are also helpful in removing any toxins released from corals or invertebrates in the aquarium (Marini F.C., 2008).

As a result of these effects, the water quality is improved and frequent water changes are less necessary. Protein skimmer have an advantage in increasing oxygen redox potential (O.R.P.) in the aquarium. Therefore, salt water aquariums could benefit greatly from having a skimmer.

The use of protein skimmers in reef aquariums is more controversial. In addition to removing phosphates, skimmers also remove trace elements which are necessary for corals and invertebrates (Sprung J. and Delbeek C., 1994). Therefore some reef aquarium keepers will turn off the protein skimmer for 3-4 hours after adding phytoplankton.

There are 3 basic designs of protein skimmers; counter current (air driven), venturi and turbo.

The effectiveness of a protein skimmer is based on the;

- Amount of bubbles produced
- Size of bubbles (0,5-1 mm preferred)
- Contact time of bubbles with water

How does P.S. Works? Dissolved organic compounds (DOC)'s are waste molecules skimmers are designed to remove; these are produced as by products from the break down of biological material. This pollution arises not only the deliberate food input in our tank, but also waste products from fish, plants, invertebrates and decaying bacteria, algae etc. DOC's are bipolar molecules, these surfactants are attracted to air/water interfaces, i.e., bubbles. A bipolar molecule contains one or more atoms attracted to air, and one or more atoms attracted to water. A skimmer exploits this difference in the following manner;

As an air bubble moves through the column of organic-laden water the electrically charged protein molecules

are attracted to the air/water interface of the bubble. The polar regions of the molecule are attracted to the air/water interface and these polar tails stick out away from water bubble into the water column. The nonpolar regions stick out into the air bubble because it does not like to be in contact with polar solvent (water). The polar regions outside of the air bubble stabilize the air bubble very much like a soap bubble in our kitchen sink.

This is reason why foam begins to build up at the surface of the skimmer. As protein laden bubble reaches the top of the protein skimmer, the proteins begin to accumulate which creates stable foam bubble.

These stable foam bubbles take along time to burst. Thus, the proteins are slowly are concentrated at the top of the skimmer where they are slowly pushed through the “throat” of the protein skimmer in to collection cup.

Methods: Information for this paper gathered from popular aquarium journals, also author experience and internet resources related to aquarium maintenance were used.

Results and Discussion: Protein skimmers are irreplaceable parts of marine aquarium filtration systems due to their excessive benefit to aquarium water quality. Protein skimmer should be the first step in our filtration process.

How much time you want to spend maintaining your skimmer is an important factor in choosing the right one, also cost is another important factor, usually more expensive skimmers are more efficient and easier to set up and adjust. All skimmers require cleaning to work their best otherwise their efficiency will decrease.

Adequately chosen skimmer should cycle aquarium water 3-4 times within an hour. Also it is important to know that “we can not over skim our aquarium water”.

Keywords: Protein skimmers, marine aquarium filtration, DOC's

Transition from Farming to Sustainable Fisheries in Beydağ Dam Lake formed by Condemnation

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Objective: Dams formed through condemn offer business opportunities as well as a new habitat and ecological formation. These areas also assert many historical, economical and socio-economical changes for the local population. As an example, the changes in the local development and perception of sustainable fisheries in the Beydağ Dam Lake (which began in 2007 with its construction and gained pace ever since) was examined.

Methods: In 2017, face-to-face interviews were conducted with 50 cooperative shareholders and the 12 women working only in certain times of the year, both calculated by complete enumeration method. In the scope of this method, current status of the lake fisheries and hypothetical scenarios were evaluated to study the willingness to pay (WTP) of cooperative shareholders for the sustainable use of the lake and variables affecting this WTP.

Results and Discussion: In order to sustain the livelihood of the local population who lost fertile lands due to the construction of the lake and to contribute to the socio-economic development of Beydağ county's migration-based declining economy, "contract production model" was deployed to create manufacturing opportunities and a new business space in the 760-hectare lake. In 2011, with the start of the Beydağ Fishery Cooperative, the limited liability fisheries cooperative in Beydağ Dam Lake, fisheries activities became official, leading to financial recovery in the area. However, problems such as decreasing size and water level, illegal fishing and unpurged depths of the catch zones are confronting these new fisher families with the depletion of their source of income once again. Decision makers should be informed of the outcomes of the fisheries started with the condemnation of the lake and all shareholders should consider the developments in Beydağ Dam Lake in terms of sustainable management.

Keywords: Condemnation, Beydağ Dam Lake, fisheries, environmental evaluation, sustainable use.

Distribution of the Aquatic Oligochaete *Tubifex tubifex* Host for the Salmonid Whirling Disease Parasite *Myxobolus cerebralis* in Turkey

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Objective: The distribution of *Tubifex tubifex* to find places, which is the risk of Whirling disease may be possible in Turkey was investigated in this study.

Methods: A total of 83 articles providing information on the distribution of this species were used to determine the distribution map of *T. tubifex*.

Results and Discussion: Whirling disease is caused from an infestation of *Myxobolus cerebralis* within fish in the family Salmonidae. The disease has been implicated as a factor in severe recruitment declines in wild rainbow trout *Oncorhynchus mykiss*. The disease afflicts juvenile fish (fingerlings and fry) and causes skeletal deformation and neurological damage. Fish “whirl” forward in an awkward, corkscrew-like pattern instead of swimming normally, find feeding difficult, and are more vulnerable to predators. The mortality rate is high for fingerlings, up to 90% of infected populations, and those that do survive are deformed by the parasites residing in their cartilage and bone. *M. cerebralis* is a myxozoan parasitic organism with a complex life cycle requiring two hosts, *T. tubifex* and a trout. The host aquatic worm *T. tubifex* is a member of the oligochaete family Tubificidae, is commonly found in extreme trophic conditions; the species inhabits both organically polluted sites and pristine, oligotrophic sites characterized by low species diversity. Invertebrate hosts, especially *T. Tubifex*, have been known associated with in the life cycles of freshwater myxozoans. Considering the previous studies, we described the intensive distribution areas of *T. Tubifex*, wild trout species, and cultured trout facilities in inland waters in Turkey. Even though any case for occurrences of *M. cerebralis* was reported from Turkey, we investigated that could be potential risk area for cultured and wild trout species.

Keywords: Whirling disease recruit, *Tubifex tubifex*, Distribution, *Myxobolus* sp., Turkey.

Congo Red Effects on Detoxification and Metabolic Enzymes in liver of rainbow trout (*Oncorhynchus mykiss*, Walbaum, 1792)

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Objective: Congo red (CR) is widely used in the especially textile industry, but it has a series of toxicological and environmental problems. The aim of the present study was to evaluate the effects of CR exposure on the biotransformation enzymes (Glutathione S-Transferase (GST) and cytochrome P450 (CYP1A1)) and metabolic enzyme (Lactate dehydrogenase-LDH) in the liver of rainbow trout (*Oncorhynchus mykiss*).

Methods: Rainbow trout, weighing 139.0 ± 25.0 g (mean \pm SE) were obtained from a local commercial fish farm (Tunceli, Turkey). They were held in a fish tank (2.0x2.0x1.0 m, 18.0 ± 0.5 °C temperature, and a 12:12 light-dark photoperiod cycle) for acclimatization. Fishes were acclimatized for 2 days, and starved for 24 h prior to exposure and during the experiment to avoid prandial effects during the assay. The rainbow trout was transported to experimental aquariums (90 l) and exposed to 0.5, 1.0, and 2.0 mg l⁻¹ CR. Fish were sampled after 24 h and 48 h. After the experimental periods, fishes were anaesthetized, and then dissected for obtaining of the liver tissue. Enzyme analyses were carried using the commercial kits with a Thermo Scientific Multiskan FC – filter-based microplate photometer.

Results and Discussion: Congo Red altered the activities of liver GST, CYP1A, and LDH enzymes of *O. mykiss* in a dose-dependent manner. The differences of GST, CYP1A1 and LDH activities were not statistically significant among the times (0, 24 and 48 h) of exposure to CR ($P > 0.05$), except Group C (2.0 mg l⁻¹ CR) in terms of GST activities ($P < 0.05$). Exposure duration of CR did not affect the biochemical response of rainbow trout. The differences in GST activities among the groups after 24 and 48 h were statistically significant ($p < 0.05$), and for only 24 h in the LDH activities ($P < 0.05$). Thus, CR exposure changed the biotransformation and metabolic enzymes, and these changes may be used as potential bioindicators of the exposure.

Keywords: Rainbow trout, Congo Red, CYP1A1, LDH, GST

***Ligula intestinalis* Infection in Invasive Fish, *Pseudorasbora parva* (Temminck & Schlegel, 1846) from Hirfanlı Dam Lake**

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Objective: The aim of this study was to determine the *Ligula intestinalis* infection at *Pseudorasbora parva* in Hirfanlı Dam Lake.

Methods: The study animals were fishes these species that were collected from Hirfanlı Dam Lake. The fish samples was collected with gill nets and fyke net from Hirfanlı Dam Lake, between 2015 and 2016. For each fish collected the fork length (nearest to 0.1 cm) and total weight (nearest to 0.01 g) were recorded and the sex was determined by the macroscopic examination of gonads. Fish were dissected and the parasites were examined. The parasites found were determined numerically and their weights (nearest to 0.1 g) and lengths (nearest to 0.1 cm) were measured. The fish species were identified; the parasite species were identified.

Results and Discussion: It was seen that the 30 of 386 fish were infected by *L. intestinalis*. The average length of the fish infected by *L. intestinalis* was 4.07 cm while this value was 5.96 cm in uninfected fish. The average weight of the fish infected by *L. intestinalis* was 2.11 g while this value was 3.29 g in uninfected fish. The maximum and minimum of *L. intestinalis* length were 1.10 cm and 9.60 cm while maximum and minimum of *L. intestinalis* weight were 0.03 g and 0.91 g. This study showed infection of *L. intestinalis* from *P. parva* inhabiting Hirfanlı Dam Lake which is an important reservoir for fisheries. It is the first report for *L. intestinalis* infection in *P. parva* from Hirfanlı Dam Lake. The negative effects on fish growth, it may have effected on fish reproductive activity.

Keywords: *P. parva*, *L. intestinalis*, infection, Hirfanlı Dam Lake.

An Evaluation on the Metazoan Parasites of the Freshwater Fish from Mediterranean Region of Turkey

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Objective: In this study, **it was** aimed to evaluate Metazoan parasites of the fish which live in the freshwater resources of Mediterranean region of Turkey.

Methods: All information regarding metazoan parasites from Mediterranean region are found in the reference national and international articles, reports and theses. The data of the metazoan parasite are listed in a table with their hosts and some representatives of the metazoan species are illustrated in the figures.

Results and Discussion: Fish species live in inland waters of Turkey has increased considerable as reported in the recent studies. In this context, the freshwater fish species containing 371 species in 27 families and 92 gen-era are reported. According to the reviewed literature, metazoan parasites of total 20 fish species were reported from freshwater resources in provinces (Antalya, Burdur, Isparta, Mersin, Adana, Osmaniye, Kahramanmaraş and Hatay) of Mediterranean region of Turkey. A total of 11 monogenean species in ten fish species, four Digenean species in ten fish species, seven Cestoda species in three fish species, five Nematoda species in eight fish species, six Acanthocephala species in eight fish species, one Crustacea species in two fish species, one Copepoda species in two fish species and two Annelida species in two fish species were studied.

Keywords: parasites, freshwater fish, Mediterranean, Turkey

Investigation of the Usability as an Fish Feed and Cultivation Ability of Niger (*Guizotia abyssinica* Cass.) Seed in Our Country

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Objective: The aim of this study is literature search for the usability as fish feed and a preliminary experiment for cultivation of niger (*Guizotia abyssinica* Cass.) seed in our country.

Methods: This study contains literature search and a preliminary experiment for cultivation of niger. Niger seeds planted in three localities (Isparta, Aydın, İskenderun) and their development are followed with measurements and photo.

Results and Discussion: Niger (*Guizotia abyssinica* Cass.) oil seed has been cultivated in Ethiopia, India, Sudan, Uganda, Zaire, Tanzania, Malawi, Zimbab, West Indies, Nepal and Bangladesh. Also, It's cultivation has began in America in recent years. Niger oil is used in meals. Also, it is used in soaps, paints, lubricants, lighting fuels, fertilizers and cosmetic in very small quantities. The niger meal is the main protein supplement for livestock in Ethiopia. It is used especially in sheep and goat diets for growth, milk and cattle diets. There is only one study on use of niger in fish diet. The protein content of niger (34%) is high. In terms of chemical composition, niger meal, which are similar to sunflower meals. Compared with the mineral content of niger and sunflower seeds, the contents of magnesium and sodium are in sunflower seeds and iron content is higher in niger seeds. However, niger oil meal contains high percentage of cellulose (20%) and ash (10%). The percentage of cellulose in dehulled niger meal decreases by 2%, the fat and protein ratios increase. The niger seed is a very rich seed with linoleic acid content and essential amino acids. The most important advantage of the niger cultivation is its ability to grow in marginal areas with extremely low input costs. As a result, It has the potential to be cheaper oil source and raw feed material for suitable countries for cultivation. The preliminary study on cultivation of niger has been begun in our country.

Keywords: niger seed, *Guizotia abyssinica*, chemical contents, animal feed

Thermal Tolerance of Turkish Crayfish (*Astacus leptodactylus*) Fed Different Dietary Vegetable Oil Sources

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Objective: The aim of this study was to investigate the effects of four dietary vegetable oils on thermal tolerance of *A. leptodactylus*.

Methods: Juvenile Turkish crayfish averaging 24.14 ± 0.23 g (SD) were captured from the Keban Dam Lake. Each group was then acclimated to 21 °C in thermostatically controlled tanks at a rate of 1 °C increase or decrease per day. The animals were cultured at the respective temperatures for a period of 60 days prior to the onset of the experiment in round fibreglass tanks in order to stabilize their physiology and allow metabolic compensation. Crayfish (20-25 g) were fed twice a day (09.00, 17.00) by 2% of biomass with five different isonitrogenous and isolipidic diets, containing 35% protein and 8% lipid. The composition of the experimental diets was the same except for the lipid source and including protein primarily from soybean meal and solvent-extracted menhaden fish meal (FM). As lipid sources, fish oil (FO), peanut oil (PO), cottonseed oil (CSO), linseed oil (LO) and hazelnut oil (HO) were added to the basal diet at a level of 7%. Following 60-days culture period, each diet-group was divided into two groups to determine the critical thermal minimum (CTMin) and the critical thermal maximum (CTMax) in separate trials. The CTM tests were conducted in rectangular plastic containers (0.8 m x 0.35 m x 0.5 m) containing thermostatically controlled water baths. Three containers were allocated for each acclimation group and 5 crayfish were randomly allocated to each container. During the experiment, the crayfish were not fed. Continuous aeration was provided to all containers to maintain dissolved oxygen above 5 ppm. The trials were separately conducted at two cooling or heating rates of 0.3 °C min⁻¹. CTMin or CTMax was determined as the sublethal thermal point at which locomotory movements became disorganized and crayfish lost the ability to escape from conditions, which ultimately lead to death. The CTMin and CTMax values were calculated as the arithmetic mean of the collective endpoint of individuals of random sample of crayfish.

Results and Discussion: The CTMin and CTMax values dropped down to 0.5°C or went up to 40.1°C when the juveniles were fed vegetable oil-based diets ($P < 0.05$). At the heating/cooling rate of 0.3°C/min, the CTMin values ranged between 0.5 and 1.5°C, while the CTMax values ranged between 38.1 and 40.1°C. Our study has demonstrated that tolerances to extreme temperatures of crayfish which were fed on LO or HO for 60 days could significantly be enhanced but increased tolerance to low temperatures was more evident in this respect.

Keywords: thermal tolerance, CTMin and CTMax, vegetable oil, *A. leptodactylus*.

Fatty Acids Composition of *Alburnus chalcoides* Güldenstädt “Caspian shemaya” or “Koli mahi” Meat

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Objective: In this study, it is aimed to determine fatty acid compositions of total lipids in the muscle of *Alburnus chalcoides* Güldenstädt by gas chromatography-mass spectroscopy.

Methods: The species of samples were characterized in department of pharmacognosy of Guilan pharmacy faculty. White muscle was separated from the skin and the red muscle. The white muscle was homogenized. Total lipid extraction was performed according to the method of Hamed et al. A chloroform and methanol mixture (2:1) was used for extraction. By using of hexane fatty acid methyl esters (FAMES) of the white muscle was extracted and analyzed by gas chromatography with a HP-5MS capillary column (phenyl methylsiloxane, 25 m, 0.25 mm i.d.). Identification of the fatty acids was done by comparing the mass spectra. Results were expressed as FID response area relative percentages.

Results and Discussion: The total single fatty acid (SFA) and total monounsaturated fatty acid (MUFA) percentages of the Caspian shemaya total lipid are 17.84% and 42.4% respectively. Oleic acid (18:1 ω 9) was the main MUFA in Caspian shemaya. This was followed by palmitoleic acid (16:1 ω 7) and then 9-eicosenoic acid (20:1 ω 11). The total polyunsaturated fatty acid (PUFA) percentages of the Caspian shemaya are 38.99% which arachidonic acid (20:4 ω 6) constituted the dominant compound among the Caspian shemaya PUFA. This followed by linoleic acid (18:2 ω 6) and eicosapentaenoic acid (20:5 ω 3) which these results are congruent with previous reports about C20:5 ω 3 and 18:2 ω 6 values for freshwater fishes. The amounts and balance between ω 3/ ω 6 fatty acid in diet will affect the eicosanoid-controlled functions in human body. Many of the pathological conditions such as atherosclerosis, neurodegenerative, inflammatory diseases as well as risk of cancers correlated with human dietary ω 3/ ω 6 fatty acid ratio. An increase in this ratio could be help for prevention of coronary heart, neurodegenerative, inflammatory diseases also reduce the risk of cancer. The present study suggests that *A. chalcoides* “Koli mahi” is preferable sources for arachidonic acid (20:4 ω 6) and oleic acid (18:1 ω 9). However, *A. mossulensis* and *L. abu* are not good sources of ω 3 fatty acids. In addition, *A. chalcoides* is a good sources of ω 6 polyunsaturated fatty acids.

Keywords: *Alburnus chalcoides* Güldenstädt, muscle, fatty acids.

Fish Species of Caspian and Ponto-Caspian Region as a Valuable Source of Unsaturated Fatty Acids

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Objective: The aim of this review is to present a compression between fatty acid compositions of different important fish of Ponto-Caspian region. Gobies species are widespread throughout the Ponto-Caspian particularly Caspian Sea. However these fish constituted the major number of the Caspian Sea species but negligible researches have been conducted about potential of them. Among the important genus of Gobies, *Benthophilus* has massive diversity and constituted the major of endemic species of the Ponto-Caspian region.

Introduction: Preventive effects of polyunsaturated fatty acids (PUFA)'s in many human diseases such as arterial, neural, inflammation and immune system disorders caused more attention for finding new polyunsaturated fatty acids sources specially between marine sources. Fisheries industries are very important between Caspian countries. Some of the most commercially valuable fish of the Caspian Sea include sturgeons, Persian sturgeon (*Acipenser persicus*), beluga (*Huso huso*) and the starry sturgeon (*Acipenser stellatus*). Other species, Fringebarbel sturgeon (*Acipenser nudiventris*) pollution severely decline and presently only fished in Kazakhstan. Another commercially important genus is *Alosa* (herring or shad) particularly black-spined herring (*Alosa kessleri*), Caspian marine shad (*Alosa brashnikowi*), Anzeli shad (*Alosa caspia*). Some of salmon species found in the Caspian Sea include *Salmo caspius* and *S. ciscaucasicus* which used for commercial purposes. These species population migrate to the southwestern coasts in order to feed and remain in depth of waters. Several with fish include some *Rutilus* species. *Rutilus frisii* can be split into western and southern of the Caspian Sea. *R. lacustris* and *R. rutilus* more observed in North region of Caspian Sea.

Conclusion: Fish are the best source of ω -3 fatty acids including eicosapentaenoic acid (C20:5 n-3) and docosahexaenoic acid (C22:6 n-3). Although it is cleared that PUFA compositions difference among fish species, little attention has been paid to the composition of different species when selecting fish as a source.

Keywords: Polyunsaturated fatty acids, Ponto-Caspian Region, fish.

Crude Protein Contents of Three Fish Species from Ataturk Dam Lake

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Objective: In this research, it is aim to search protein levels of three fish species, grass carp (*Ctenopharyngodon idella*, Valenciennes, 1844), trout barb (*Capoeta trutta*, Heckel 1843), and Prussian carp (*Carassius gibelio*, Bloch 1782), from Ataturk Dam Lake.

Methods: Crude protein content was calculated by using nitrogen content obtained by the Kjeldahl method. A conversion factor of 6.25 was used for calculation of protein content (Anonymous, 1992).

Results and Discussion: Protein levels of grass carp (*Ctenopharyngodon idella*, Valenciennes, 1844), trout barb (*Capoeta trutta*, Heckel 1843), and Prussian carp (*Carassius gibelio*, Bloch 1782) were calculated in this current study. Of the three fish, grass carp had the slightly higher protein value (19.84%) comparing the two other fish. The levels of trout barb and Prussian carp were found to be 18.14% and 18.46%, respectively. Even though protein levels of these fish were slightly differed from each other, differences were found to be statistically significant ($P < 0.05$) between trout barb and grass carp. No significant differences were observed Prussian carp to others ($P > 0.05$). In conclude, all three fish used in this study can be considered a good source of protein people around the lake.

Keywords: Protein levels, *Carassius gibelio*, *Ctenopharyngodon idella*, *Capoeta trutta*

The Processing of Freshwater Fish Species in Turkey

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Objective: The objective of this review was to discuss processing of the species of freshwater fish which have been living in inland waters of Turkey. The amounts of aquacultured freshwater fish species and processing technologies types of these freshwater fish species were also explained.

Methods: Large amounts of freshwater fish species have been found in freshwaters in Turkey. The species of aquacultured fish and processing technologies of freshwater fish species were cleared by giving literatures.

Results and Discussion: In Turkey the most popular freshwater fish species are *Cyprinus carpio*, *Barbus barbus*, *Salmo trutta*, *Tinca tinca*, *Sander lucioperca*, *Silurus glanis*, *Anguilla anguilla* etc. These freshwater fish are mostly consumed as fresh in Turkey. Some of freshwater fish are also produced by aquaculture such as rainbow trout. Rainbow trout are consumed as fresh chilled, frozen and smoked in Turkey commonly. Smoked rainbow trout are also exported to the other countries. This species are evaluated as marinated and minced (fish ball & burger) fish also. *C. carpio* are mostly consumed as fresh. They are also consumed as fried and stuffed in Turkey. *T. tinca* are used as fresh. *A. anguilla* are used as fresh, frozen, smoked, salted, marinated and canned. *S. lucioperca* are used as fresh, frozen, salted. *S. glanis* are consumed as fresh, frozen and canned. In this review; processing technologies of freshwater species in Turkey and in another countries were discussed by using literatures. Production of fish pate from *S. lucioperca* and *T. tinca* was studied. The effects of thyme oil concentration on liquid-smoked vacuumed rainbow trout was studied. Production of Fish Chips & fish finger from *Atherina boyeri* was made. Fish crackers were made from *Carassius gibelio*. Fish skin collagen was extracted from different freshwater species.

In conclusion; In lights of above studies and informations new fishery products and by-products should be produced from freshwater fish species. New fishery products should be introduced to Turkish people and they also should be sold in Turkish markets. Many freshwater fish species are found in freshwaters. Some freshwater species are harvested large amounts. Some of these freshwater species are consumed in Turkey or they are exported to the other countries without being applied processing. Some of these freshwater fish species are not consumed in Turkey. It is very important that all the freshwater fish species should be utilized for Turkish economy. It is recommended in this review that the freshwater fish species, which have not been utilized as fresh, should be evaluated by processing technologies.

Keywords: freshwater, freshwater fish species, processing, Turkey

Fatty Acid Contents of Some Freshwater Fish from Anatolia: A review**Ayşe Özyılmaz, Ece Kılıç, Sevil Demirci***Iskenderun Technical University, Faculty of Marine Science and Technology, Iskenderun- Hatay, Turkey.*

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Objective: This research was undertaken to get general perspective of freshwater fish widely consumed in Anatolia.

Introduction: A healthy life starts with healthy diet which needs to be include fish. It is considered to be healthiest food and best source of fatty acids such as omega-3 fatty acids, which are crucial for health. They help body, brain function optimization and, reduce the risk of many diseases such as heart attacks and strokes. The docosahexaenoic acid (DHA, C22:6n3) and eicosapentaenoic acid (EPA, C20:5n3) are the main two omega-3 fatty acids which found in fish.

Conclusion: In this review, in addition to DHA and EPA levels, ARA, SFA, MUFA, and PUFA levels of from previously studied freshwater species collected from various lakes with 114 sampling data were investigated. The average ARA, EPA, DHA, SFA, MUFA and PUFA levels are 4.28%, 5.46%, 12.22%, 28.56%, 31.98% and 33.66%, respectively. Additionally, the levels of ARA, EPA and DHA were varied within the range of 0.06%-11.22%, 0.19%-20.91%, and 0.74%-29.65%, respectively. This wide change interval indicates that fatty acid profile of fish changes depending on the species, habitat and season. To conclude, fish is a good source of omega-3 fatty acids and should be consumed in order to get health benefits.

Keywords: Freshwater fish, fatty acid, DHA, EPA, omega-3

The Role of the Lakes Region in the Fish processing Sector of Turkey

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Objective: In this study, it was aimed to evaluate the role of Lakes Region in the Fish Processing sector of Turkey.

Methods: Many of the facilities in the Lakes Region were visited on site and information was obtained. Technical, physical, administrative and operational information about the fish processing plant has been obtained and evaluated.

Results and Discussion: A total of 18 fish processing plant are located in the Lakes Region. The numbers of Fish processing Plants as follows: 6 in Konya, 3 in Isparta, 4 in Afyon and 5 in Antalya. There is no fish processing plant in Burdur. A lot of them have been found to have an export permit. It has been determined that about 50% of the processed products are composed of freshwater fishes, and the other 50% are marine fish, crayfish and land snail. In terms of product distribution, the highest level frozen fillet, fresh chilled vide and canned crayfish processes are produced in these processing plants. The processing plants in the Lakes Region make up about 9% of the processing plants of Turkey. Significant amount of seafood is produced in the Lakes Region and the region has a large share in the processing sector of Turkey.

Keywords: Fish processing, Lakes Region, Turkey, seafood Sector, Role

Evaluation of Microalgae as Carotenoid Source in Food Technology

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Objective: In this review, the possibilities of using carotenoids isolated from microalgae were investigated in food technology.

Introduction: Carotenoids, one of the natural coloring agents, are an important pigment and antioxidant source of choice for foods. Carotenoids in the class of oil pigments can only be produced by plants, algae and a limited number of fungi and bacteria.

Conclusion: When the sensory characteristics of foods are taken into consideration, the color plays an important role in terms of consumer preferences. The preference of foods by producers depends on acceptance or rejection of their colors. So, coloring additives are used in order to maintain the sensory and quality properties of foods.

According to the obtained forms, the coloring additives are separated into two main groups: natural and artificial. The use of natural coloring materials is increasing due to the adverse health effects of artificial color additives used in food for many years. And these natural pigments are not only a source of color but also useful for health. In addition to they contain some protective compounds.

Microalgae are microscopic organisms that live in water and can passively displace with the movement of water. When microalgae are compared with plants, they are seen as potential organisms in the production of carotenoids. Because microalgae can be grown more easily and quickly and synthesized carotenoids in high amounts such as *Spirulina*, *Chlorella*, *Scenedesmus* and *Dunaliella* spp.

Keywords: Carotenoids, microalgae, food additives, natural pigments

Human health risks from heavy metals via consumption of *Capoeta trutta* from the Keban Dam Reservoir, Turkey

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Objective: Fish is a very important part of a healthy human diet as it is an excellent source of high quality proteins and is rich in omega-3 polyunsaturated fatty acids, essential elements and liposoluble vitamins. However, fish can also contain certain environmental contaminants, such as heavy metals, PCBs, pesticides, dioxins and PAHs, which may have harmful effects on human health. In this study, the concentrations of ten heavy metals (As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn) were investigated in the muscle tissue of trout barb (*Capoeta trutta*) collected from the Keban Dam Reservoir.

Methods: In the present study, eleven sampling sites were selected on the Keban Dam Reservoir. At sampling sites, trout barb individuals were caught using gill nets. Immediately after collection, fish samples were transferred to the laboratory and they were dissected to obtain muscle tissues. Concentrations of As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn were determined in muscle tissue of trout barb. For this, 1.0 g of previously homogenised muscle sample was digested in teflon vessels with $\text{HNO}_3 + \text{H}_2\text{O}_2$ in a microwave digestion unit. After cooling to room temperature, the digested sample solutions were transferred into polyethylene flasks and adjusted to 50 mL with ultrapure water. Concentrations of ten metals in extracts were determined by using an atomic absorption spectrometry.

Results and Discussion: The levels of heavy metals in trout barb were below the maximum permissible levels set by international food standards. From the human health perspective, the estimated daily intake value of each metal was much lower than the respective tolerable daily intake. The target hazard quotient (THQ) values for individual metal and the total THQ values for combined metals were lower than 1, indicating no health risk for humans. The cancer risk value for inorganic As was within the acceptable lifetime risk range of 10^{-6} and 10^{-4} , which does not pose any potential carcinogenic health risk to the consumers. In conclusion, this study revealed that the consumption of trout barb in the Keban Dam Reservoir is safe for consumers.

Keywords: Human health risks, heavy metals, trout barb, Keban Dam Reservoir

Extraction and Purification of Hydrolytic Lipase Enzyme from the Visceral Organs of Trout (*Oncorhynchus mykiss*) and Determination of their Functional Characteristics

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Objective: Fish intestines as a source of digestive enzymes have wide biotechnological potential. In particular, digestive proteases can be specific for industrial applications and produce new bioactive molecules, it also provides a potential source for basic research. Wastes from fish internal organs in large quantities in the fishing industry cause environmental problems. In fact, these wastes constitute a potential source for the production of various enzymes with specific properties for basic research and industrial applications. In this study, it was possible to recover lipase from fish internal organs so as to minimize ecological problems and economic losses caused by processing waste and also can be used in various industrial areas. This study describes the extraction and purification procedure and some functional characterisation of hydrolytic lipase enzyme from Trout viscera.

Methods: Internal organs were precipitated by ammonium sulfate and acetone then extracted lipase in liquid form dried by lyophilizer and lipase was investigated by sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) with a molecular weight of about 74 kDa. Optimum pH and temperature were determined as 8.0 and 37 ° C, respectively, using p-nitrophenyl butyrate (p-NPB) as the substrate. Surfactants such as sodium dodecylsulfate (SDS), Triton X-100 and Na-taurocholate have been shown to act as inhibitors on lipase activity. The hydrolytic activity of the enzyme was increased by Ca + 2, while slightly inhibiting with the presence of Cu + 2 salts as well as EDTA, but was inhibited strongly by Zn + 2 and Hg + 2 heavy metals.

Results and Discussion: Hydrolytic lipase enzyme was purified from Trout (*Oncorhynchus mykiss*) viscera. Biochemical characterisation of Trout hydrolytic lipase enzyme showed that this enzyme can be used as a possible biotechnological tool in the fish-processing and food industries.

Keywords: trout, fish internal organs, lipase, enzyme, characteristics.

Extraction and Purification of Hydrolytic Trypsin Enzyme from the Visceral Organs of Trout (*Oncorhynchus mykiss*), and Determination of their Functional Characteristics

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Objective: The digestive tract of fish in general is rich of hydrolytic enzymes, and internal organs are an important source of digestive enzymes such as proteases. These enzymes have a high potential in use of additives for different industrial products, they are especially used to improve the production of food products, quality, resolution and durability. Internal organs are considered as waste, in large quantities in the fishing industry, this means an ecological and economical loss cause. This study describes the extraction and purification procedure and some functional characterisation of trypsin from Trout viscera.

Methods: In this study; Trypsin was purified from frozen internal organs of trout which is one of the most common specie in Turkey. Trypsin was purified with ammonium sulfate and acetone precipitation and migrated as a single band using both sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE) and molecular mass was identified. Trypsin migrated as monolithic (single) band using polyacrylamide gel electrophoresis (SDS-PAGE) and native-PAGE, the molecular mass was determined to be 28 kDa. The optimal pH and temperature for the hydrolysis of benzoyl-DL-arginine-p-nitroanilide (BAPNA) were 9.5 and 55 ° C, respectively. Enzyme was stable at temperatures above 40 ° C until 70° C; stable on wide pH range (7 to 12), while variable on acidic pH. Enzyme inhibited by some specific trypsin inhibitors; (SBTI), N-p-tosyl-L-lysine chloromethyl ketone (TLCK), the serine protease inhibitor phenylmethyl sulphonfluide (PMSF) CaCl₂. At 40 ° C, the trypsin was partially protected against loss of activity, but NaCl (0 to 30%) reduced the activity depending on the concentration. So it can be pointed out that raw protease is a perfect candidate to be a biocatalyst for detergent, food, pharmaceutical and environmental applications.

Results and Discussion: Trypsin was purified from Trout (*Oncorhynchus mykiss*) viscera. Biochemical characterisation of Trout trypsin showed that this enzyme can be used as a possible biotechnological tool in the fish-processing and food industries.

Keywords: trout, fish internal organs, trypsin, enzyme, characteristics.

Biochemical Composition of *Capoeta barroisi* Lortet, 1894 Caught by Gillnet in Seyhan River

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Objective: In this research, it is aim to investigate some biochemical compositions (moisture, lipid level, and fatty acid profiles) of *Capoeta barroisi* named siraz or zertzuri in Turkish and orontes scraper or Tigris barb in English, is a cyprinid family member, an endemic, and endangered fish species in Seyhan River, Adana/Turkey.

Methods: A GC-MS (Gas Chromatography-Mass Spectrometry) was used to determine fatty acids of the fish flesh. Moisture content was determined by drying an accurately weighted sample of minced fish flesh in a drying oven at 105 °C for 24 h (commission of European Communities EE, 1979). The crude lipid was determined on a 10 gr. sample of the minced fish fillets using the chloroform-methanol extraction procedure of modified Bligh & Dyer.

Results and Discussion: Orontes scraper is an economically important fish species and constitute a considerable amount of landings, by volume, in Seyhan River, Adana/Turkey. The average moisture and lipid levels of the orontes scraper was calculated to be 77.69±0.83% and 2.13±0.165, respectively. Additionally, the average levels of eicosapentaenoic acid (EPA, C20:5n3) in orontes scraper's lipid was found to be higher than that of docosahexaenoic acid (DHA, C22:6n3) which was very closer to that of

arachidonic acid (ARA, C20:4n6). The C16:0, C18:0 in saturated fatty acids (SFA), C16:1, C18:1n9, C18:1n7 in monounsaturated fatty acids (MUFA), and ARA, EPA, DHA in polyunsaturated fatty acids (PUFA) were found to be major fatty acid in lipid of orontes scraper.

Keywords: *Capoeta barroisi*, zertzuri, siraz, Orontes scraper, Turkey

Fish&Bread, Could Be Rise Fish Consumption?**Aysu Besler***Department of Biology, Science Faculty, Muğla Sıtkı Kocman University, Kötekli-MUĞLA*

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Objective: The aim of this study is to collect information about consumption of fish&bread as a fast-food and also obtain the cooking methods of fish for it.

Introduction: Today, consumers tend towards foods which usually ready to eat things, cooked quickly like in the form of fast-food. To this end, fish&bread a healthy food contains the several food items (lettuce, onion, spicy etc) which could be chosen by an individual who could prefer what should be included in fish&bread. In our country, annual fish consumption per capita is reported as 6.5 kg in 2014. According to other countries consumption seem quite low. As an option, fish consumption can be rise by making food chains of fish&bread all over the country.

Fish species and cooking: In general, the preparing of the fish&bread, imported fish (mackerel and cod (haddock)) preferred because they do not have small bones and also have more flesh. Grilling and frying in hot-oil methods have been applied for cooking of fish species. Fish& bread could be prepared according to the individual's wishes, using corn flour or white flour bread, vegetables and special sauces, even the fish species.

In conclusion, Fish&Bread is a valuable and healthy diet which has a great nutritional value and also ready-to-eat food for the whole age groups. It might be suggested that it is neglected food among processed products and needed more studies to create new alternative cooking or favoring methods. I believe that if we improve the fish&bread as a food sector it will help to increase fish consumption in Turkey.

Keywords: fish&bread, fish consumption, consumers, cooking methods.

Antimicrobial Effects of Sage, Thyme and Rosemary on the Sous Vide Cooked Rainbow Trout

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Objective: In this study, it is aimed to determination antimicrobial effect of sage, thyme and rosemary on the sous vide cooked rainbow trout (*Oncorhynchus mykiss*).

Methods: The fish has brought to laboratory in the hygienic conditions, and filleted. The grounded sage, thyme and rosemary were applied to the filleted surface, vacuum packaged, and sous vide cooked. For the microbiological analyses, in the hygienic condition, 10 g fish meat was weighed than 90 ml peptone water was added and homogenized in the stomacher for 60 seconds. Other dilutions were prepared in this dilution, respectively, and inoculated as 1 ml into petri dishes. Total mesophilic and psychrophilic aerobic bacteria counts analyses were made pour plate method by using PCA. *Enterobacteriaceae* counts analyses were made pour plate method by using violet red bile agar. Purple centered colonies were counted after the incubation in the 37°C for 48 h. Also, for the lactic acid bacteria, MRS agar and pour plate method was used. The analyses were repeated every 5 days.

Results and Discussion: In our study, the value of total mesophilic aerobic bacteria count (\log_{10} cfu/g) is 3.32 ± 0.074 for control group, whereas for the sage, rosemary and thyme is 3.23 ± 0.02 , 3.25 ± 0.10 and 3.12 ± 0.03 respectively. But, at the end of storage (40th days), those value determined as 6.90 ± 0.11 for control group, and for others as 6.77 ± 0.08 , 5.77 ± 0.13 , and 5.21 ± 0.11 respectively. On the other hand, the total psychrophilic aerobic bacteria counts (\log_{10} cfu/g) were determined at the end of storage period for control, sage, rosemary and thyme as 5.07 ± 0.12 , 4.26 ± 0.23 , 4.22 ± 0.14 , 4.94 ± 0.16 , respectively. *Enterobacteriaceae* counts were determined for the control at the initial and at the end of storage as 2.39 ± 0.21 , 6.13 ± 0.21 . Also, *Enterobacteriaceae* counts of thyme added group were 2.11 ± 0.23 , 4.92 ± 0.13 , respectively. The lactic acid bacteria counts (\log_{10} cfu/g) were determined at the end of storage period for control, sage, rosemary and thyme as 5.22 ± 0.13 , 3.43 ± 0.12 , 4.10 ± 0.13 , 4.07 ± 0.07 , respectively. For the analyses parameters, the value of control group always higher than all of group value at the end of storage.

Keywords: Microbiology, PCA, VRB, MRS, plate count

Microbiological Characteristics of Sous Vide Method in Fisheries Processing

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Objective: In this review, the microbiological characteristics of sous vide method used in the studies previously were reviewed, which it used like as rainbow trout and pike perch processing studies in our country.

Introduction: The sous vide method differs to the traditional cooking method due to raw food material fill in the plastik bag, vacuum packaging and cooking by the way controlled heating. Vacuum packaging avoids evaporation losses of moisture and volatile flavor components during cooking and limits the formation of undesirable flavors resulting from oxidation (Church and Parsons, 2000). This case is formed especially in the delicious and nutritious foods (Ghazala et al., 1996; Schellekens, 1996; Church, 1998; Creed, 1998; García-Linares et al., 2004; Stea et al., 2006). Vacuum packaging also reduces bacterial growth and allows heat energy to be effectively transported from water (by the way vapor) to food (Baldwin, 2008). This method was applied to freshwater fish species like as the rainbow trout (Çetinkaya, 2012), and pike perch (Çağlak et al., 2017) in our country.

Conclusion: As a consequence of the inadequate production conditions for both inland water fish and marine fish, inadequate pathogenesis of the applied pasteurization process and low microbiological quality of the raw materials will pose a danger to consumer safety (Kılınç and Çaklı, 2001). For this reason, health conditions require a high level of supervision during the production period, storage period and final preparation period (Stranks, 2007).

Sous vide term means the foods is packaged in vacuum in airtight bags of food then cooked at low temperature and for a long time. Sous vide cooking method, which reported has been apply to fisheries products and other meat products, fruits and vegetables in all over the world, a different product is supplied which is easy to prepare to consumption or ready to eat and has an extended shelf life (Oliveira, 1995). It has been reported, by the pasteurization applied during the production stage of the products prepared by the vacuum packed cooking method, could be prevent the microorganisms, which might cause undesired and poisoning effects in food, (like as *Clostridium botulinum*, *Bacillus cereus*, *C. perfringens*, *Staphylococcus aureus*, *Salmonella* sp., *Vibrio parahaemolyticus* etc.) (Creed and Reeve, 1998). Nilsson and Gram (2002) reported that, in the sous vide cooked fisheries products *C. botulinum*, *L. monocytogenes*, *S. aureus*, *E. coli*, *Salmonella* spp., and *Vibrio* spp. would be highly hazardous for human health.

Keywords: *Clostridium botulinum*, *Bacillus cereus*, *Staphylococcus aureus*, *Salmonella* sp.

The Effects of Some Herbs on Sous Vide Cooked Rainbow Trout Fatty Acids

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Objective: In this study, the rainbow trout was cooked by used sous vide method. Also, the antioxidant effects were known sage, rosemary, thyme were used to determination the effects on the fatty acids.

Methods: The rainbow trout was filleted. Grinded dust sage, rosemary and thyme were applied to fillets surface, vacuum packaged, and sous vide cooked. Fatty acids analyses were conducted to control group, sage group, rosemary group, and thyme group. The GC Clarus 500 (Perkin–Elmer, USA) equipped with FID, and silica SGE colon (30 m x 0.32 mm IDx0.25 µm, BP20 0.25 UM, USA) was used. The injector and detector temperatures were set at 220°C and 280°C, respectively. The oven temperature was held at 140°C for 5 min, then increased to 200°C at 4°C/min and finally to 220°C at 1°C/min. The carrier gas was helium and controlled at 110 kPa, and the Split ratio used was 1:50. Fatty acids were defined by comparing the retention times of FAME with the standard (Supelco 37 FAME MIX. Catalog No: 18919-1 AMP). The results were expressed in GC area (%) as mean values and ± standard deviation

Results and Discussion: In the conducted analyses, 20 different fatty acids were determined. 6 of all of them were saturated fatty acids (Laurik Asit (C12:0), Myristic acid (C14:0), Palmitic acid (C16:0), Heptadecanoic acid (C17:0), Stearik asit (C18:0), Arachidonic Acid (C20:0)). Mono unsaturated fatty acids counts were determined as 7 (Myristic acid (C14:1), Palmitoleic acid (C16:1), Cis-10-Heptadecenoic acid (C17:1), Vaccenic acid (C18:1n7), Cis Oleik asit (C18:1n9), Eicosenoic asit (C20:1n9), Erucic acid (C22:1n9)). Also, it was determined 7 of all fatty acids were poly unsaturated (Linoleic acid (C18:2n6), Linolenic asit (C18:3n3), Eikosadienoik asit (C20:2cis), Dokosadienoik asit (C22:2cis), Arakhidonik asit (C20:4n6), Eikosapentaenoik asit (C20:5n3) (EPA), Dokosaheksaenoik asit (C22:6n3) (DHA)). When the total values of undefined fatty acids were examined, the highest values for all product groups were obtained in the control group. The ratio of poly unsaturated fatty acids was higher in the all unsaturated fatty acids. Also, totally unsaturated fatty acids ratio was higher than total saturated fatty acids ratio.

Keywords: Sage, rosemary, thyme, SFA

Antioxidant Capacities of Rainbow Trout Hydrolysates Obtained with Different Enzyme Profiles

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Objective: In this study, it is aimed to determine of antioxidant capacities of rainbow trout hydrolysates obtained with different concentrations of Flavourzyme and Alcalase.

Methods: Fish samples were bought from supermarket and immediately filleted at laboratory. Hydrolysis process was carried out according to Bougateg et al. (2010) with standard procedure steps of homogenization and inactivation of endogen enzymes. Optimal conditions were set as pH 8.0/50°C for Alcalase and pH 7.0/50°C for Flavourzyme during 3 hours operation, then heated again to stop enzymatic activation. After centrifugation, liquid phases were separated and lyophilized. DPPH (1,1-diphenyl-2-pic-ryhydral) analysis was carried out according to Yen and Wu (1999) and metal chelating activity determination was done according to Chung et al. (2002).

Results and Discussion: According to DPPH data, the hydrolyzate obtained with Alcalase yielded higher results than Flavourzyme. The Alcalase group with 2% concentration has the highest DPPH activity while the 2% Flavourzyme group has the lowest activity. With higher concentration of enzyme, activity of Alcalase was increased and Flavourzyme was decreased. DPPH radical scavenging activities for the four groups were determined between 85 and 90%. Metal chelating also plays a role in antioxidant activity determination by inhibiting free iron which causes oxidation. There were no statistical difference between chelating capacities with different concentrations of same enzymes used for hydrolyzate production ($p < 0.05$). All chelating activities lower than %70 were detected with Alcalase and the rest with Flavourzyme. The Flavourzyme group with a concentration of 2% has the highest chelating activity with 75.2%. In contrast, Alcalase 2% group has the lowest iron ion chelating activity in the study with 67%. With increased enzyme concentration, the activity of Flavourzyme increases where Alcalase activity decreases. It's ongoing study and results of other enzyme profiles will be given on poster presentation.

Keywords: Rainbow trout, hydrolysate, antioxidant, enzyme.

Giant Spring Minnow 's (*Pseudophoxinus anatolicus* Hanko, 1925) Meat Yield Determination According to the Gender Change

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Objectives : In this study, were investigated the differences in meat yield according to the genders of Dev Spring Minnow (*Pseudophoxinus anatolicus* Hanko, 1925), which is endemic in Anatolia.

Methods : The samples were obtained from 5 fishing operations using fish pinter, multifilament pannier mesh and electro-choker from the source located in Konya Province Seydisehir District Kuğulupark region in February, March, April and May of 2015 and 2016. The total weights, visceral weights, head weights, fin weights, fillet weights, skin weights and skeleton weight of fishes were determined on a 0.01 g precision scale. During the evaluation period, the weights of the different body parts are proportional to the total weight. One-way ANOVA was used to determination of whether the weight of the body part varies between the genders.

Results and Discussion: In this study; fork length between 4.2 and 21.3 cm and total weights between 0.98-160.97 g 16 female, 35 male fish and 67 juvenile were used. It was detected the ratio of viscera, head, fin, skin, skeleton and fillet weight to total weight (%), respectively; 14.11, 20.25, 2.47, 5.44, 9.83, 39.25 in females; 10.87, 19.12, 2.72, 6.72, 11.21, 38.00 in males and 9.73, 20.86, 2.13, 6.91, 11.31, 34.85 in juvenile group. Visceral, head, fins, skin and fillet rates show the differences between gender groups ($p < 0.05$); there was no differences between the skeletal weights ratios ($p > 0.05$). As a result, it can be said that the meat yield of the Giant Spring Minnow's is equally or higher than the other freshwater fishes.

Key Words : Giant Spring Minnow, *Pseudophoxinus anatolicus*, meat yield, fillet, endemic

Acknowledgements: The samples used at this study are provided from the preliminary study of TAGEM/HAYSUD/2016/A11/P-01/1 project of Fisheries Research Institute

Study on the Level of Knowledge Among Consumers in Osmaniye Province Regarding Seafood Safety and Consumption

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Objective: This study aims to identify the fish consumption behavior and preferences, and the approach towards seafood with regards to food safety among inhabitants of Osmaniye province.

Methods: The material for this 2015 study is comprised of the data collected as a result of a survey conducted with a total of 399 people living in Osmaniye province

Results and Discussion: According to analysis results, 78.4% of the survey participants in Osmaniye province stated that they consume fish. Frequency of fish consumption is mostly on a monthly basis, and it centers around winter months. The annual amount of fish consumption in the province was found out to be 6.1 kg per capita, which is below the national average of Turkey. In the province where 82.4% of the participants consume fish when it is fresh, their preferred cooking methods are grilling (32.3%) and frying (65.2%). The rate of consumption of processed seafood was recorded as 12.1%. Anchovy is the preferred saltwater fish of 63.9% of participants, while 33.2% prefer rainbow trout as freshwater fish. It was observed that 86.3% of married consumers and 13.7% of single consumers consume fish. The highest rate of fish consumption was observed in the 32-38-year-old age group (31.7%) with regards to age, and in participants with an associate degree (47.8%) with regards to level of education. Concerning food safety, it was found out that consumers always check the expiry date when buying seafood. Participants indicated radio and television shows as their principal source of information about food safety. Majority of survey participants believe that Ministry of Food, Agriculture and Livestock bears the main responsibility in ensuring food safety. With this study, it was found out that consumers have a high level of awareness regarding food safety.

Keywords: Seafood, fish consumption, consumption behavior, food safety, survey, Osmaniye

Depuration Treatments for Shellfish Before Marketing Stage

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Objective: Depuration is very important process for removing microbial contaminants from shellfish before human consumption. This study is a review article which is include importance of depuration and its systems before marketing of shellfish species.

Introduction: Shellfish are very important food source for human consumption in many countries. Therefore, commercial value and popularity of these species have been increasing dramatically day by day. Bivalve species are distributed in marine and freshwater ecosystems and play very important role due to filtering large volumes of water. They remove large quantities of suspended material such as non-toxigenic/toxigenic micro-algae, pathogenic bacteria and viruses from the water and these pathogens have been shown to be 100 times greater in bivalves than in the water column. Therefore, shellfish have to be purified before human consumption.

Importance of depuration: Depuration is a controlled process that relies on the ability of shellfish to purge their gastrointestinal contents by filtering clean water. Depuration technics apply in many countries for the removal of contaminants from shellfish. For human consumption of shellfish, contaminants such as bacteria and viruses have to be reduced edible level so this step is very important for the shellfish marketing. This method is a very effective process and relatively fast for the elimination of faecal bacteria, such as *Escherichia coli*, but is less effective for naturally occurring *Vibrio* spp. At the same time, depuration is not suitable for shellfish harvested from more heavily contaminated and/or subjected to contamination by hydro-carbons, heavy metals, pesticides, or biotoxins.

Depuration systems: It is important for effective shellfish depuration that the water disinfection system used is capable of inactivating contaminants. Although there are three fundamental methods such as chlorine, ultraviolet and ozone for water treatment, the use of iodophore is limited in some depuration plants. Early depuration experiments utilised calcium hypochlorite as a seawater disinfection agent. Chlorine is effective bacteria but there are concerns with its effectiveness against viruses. For the purposes of depuration, 2 to 3 mg/l free chlorine is normally used for a contact time of up to an hour. Ozone is very effective at inactivating both bacteria and viruses. Ozone at a concentration not exceeding 0.5 mg/l can be used to treat seawater in batches for periods up to 10 minutes. Disinfection of depuration water by Ultraviolet (UV) radiation has the advantage of producing few residuals in the water that may contaminate the shellfish. It is for this reason that the US Food and Drug Administration (USFDA) prefers UV disinfection to chlorine or ozone and accepted dosage for UV treatment is commonly 30 mW s per cm² for waters.

Conclusion: Depuration efficiency is primarily related to bivalve species, size, siphoning activity, and physiological conditions and also this period may range from several hours to days Depuration is only remove from light to moderate levels of microbial contaminants and cannot be used for heavily contaminated shellfish. After sufficient depuration treatment, shellfish have to be purified from microbiological contents and product standard have to be *E. coli* $\leq 230/100$ g and absence of *Salmonella* in 25 g flesh.

Keywords: Bivalvia, microbial contamination, purification

Investigation of Approaches to the Fisheries Products of People Living in Central District of Şanlıurfa Province

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Objective: This study was conducted to investigate the approaches to the fisheries products, the fish consumption behaviours and effecting factors of people living in Central District of Şanlıurfa Province.

Methods: This study is a public survey research, and in addition to previous studies, to determine the disposition of the people in lower age groups together with adult people, it was concerned the people in every education levels (first, middle and high schools) by concerning “the education system model (4+4+4)” in our country. It was utilized totally 1400 and 350 people in every level.

Results and Discussion: As well as 62 % of individuals attending the study was man, general age range was found higher in 31-40 range (28 %). It was seen that when the consumption amounts of meat kinds were investigated, the chicken meat is in the first place (61 %); fish meat is only in the third place (15 %); the most consumed fish species were common carp (31 %), anchovy (29 %), and rainbow trout (15 %), but, the first species preferred to consume were common carp (31 %) and anchovy (29 %). The fish like rate was 74 %. It was observed that the most important point in the fish buying was fish freshness (42 %); price index (77 %) was concerning while buying; the most part of the attending people consume fish one times in a month (40 %), when the consuming frequency was investigated; fish consuming was the mostly in winter (51 %); and the benefits of fish consuming for the human health were learned a middle level (29 %). When fish cooking methods were investigated, it was determined that the greater part of people preferred frying (58 %), and the grill (34 %) followed it. The rate of people, who prefer not processed products, was high (69 %). The differences of student groups attending the study were raised to their education levels. In the study, conducted in Central District of Şanlıurfa Province, it was determined that the average fish consumption amount per house in a year was mostly 5-10 kg range (27 %), and the average fish consumption amount per person in a year was 3.2 kg. It was concluded that education, organization of seminars, workshops, and entertainments by the related agencies and institutes, nongovernmental organizations will be effective for all folk onwards the school ages to gain fish consumption habits.

Keywords: Şanlıurfa, fish consumption, consumption behaviours.

Acknowledgement: This study contains the results of a M.Sc. Thesis presented in Department of Fisheries, Institute of Science and Technology, Munzur University,

Watercress (*Nasturtium officinale* R. Br.; Brassicaceae) as an Edible Freshwater Plant**Sükran Çakır Arıca, Sevil Demirci, Ayşe Özyılmaz***Iskenderun Technical University, Faculty of Marine Science and Technology, Iskenderun- Hatay, Turkey.*

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Objective: The aim of this study is to assess the nutrient potential of Watercress (*Nasturtium officinale*) an edible freshwater plant. This study is a review.

Introduction: The literature research suggests that many wild edible plants are used for in traditional medicine since ancient times in the World. Turkish flora with more than 30000 plant species is one of the world's richest flora and contains many plants used in traditional medicine. It is known that many wild edible plants are rich in valuable nutrients, vitamins, minerals and some potential compounds such as antioxidants. Recently, there is an increasing interest in the wild edible foods of the Mediterranean region. Some researchers attribute the relatively long lifespan of the Mediterranean people to the type of diet they consume.

Watercress (*Nasturtium officinale*) is an edible freshwater plant called as ıspatan in Mediterranean Region. Researchers reported that the leaves of this plant have diuretic, anti-diabetic and anti-carcinogenic and anti-oxidant effects. In addition, it was reported that, watercress supplementation in the diet reduces serum lipids and alters blood antioxidant status in hypercholesterolaemic rats. Consuming watercress is thought to provide health benefits as a consequence of its phytonutrient composition.

Conclusion: In conclusion, freshwater plants have many discovered potential due to their functional components which are useful for human health. Watercress (*Nasturtium officinale*) is only one of them and need to be researched for possible other benefits.

Keywords: Watercress, *Nasturtium officinale*, Phytonutrients, Brassicaceae, Antioxidant capacity

Non-Thermal Novel Technologies in Fish Processing

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Objective: Fish are excellent sources of protein, vitamin, minerals and polyunsaturated fatty acids. However they are also highly perishable product due to their composition and usually spoil faster than other foods. Therefore, improvements in existing fish processing methods is important to prevent the microbial growth, inhibit lipid oxidation of fish product.

Introduction: Salting, drying, marinating and smoking are mostly used processing techniques for extend the shelf life of fish product. With the increased consumers preference for high quality, safer and fresher product, research on novel non-thermal food processing technologies such as High Hydrostatic Pressure, Pulsed Electric Field, Pulsed Light and Irradiation have been promoted. In order to eliminate undesirable changes during heat treatment, these technologies are receiving much interest.

Conclusion: The current trend in consumers' demand is minimal processed and high quality products. Novel technologies improve the microbial stability and sensory stability of fish as well as their nutritional properties. Non-thermal fish processing technologies can be beneficial for the extension of shelf life with desirable sensorial properties in fish processing. In this review, an overview of non-thermal technologies in fish technology is given.

Keywords: Seafood processing, shelf life, HHP, PEF

The Market Situation Of Smoked Trout Processing Companies In The Aegean And Mediterranean Region Of Turkey

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Objective: The main purpose of the study is to determine the assets and market structure of smoked rainbow trout (*Oncorhynchus sp.*) processing companies in the Aegean and Mediterranean regions.

Methods: There are 17 smoked trout processing companies in Turkey according to the records of the Ministry of Food, Agriculture and Livestock that 65% of these enterprises are located in Aegean and Mediterranean Region. This study is carried out in smoked trout processing companies operating in the Aegean and Mediterranean regions. Total eleven smoked rainbow trout processing companies in Afyon (2), Aydın (1), Denizli (1), Muğla (3) and Antalya (4) cities were selected as the main population of the study. The whole population was surveyed by face-to-face surveys using the integral method to obtain the original data. Secondary data are provided from previously issued publications on the statistical data of relevant government agencies, seafood processing companies, and relevant regulations on seafood processing facilities.

Results and Discussion: In 2012, 63 million tons (46% of total) of live, frozen or chilled products and 16 million tons (12% of total) of dried, salted and smoked products presented at the world markets. Most of the rainbow trout are filleted and some of these fillets are smoked before they are served to the market. Processing companies are focusing on the foreign markets because most of the fish in Turkey are freshly consumed. There are 126 large and small scale seafood processing companies in Turkey. Most of these companies processing frozen seafood. Some of these companies also process smoked aquatic products. Turkey is mainly exporting the smoked trout fillet to the European Union countries. Germany, with an important market share, is the most exported country in 2014 with 3630963 kg of smoked rainbow trout fillets. Turkey has made approximately 83% of its total smoked trout fillet exports to Germany and 13% to Netherlands. In the study, it was determined that 73% of the companies actively produce smoked trout, one is closed and the two companies no longer produce smoked trout. According to the survey results; 100% of the enterprises exported smoked trout to Germany, Poland, Denmark, Turkey and Chile are the biggest competitor countries in 2014. The most important problems are; Lack of consumption in the domestic market, various problems arising from the procedures at the customs, logistics and lack of qualified personnel.

Keywords: Rainbow trout, trade, economics, value-add

Purification and Characterization of Trypsin from Rainbow Trout (*Oncorhynchus mykiss*) viscera*

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Objective: Waste and by-products discharged by fisheries are currently rising, driven by both a net increase in fisheries products consumption and the changing consumer trend towards ready-to-use products. The seafood consumption has consistently increased during recent years as seafood has been progressively recognized as an important source of nutrients for human health. Fish viscera have biotechnological potential as a source of proteinase, especially trypsin. The isolation and recovery of trypsin from fish internal organs can increase its value and reduce waste disposal or treatment, thereby lowering environmental pollution. Hence, fish internal organs can serve as a cheap and promising source of proteinase for further applications. The objectives of this study were to purify and characterize trypsin from rainbow trout viscera.

Methods: Frozen cultured rainbow trout (*Oncorhynchus mykiss*, harvested in winter and spring from Egean Sea) viscera trypsin activity (Klomklao et al., 2007) and pH and temperature profile (Klomklao et al., 2006) were determined.

Results and Discussion: Trypsin from viscera of cultured rainbow trout showed the maximal activity at pH 8 and 50°C in both winter and spring. Between pH 5-9, more than 85% of activity was observed in winter sample. Also, between pH 5-9, more than 86% of activity was observed in spring sample. These characteristics suggest that trypsin from viscera of rainbow trout could be a promising alternative for the fish processing and industries.

Keywords: rainbow trout, trypsin, purification, characterization, fish viscera

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Review: Production of Protein Hydrolysates from Freshwater Fish Processing Co-Products

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Objective: The worldwide demand for both fish and aquaculture production has increased. The current practice of fish processing generates large amounts of by-products, which can account for up to three quarters of the total fish weight. Typically, fish processing by-products consist of viscera, heads, trim, skins, scales, and bones, as well as fish that are damaged or unsuitable for human consumption or further processing and bycatch. The demand of the sustainable use of fish processing co-products has led to the development of processes for the recovery and hydrolysis of proteins, the assessment of their functionalities, and application into different products. The aim of this review is to critically analyze the state of the art on the functions, applications and production processes of freshwater fish processing co-products protein hydrolysates and identify the key research trends and future research directions that will maximize the economic and environmental benefits for the fish processing industry.

Methods: Fish protein hydrolysate, which contains high protein, could be produced from freshwater fish co-products. Degree of hydrolysis, functional properties (protein solubility, emulsion properties, foaming properties, color properties, water binding capacity, antioxidant properties (DPPH (1,1 –diphenyl-2-pic-ryhy-drayl), free radical scavenging capacity, antioxidative activity, metal chelating) determination of amino acid sequencing have been investigated in protein hydrolysate.

Results and Discussion: Protein hydrolysates from freshwater fish co-products showed enhanced physico-chemical properties, when compared with non-hydrolyzed fish protein, or other commercial food-grade products having the same function. The commercial development of fish protein hydrolysates as functional ingredients for the formulation of daily-consumed food, functional food, and nutrition supplements.

Keywords: Protein hydrolysates, functionality; process; industrial application, fish processing co-products

Amino Acid Composition and Chemical Score of Hydrolysate Gained by Freshwater Crab (*Potamon potamios*, Olivier 1804) in Lake Eğirdir, Isparta (Turkey)

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Objective: Although freshwater crabs are commonly founded in Turkey in land waters, there are no direct contribution in national economy. In this study, we aimed determination of the freshwater crab hydrolysate amino acid composition so as to comparison of the chemical score other reference protein source.

Methods: Crabs were caught in Eğirdir Lake seasonally (January, April, July and October) by using crayfish fyke-nets. In the hydrolysis process, commercial 3 enzymes [Alkalaz (*Bacillus licheniformis*) 2,4L FG (2.4 AU/g), Protamex (*Bacillus subtilis*) (1.5 AU/g) and Flavourzyme (*Aspergillus oryzae*) 500 L (1.5 AU/g)] were used. Chemical score was calculated concentration of hydrolysate essential amino acid proportion on the concentration of standard protein source essential amino acid which announcement by FAO&WHO. Chemical score= essential amino acid amount of test protein (g100g⁻¹)/ essential amino acid amount of standard protein source (g100g⁻¹).

Results and Discussion: The essential amino acids amount of freshwater crabs were founded different both between enzymes and seasons in terms of statistically (p<0.05). It is thought that, this differences steaming from feeding condition of crabs by season, reproduction season and differences of body food composition. By the result, it is determinate that chemical score of the *Arginine and Phenyl alanine* higher than other essential amino acid of standard protein source.

Keywords: Freshwater crab, chemical score, hydrolysate, amino acid

Acknowledgement: This study was supported by the Republic of Turkey, Ministry of Food Agriculture and Livestock, General Directorate of Agricultural Research and Policy.

Biomarker Response of Crayfish *Astacus leptodactylus* to Textile Dye Congo Red**Onder Aksu¹, Nuran Cikcikoglu Yildirim², Durali Danabas¹, Numan Yildirim²**¹*Munzur University, Fisheries Faculty, TR62000, TUNCELI, TURKEY*²*Munzur University, Faculty of Engineering, Department of Environmental Engineering, TR62000, TUNCELI, TURKEY*

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Objective: The immediate toxic effects of dyes and degraded products on a variety of aquatic organisms had been reported. In this study, it was determined the effects of Congo Red (CR) exposure on the activities of Glutatyon S-Transferase (GST), cytochrome P450 (CYP1A1), and Lactate dehydrogenase (LDH) in the hepatopancreas of *Astacus leptodactylus*.

Methods: The crayfish, weighing 64.6±25 g (mean±SE), used in study, came from the crayfish population of Keban Dam Lake, İçme Region (Elazığ, Turkey). They were held in aquariums (90 l, 18.0±0.5 °C temperature, and a 12:12 light-dark photoperiod cycle). Crayfishes were acclimatized for 2 days, starved for 24 h prior to exposure and during the experiment to avoid prandial effects during the assay. The crayfishes were exposed to 0.5, 1.0, and 2.0 mg l⁻¹ CR for 24 h and 48 h. After the experimental periods, crayfish were anaesthetized, and then dissected for obtaining of the hepatopancreas tissue. Enzyme analyses were carried using the commercial kits with a Thermo Scientific Multiskan FC – filter-based microplate photometer.

Results and Discussion: The GST activities were clearly increased, after 24 and 48 h exposure to CR, compared to control group (p<0.05), Activities of CYP1A1 were generally decreased, but LDH activities were increased in the groups, exposed to different doses of CR, when compared to the control group. Detoxification enzymes (GST and CYP1A1) and a metabolic enzyme (LDH) could provide useful parameters for evaluating the physiological effects of the CR on crayfish.

Keywords: *Astacus leptodactylus*, Congo Red, CYP1A1, LDH, GST

Biochemical Response of Crayfish *Astacus leptodactylus* to Remazol Brilliant Blue R Textile Dye

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Objective: Industrial processes generate different molecules that pollute water system due to their negative impacts on ecosystem. Azo dyes pose a long-term challenge for the structure and function of different ecosystems due to their xenobiotic and recalcitrant nature. In this study, it was determined the effects of Remazol Brilliant Blue R (RBBR) on activities of Glutatyon S-Transferase (GST), cytochrome P450 (CYP1A1), and Lactate dehydrogenase (LDH) in the hepatopaneas of *Astacus leptodactylus*.

Methods: The crayfish, weighing 64.6±25 g (mean±SE), used in study, came from the crayfish population of Keban Dam Lake, İçme Region (Elazığ, Turkey). They were held in aquariums (90 l, 18.0±0.5 °C temperature, and a 12:12 light-dark photoperiod cycle). Crayfishes were acclimatized for 2 days, starved for 24 h prior to exposure and during the experiment to avoid prandial effects during the assay. The crayfishes were exposed to 0.5, 1.0, and 2.0 mg l⁻¹ RBBR for 24 h and 48 h. After the experimental periods, crayfish were anaesthetized, and then dissected for obtaining of the hepatopaneas tissue. Enzyme analyses were carried using the commercial kits with a Thermo Scientific Multiskan FC – filter-based microplate photometer.

Results and Discussion: The GST activities depending on time and dose were not statistically significant in experimental groups (p>0.05). Activities of CYP1A1 were generally decreased, but LDH activities were increased in the all groups, exposed to different doses of RBBR, when compared to the control group. Detoxification enzymes (GST and CYP1A1) and a metabolic enzyme (LDH) could provide useful parameters for evaluating the physiological effects of RBBR on crayfish.

Keywords: *Astacus leptodactylus*, RBBR, CYP1A1, LDH, GST

Socio-Economic Analysis of Employee in Rainbow Trout (*Oncorhynchus mykiss*) Farms with Different Capacity in Elazığ Region

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Objective: In this study, the socio-economic analysis of employee in rainbow trout (*Oncorhynchus mykiss*) farms with different capacity in Elazığ were investigated.

Methods: The research was carried out between November 2011 and April 2014, in 2nd, 3rd and 6th district fishing areas of Keban Dam Lake and 8th, 9th and 10th district hunting areas of Karakaya Dam Lake where 162 rainbow trout farms are located. The material of the research was formed by the farms (162 farms + 1 public farm) be interested in aquaculture of rainbow trout (*Oncorhynchus mykiss* W., 1792) in Elazığ province and the 4 questionnaires prepared for the purpose of the study. The data obtained from questionnaires are evaluated that there were active 72 small (≤ 25 tons / year), 50 medium (25.01-250 tons / year) and 37 large (≥ 250.01 tons / year) capacity farms and 159 cages and pools and 3 fry farms that is one of them owned to public. While examining the socio-economic structure of farms, it has been identified the structure and enterprise financing of the farms, the occupational groups of the farm owners, the reasons for choosing aquaculture by the farm owners the marketing situation of farms, (the professional character and professional experience of the personnel), the social status of the personnel in farms (gender status, age, marital status, working partner, household population, number of children, education level, non-aquacultural activities, home and car ownership, social security situation, aquaculture experience, reasons for choosing this profession) and assets owned by farms.

Results and Discussion: As a result of socio-economic analyzes made for farm owners and employees it was determined that 731 people were employed in the farms and 55.40% of them chose this profession due to unemployment. When 1-20 employees are employed in the farms, it is seen that the number of employees was 1-3 with a high rate of 58.90%, the age distributions were changed between 19-50, 43.37% of them were in the 20-29 age group and 94.66% were men and 5.34% were female. It was determined that 71.14% of the employees were married and when the educational status was examined, it was seen that the highest group was secondary education graduates with 46.37% rate.

Key Words: Elazığ province, rainbow trout farms, socio-economic analyzes

Foreign Trade Performance Index of Turkey for Freshwater Fishes

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Objective: In this study, it is aimed to evaluate the foreign trade performance and competitiveness of Turkey's freshwater fish production over last 5 years.

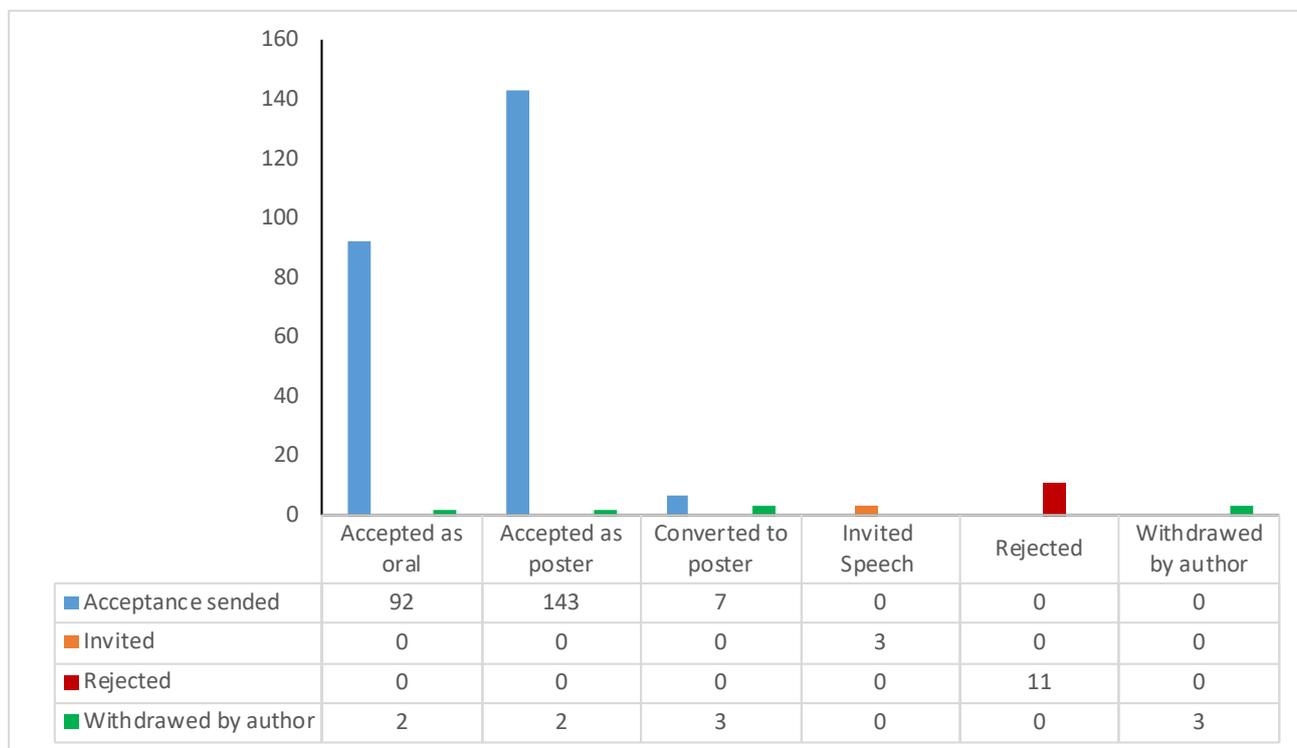
Methods: The export and import data related to the inland fish production of Turkey and the other main exporter countries derived from the Turkish Institute of Statistics, United Nations Comtrade Database and International Trade Center. The raw data belongs to the period of 2012-2016 were analyzed to create freshwater fish trade performance index of Turkey including exports in value, exports as share of total exports, exports as share of world exports, net trade, growth of exports in value and growth of exports in volume. In order to identify the obvious advantage or disadvantage of Turkey in international trade competition, Balassa (RCA) and Lafay (LFI) indexes are calculated for selected freshwater fishes. The selection of countries is based on the 10 largest exporters in 2016.

Results and Discussion: The capture and aquaculture production of freshwater fish from inland waters of Turkey in 2016 constituted 33856 and 101557 tons, respectively. Total 22 species captured from inland waters where 5 freshwater species cultured. Export value of freshwater fish in fresh, chilled, frozen and smoked form was 116 582 000 USD and import value was 46 172 000 USD in 2016. The share of freshwater fish in total export of Turkey was 0.08%, however, Turkey is the leading exporter in fresh or chilled carp, third in frozen and smoked trout, sixth in frozen fillets of carp and frozen fillets of trout and ninth in fresh or chilled trout in the world. The total export value of freshwater fish between 2012 and 2016 was 546 571 000 USD and the total import value was 256 330 000 USD. The Balassa index of Turkey for fresh or chilled carp, smoked trout, frozen trout, fresh or chilled trout, frozen fillets of carp and frozen fillets of trout were 72.71, 19.15, 10.89, 2.73, 2.48 and 2.19, respectively. Turkey has export specialization for the export of selected freshwater products compared with the top exporters. Moreover, positive values of Lafay index indicated the existence of comparative advantages in the freshwater fish exports when both export and import values are taken into consideration.

Keywords: Export, Balassa, Lafay, freshwater fish, competitiveness

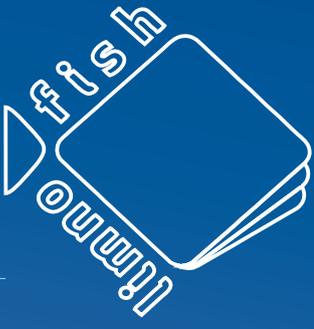
SYMPOSIUM METRICS

Result of assessing process



Distribution of submitted abstract by topics

Topics	Accepted as oral	Accepted as poster	Converted to poster	Invited	Rejected	Withdrawed by author	Total
Invited	0	0	0	3	0	0	3
Aquaculture and Disease	41	34	3	0	6	0	84
Biology	13	31	2	0	0	0	46
Ecology	19	36	4	0	1	2	62
Fish Processing Technology	7	26	1	0	4	0	38
Fisheries Management	10	13	0	0	0	0	23
Genetic	4	2	0	0	0	0	6
Socio-Economi	0	3	0	0	0	1	4
Total	94	145	10	3	11	3	266



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