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Limnology and Freshwater Fisheries

SYMPOSIUM ABSTRACT BOOK

03-05 September 2019
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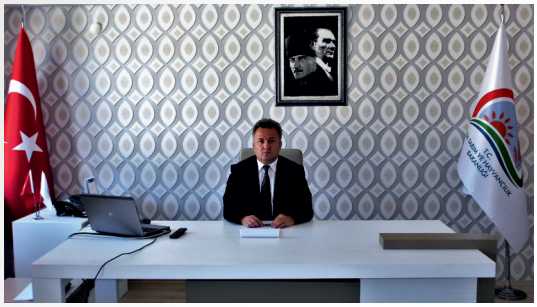
SYMPOSIUM ABSTRACT & FULLTEXT BOOK

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All manner responsibility of legal and spelling errors are incumbent on authors interested in the abstract, that published in abstract book of *2nd International Symposium on Limnology and Freshwater Fisheries.*

Welcome speechs



Prepared jointly by Elazığ Fisheries Research Institute (ELSAM) and Eğirdir Fisheries Research Institute (SAREM), *2sd International Limnology and Freshwater Fisheries Symposium*, hosted by ELSAM, will be held on 03-05 September 2019 in Elazığ. We will be delighted and honoured by hosting such important attendants as you in our precious city.

Our limited water resources have become more valuable with global warming. All studies that emphasize water are extremely important. The importance of limnology and freshwater resources essential for the continuity of terrestrial life is increasing day by day.

Existing water resources are used for energy production, agricultural irrigation, domestic use, supply of drinking water, transportation, recreational and aesthetic needs. In addition, these resources constitute an important economic potential. Considering that the only animal product exported by our country is aquaculture, all activities and studies related to the current status, protection and usage of our fresh water resources are unique for the growth and development of this sector.

The symposium will focus on basic limnological studies as well as aquaculture and problems in inland waters. Through this way, it is aimed to provide important information for the formation of forward-looking regional, national and international policies. In this direction, the symposium titles were determined as Fisheries Management, Biology, Genetics, Ecology, Fisheries Health, Fish Processing Technology and Fisheries Socio-Economics.

Hope to form ideas to help to develop future-oriented projects and to shed light on the studies, see you in Elazığ, the capital of the trout.

Özkan ÖZBAY
Director of Elazığ
Fisheries Research Institute
Co-Chair of Symposium



In our world, where 1% of the total water volume is usable, the value of water is better understood. Our country are a water poor country with 1500 m3 by the world water classification in inland water. Our limited water resources have become more valuable with global warming. Every study on fresh water is extremely significant. For this reason, the importance of limnology science is increasing every passing day. With this mission, our institute, which has carried out more than 100 projects in inland waters since 1986, maintains its studies.

"*1st International Limnology and Freshwater Fisheries Symposium*", which was organised on 04-06 October 2017 in Egirdir, was hosted by Our Institute. With the experience we gained from this symposium, between 03-05 September 2019 "*2nd International Limnology and Freshwater Fisheries Research Symposium (Limnofish 2019)*" is hosted by Elazig Fisheries Research Institute, which is a sister organization and under the coordination of our institute.

In this symposium, it is aimed to reveal basic limnological studies and problems that were encountered in inland waters and to develop forward-looking policies. Thus the current and original studies will be discussed and considered with the participation of sector representatives, academicians, research institutes and related public institutions.

We are very glad to meet in Elazig, which is the capital of the trout, we wish "*2nd International Limnology and Freshwater Fisheries Research Symposium (Limnofish 2019)*" being organised sheds light on our studies.

Şakir ÇINAR
Director of Eğirdir
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ORAL PRESENTATIONS

Abstract ID: IVT-094

"Lectures From "Water"

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Everyone knows that "WATER" is the source of life. The material value of water is better understood day by day by humanity however the spiritual dimensions of it still waiting to be discovered. This unique compound gives us lessons and advices with its oratorical.

In this presentation, it is aimed to approach to "water" with a different point of view and to reveal some clues that exist in this treasure.

Abstract ID: IVT-095

Trocheta Leeches (Hirudinea: Erpobdellidae) of the Black Sea Region: Taxonomy, Biogeography and Phylogeny

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Erpobdellid leeches of the genus *Trocheta* are among the biggest and the most charismatic members of the family. The genus comprises medium and large-sized amphibiotic leeches with body segments consisting of 8-11 annuli of unequal width. The studies of the group have a long and complicated history due to the lack of reliable distinguishing features, which impedes the taxonomy of the genus. A number of *Trocheta* species have been misclassified for years if not centuries. Our present research demonstrates that the genus *Trocheta* is characterised by high cryptic diversity since some populations that have been viewed as the belonging to the same species should be, in fact, assigned to different species. *Trocheta* leeches from the Dniester basin and the Crimean Peninsula have been both confused with each other and erroneously assigned to species that do not occur in southern Ukraine. A new species from the Crimean Peninsula is described based on a phylogenetic analysis of *cox1* gene sequences and a reassessment of morphological characters in the Crimean Trocheta such as coloration, annulation, size and arrangement of papillae, and genital anatomy. The analysis suggests close relationships of the new leech to Anatolian species. Given its fragile habitats and restricted range, the species needs serious protection and further surveys. Obviously, more species await description as evident from significant genetic differences between leech populations.

Our phylogenetic analysis uncovered a complicated and deep phylogenetic structure of the family Erpobdellidae. Most of Nearctic erpobdellid species formed a well-supported clade. Our analysis also revealed a superclade consisting of three clades, which roughly match the traditionally recognized genera *Dina*, *Trocheta* and *Nephelopsis.* Most of erpobdellids with a complex heteronomous annulation formed a single clade. Obviously, the monophyly and phylogenetic relationships of *Trocheta* leeches should be substantiated using more species and molecular markers.

Abstract ID: IVT-092

Medical Leeches and Use of Leeches from Traditional to Modern Medicine

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Medical leeches have been used in the treatment of certain diseases of humans since ancient times. Leeches used for medical purposes from the past to the present day are seen to be especially focused on the Eurasian continent. Although leech species used for medical purposes are found in all continents of the world, especially leech species within the genus Hirudo have been used in treatment since ancient times. The number of medicinal leech species in Hirudo genus increased to six in 2016 with the discovery of a new medicinal leech species in Southeastern Anatolia. Medical leech treatment lasts until the 3rd century BC. The leech swallowing habit is a habit from the 4th century BC. It is possible to understand that leeches were used at least 2500 years ago in written works. This study has been prepared to introduce leech species used for medical purposes in the world and to show the development of leech therapy from past to present. In ancient times, the use of leeches and their similarities and differences in the development of the present were evaluated. While medical leeches were used directly in animals and humans in ancient times, this traditional treatment method continues to be similar today. However, in recent years' some drugs and preparations have been developed from the extraction of enzymes and hormones from leeches. In some studies today, saliva of some leeches has been converted and patented into drug form for use in the treatment of breast and prostate cancers. The leeches have provided an improvement to the drug format from directly the use, and it is anticipated that biotechnological methods will further develop this field in the future.

Keywords: Medical leech, hirudotherapy, treatment, traditional treatment, modern treatment

Abstract ID: AQD-018

Changes in Protease Activitie of Live Foods

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In this study, time dependent enzyme activities of live foods were determined according to acid (pH 3, 4, 5, 6), neutral (pH 7) and alkaline (pH 8.5) protease class. For this purpose, samples were taken from three different live food (rotifer, *Brachionus plicatilis*-R., non-enriched *Artemia*/*A*. nauplii-A0, two different enriched *Artemia*/*A*. metanauplii-A1, A1/1 and A1/2) and *Artemia* eggs. The live foods' sampling were made before enrichment (R-0, A1-0), and at 0^{th}, and stored at $^{+}4\ ^{0}C$ at the 6^{th}, 12^{th}, and 18^{th} hours (T0, T6, T12, and T18) after enrichment (R, A1), and A0's after harvest.

Rotifer's 102.76±1.48 U/mg protein R-0 alkaline enzyme value is higher than other their own enzyme classes ($p<0.05$). However, before enrichment, T0, T6, T12, and T18 alkaline enzyme values were lower than pH 3 and pH 4 at the same sampling hours. Alkaline enzyme value in A0-T18 (34.82±0.28 U/mg protein) is higher than other *Artemia* nauplii enzyme class values ($p<0.05$). The alkaline enzyme activities of *Artemia* nauplii were relatively high. Alkaline enzyme value before enrichment of *Artemia* metanauplii (134.99±0.32 U/mg protein), although fluctuates after enrichment (from 366.19±1.31 to 429.69±0.97 U/mg protein and from 461.59±1.33 to 417.74±1.47 U/mg protein) it had the highest enzyme class values. On the other hand, pH 3 and pH 4 acid protease enzyme values of rotifers (R, T0, T6, and T12) were higher than *Artemia* nauplii and metanauplii values ($p<0.05$). *Artemia* nauplii protease values showed fluctuations between rotifer and *Artemia* metanauplii values. The pH 3 and pH 4 acid protease values of A0 and A1 eggs and decapsulated A0 eggs were higher than other acid, neutral and alkaline protease values.

Considering the decrease in alkaline enzyme activities of rotifers and their decrease in time-dependent enzyme activities, exogenous enzyme contributions are lower compared to enriched *Artemia*. This should be considered as the ontogenetic digestive system pH changes of larvae, and their first foods. In contrast, the higher acid protease enzyme activities of the rotifers pH 3 and pH 4 compared to the enriched *Artemia* mean higher exogenous enzyme support for larvae that have completed gastric development. Due to the low enzyme value of non-enriched *Artemia*, it should be used with other live feeds, especially in combination with enriched *Artemia*. Due to the enrichment of *Artemia*s, the change in enzyme values should be considered. It is recommended that live feeds must be analyzed in terms of enzyme values before and during production.

Keywords: Enzyme, protease, pH, live food, rotifer, *Artemia*

Abstract ID: AQD-029

Hormonal induction of spermiation and spermatozoa morphometric features in the European eel (*Anguilla anguilla* L. 1758)

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European eel has been in the IUCN Red List of Threatened Species since 2010. Even if there is a fisheries limit for this species, an annual 73 tons of export quota has been issued in Turkey. To reduce the fishing pressure, a great effort has been devoted to produce this species in captivity in several countries. Eel production under controlled conditions has only been achieved in Japan. Up to date, no production an attempt in European eel has been made in Turkey. This study was carried out at the Beymelek Unit of Mediterranean Fisheries Research Production and Training Institute, Turkey in the scope of project titled "Investigations of Production Possibilities of European eel (*Anguilla anguilla* L. 1758) under Controlled Conditions" funded by General Directorate of Agricultural Research and Policy.

The study was conducted in two main stages; catching fish from the wild and keeping them for gamete collection. According to the project schedule, a total of 53 silver males in November 2017 and a total 22 in November 2018 were caught from Demre Çayağzı Creek and Beymelek Lagoon. After hormonal treatments, spermatozoa were sampled from the fish in March 2018 and March 2019, respectively. After catching the fish, they were kept in 2 tones tanks. Water salinity and temperature were 38 ‰ and 20 °C respectively. 10 h light and 14 h dark photoperiod was used. Human Chorionic Gonadotropin (hCG) was weekly injected at doses of 1 and 1.5 IU/g. Spermiation was achieved from 8th week onwards and at 12th week after hormone injection. Sperm samples were successfully collected from 12 males in the in the first sampling year (as 23% achievement) while 9 males in the second sampling year (as 55% achievement). The sampled fish could be used repeatedly for spermatozoa sampling by means of continuing hormone injections. External morphological features of spermatozoa and spermatozoa densities were analysed by using a sperm class analyser (SCA Microptics®, Barcelona, Spain). The average spermatozoa head length, head width, and flagellum length were determined as 6.31±0.12, 1.24±0.03, and 27.93±0.13 µm, respectively. Sperm density ranged between 1.8±0.2 and 4.2±0.1 x 10^9 per ml. This study is the first report of spermatozoa data from European eel in captivity in Turkey with an aim to use in controlled reproduction.

Keywords: European eel, hormonal induction, spermatozoa

Abstract ID: AQD-045

Dilemma of European eel (*Anguilla anguilla* L. 1758) Catch and thoughts on Aquaculture

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The European eel is the worlds most mysterious and probably the second most valuable fish in the world. The European eels spawn together with the American eels; Anguilla rostrate in Sargasso Sea located south of Bermuda. As the eel larvae start feeding, they transform into transparent leaf- shaped Larvae called Leptocephali. İn coastal areas the Leptocephali transform into glass eels. A large fraction of the glass eels migrate into freshwaters, but some remain in coastal and estuarine waters. Glass eel is an important source being used since centuries in aquaculture by European and far Eastern countries.

The average annual catch of elvers in 1974 in EU was: 378 tons, this being 124 million elvers. The official glass eel landings in EU in 2012- 2018 in average being 54 Tons per year (Hanel,R. and al 2019). PECH-study-PECH Committee: Environmental, social and economic Sustainability of the European eel Management uses 4 countries; France, Spain, Germany and Greece to put forward a first compressive analysis. The findings of this report are unsufficient.1kg of European glass eels consist of 3500 pieces. The ideal temperature range for eels to remain healthy and efficiently convert into growth is 23-28 Centigrade.

The overall reported amount of European eels landed to ICES in 2013- 2017 in EU was 3000 Tons. Most European eels are farmed in Europe and Asia; amounting approximately to 9-10. 000 tons yearly during 1996-2007. The estimated current level is 4-5.000 tons based on recent statistical reports. According to the Turkish statistics, the catch of aquatic animals in 2018 in Turkey was 314.094 tons. The Aquacultural production in 2018 in Turkey surpassed this amount with 314.537 tons. In Southern Turkey and Aegean Area, Aquaculture of European Eels could be accomplished successfully.

Keywords: European Eel, Catch, Aquaculture

Abstract ID: AQD-046

Isolation of *Yersinia ruckeri* from Rainbow Trout (*Oncorhynchus mykiss*) in Kürtün Dam Lake (Gümüşhane, Turkey)

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Enteric red mouth disease (ERM) caused by *Yersinia ruckeri* is a major fish disease involved in rainbow trout culture. In this study, the bacteriological examination was performed on disease suspected rainbow trout (*Oncorhynchus mykiss*) specimens which were kept in Kürtün Dam Lake in the Black Sea Region of Turkey.

In Autumn of 2018, about 30 moribund rainbow trout (10-30g) were sampled for bacterial examination following the disease outbreak on Kürtün Dam Lake (Gümüşhane, Turkey). For bacterial examination, liver and head-kidney samples of fish were aseptically streaked on Tryptic Soy Agar (TSA, Merck) and incubated at 25-30°C for 2 days. Following incubation, typical colonies were selected from the plate and streaked onto the same media to check the purity of bacterial colonies. The purified bacteria were biochemically characterized by following biochemical tests: Gram staining, cytochrome oxidase, catalase, and motility. Analytical Profile Index (API) was used for biochemical bacteria species identification. The causative agent of disease outbreak was further genetically confirmed by species-specific primers (5'-GCG AGG AGG AAG GGT TAA GTG -3'; 5'-GAA GGC ACC AAG GCA TCT CTG-3'). The expected PCR amplicon size for *Y. ruckeri* strains are approximately 590 bp. The antibacterial susceptibility of bacteria was also evaluated against commonly used antibiotics. The most effective antibiotics were enrofloxacin and sulfamethoxazole. The enrofloxacin was suggested for disease treatment.

In conclusion, cultured rainbow trout were investigated for bacterial fish pathogens after a suspected disease outbreak in a dam lake. *Yersinia ruckeri* was isolated from rainbow trout which caused moderate mortality. However, further studies are needed to determine the pathogenicity of the bacteria.

Keywords: Dam lake, rainbow trout, *Yersinia ruckeri*, mortality

Abstract ID: AQD-048 (Full-Text)

The effects of copper sulphate pentahydrate on the enzyme activities of rainbow trout liver's

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Copper sulphate is very toxic to aquatic organisms. Bioaccumulation of this chemical may occur along the food chain, especially in fish. The aim of this study was to determine on mechanism of toxicity by copper sulphate pentahydrate ($CuSO_4.5H_2O$) on superoxide dismutase (SOD), glutathione peroxidase (GPx), catalase (CAT), and malondialdehyde (MDA) levels in the liver tissues of the rainbow trout (*Oncorhynchus mykiss*). After fish were exposed to two different concentrations (0.175 mg/L and 0.350 mg/L) of $CuSO_4.5H_2O$ for 28 days, the levels of SOD, CAT and GPx activities of rainbow trout liver tissues decreased but MDA level increased ($p<0.05$).

Copper sulphate pentahydrate caused biochemical effects in fish liver by inhibiting the enzymes according to the findings of this research. It had also been determined that enzyme activity and MDA level can be used as a biomarker in determining the toxic mechanism of action in the aquatic environment.

***Keywords*:** Copper sulphate pentahydrate ($CuSO_4.5H_2O$), rainbow trout, antioxidant enzymes, liver

1. INTRODUCTION

Copper sulphate pentahydrate ($CuSO_4.5H_2O$) is an inorganic salt of the group of cuprates from inorganic pesticides. It is used as an aquatic pesticide for controlling wild aquatic plants, invertebrates and algae's in dams, lakes or irrigation channels (Davison, 1995). The mechanism of action of copper sulphate pentahydrate on living organisms is that it deactivates the enzymes of copper ions and fungi and algae, and defeats cellular proteins. The toxicity of metallic copper and salts changes according to their ionization properties. Because of this characteristic, they cancel the physiological duties of vital important enzymes and similar proteinaceous structures by combining with these groups (Şanlı,1995). Acute toxicity of copper sulphate pentahydrate on spleen, liver and kidneys was observed with experiments on animals. Damage to brain, lung and digestive system can be seen similarly (Kurisaki et al., 1988; Dash, 1989). copper sulphate pentahydrate is highly toxic for fish, amphibians, invertebrates and the other aquatic livings in aquatic environments (Siemering et al., 2005).

Catalase (CAT), peroxidase (POD), glutathione reductase (GSSG-Rx) and superoxide dismutase (SOD) enzymes have antioxidant effects in biological and biochemical systems. The harmful effects of free radicals are controlled by cellular antioxidant defence systems (Gülçin 2002). Antioxidant enzymes have a vital role in regulation of cell balance and are a consequence of the response to induction of contaminants (Doyotte et al., 1997; Uçar et al., 2012), and antioxidant enzyme activities and lipid peroxidation are important indicators of cell damage in toxicological studies (Zwart et al., 1999; Oruç et al., 2004; Çınkıloğlu, 2007; Uçar et al., 2012).

The presence of an oxygen-rich atmosphere ensures that an endogenous antioxidant system opposes reactive oxygen species (ROS) and reactive nitrogen species (RNS) (Sen et al. 2000; Uçar et al., 2012). O_2 metabolism products' decreasing is controlled by enzymatic (SOD), (CAT) and (GSH-Px) cellular defence mechanism.

This research was designed and realized for determining the effects of copper sulphate pentahydrate ($CuSO_4.5H_2O$) on the liver antioxidant activities of rainbow trout.

2. MATERIALS and METHODS

2.1. Experimental Design

The experiments were carried out in the Toxicology Experiment Unit in the Aquarium Fish Research and Application Centre and the Laboratories of the Atatürk University Fisheries Faculty. The water temperature was 11.5±2.5°C during the research. Totally 60 fish were put to tanks as 10 fish per tank. The rainbow trout (*Oncorhynchus mykiss*) weighing 165±25 g that were not exposed to infection or toxicity prior to the research and were obtained from Fisheries Faculty Inland Water Fish Research and Application Centre of the Fisheries Faculty were taken into the experiment tanks. Two of the tanks were determined to be the control tanks, while four of the tanks were the treatment tanks (Atamanalp, 2000). All conditions (stocking density, water parameters etc.) were designed according to the welfare-related assessments, suitable for *O. mykiss*. The copper sulphate pentahydrate was obtained in Sigma. After 14 days of acclimation period, fish were exposed to the two different doses of the pesticide for 96 hours. The application doses were determined based on the $LC_{50}96$ values: One tank received the ½ of the dose (0.175 mg/L) (D1), while the other tank received the ¾ of the

dose (0.350 mg/L) (D2). Experiments were taken in accordance with the procedure for experiments with renewed (Ünsal, 1998), the pesticide was fed to the tanks with pre-determined water volume once every 12-hours in concentrations which corresponds to this dose. Causing stress and damage to the fish was carefully avoided during all of the procedures from medium renewal to feeding and siphoning (Atamanalp, 2003).

2.2. Homogenate preparation

At the end of the trial period, the fish were euthanized by cervical section and liver tissues were collected from the control and treatment groups and all samples (liver) were homogenized (1% v/v) in 0.1 M phosphate buffer (pH 7.4) containing Triton-X 100 using a homogenizer and then centrifuged at 13000 rpm (4°C). The supernatant was used for the SOD, CAT, GPx activities and the level of MDA (Alak et al., 2017a, 2017b).

2.2.1. Measurement of Antioxidant Enzyme Activity

The method is based on the principle that the free radicals released from the enzymatic reaction are prevented from free radicals of the superoxide dismutase enzyme (SOD, EC 1.15.1.1) present in the sample during reduction of the nitro-blue tetrazolium (NBT) present in the medium. After the reaction, colour altering was measured by spectrophotometer at 560nm (Sun et al., 1988). Aebi (1984), method was used for determining the catalase activity. The reaction is obtained with measuring by spectrophotometer at 240 nm. The rate of decrease in absorbance at the resulting associates with catalase. Hydrogen peroxide-reduced glutathione (GSH) is oxidized via GPx to oxidized glutathione (GSSG). Subsequently, NAPDH (nicotinamide adenine dinucleotide phosphate), which is present in the medium, is used during the reduction of GSSG to GSH by glutathione reductase enzyme. GPx activity is calculated the absorbance decrease rate at 340 nm during the oxidation of NADPH to NADP+ (Beutler, 1975).

2.2.2. Measurement of lipid peroxidation (MDA)

MDA is formed as a secondary product by the chain reaction of lipid peroxidation. MDA creates a pink coloured complex after incubation with thiobarbituric acid (TBA) at the temperature of 95°C. This complex is measured at spectrophotometer 532 nm wavelengths (Ohkawa et al. 1979; Gutteridge 1995).

2.3. Statistical analyses

The data which obtained from the present research was analysed with SPSS software. The differences among the groups, tested by Duncan, and the importance levels were determined at the stage of $p< 0.05$.

3. Results and Discussion

While SOD, CAT and GPx activities in all tissues were significantly decreased in all pesticide concentrations compared to the control group ($p<0.05$), high dose exposure showed inhibitory effect on antioxidant enzyme activity and oxidative damage caused increase in MDA level ($p<0.05$). Fish tissue MDA levels at all concentration were significantly higher than control group ($p<0.05$) (Figure 1-4).

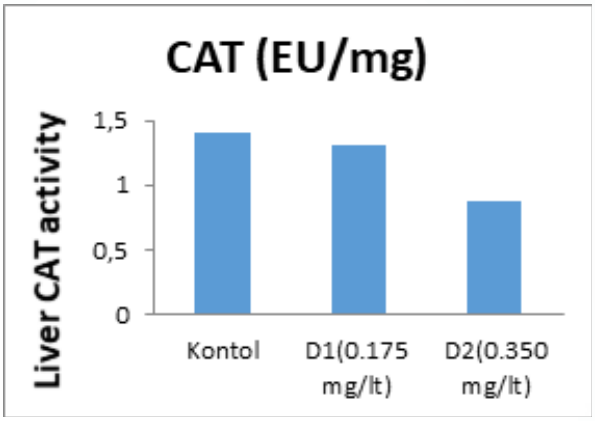


Fig.1 Lowercase superscripts (a, b) indicate significant differences among groups within each experimental time whereas superscripts in uppercase show significant differences among time. Each value is the mean ± SEM. of five individual observations. *p < 0.05.

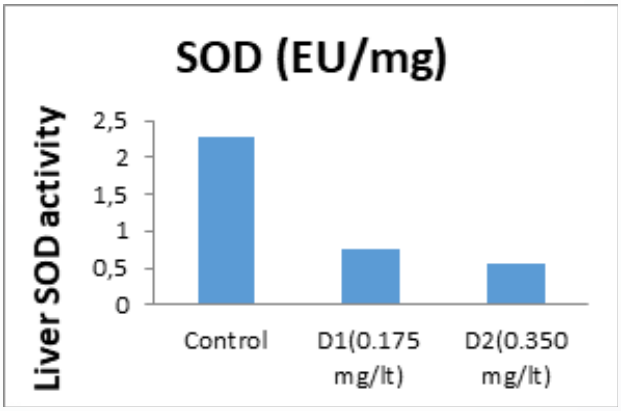


Fig.2 Lowercase superscripts (a, b) indicate significant differences among groups within each experimental time whereas superscripts in uppercase show significant differences among time. Each value is the mean ± SEM. of five individual observations. *p < 0.05.

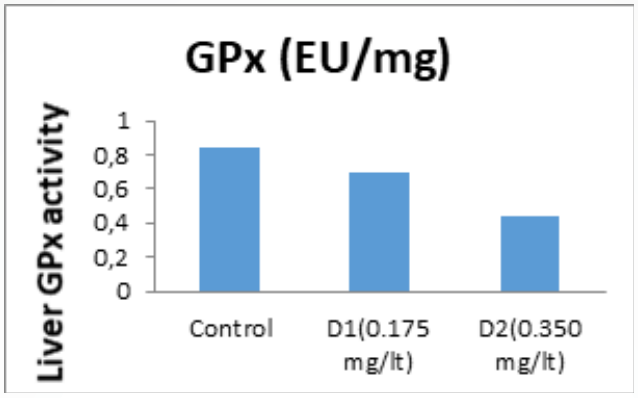


Fig.3 Lowercase superscripts (a, b) indicate significant differences among groups within each experimental time whereas superscripts in uppercase show significant differences among time. Each value is the mean ± SEM. of five individual observations. *p < 0.05.

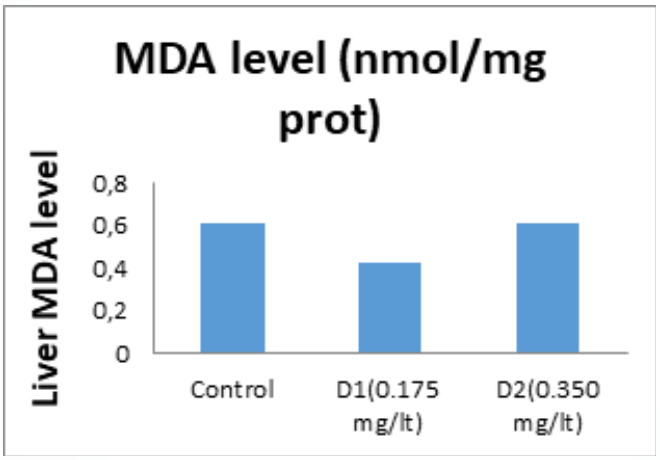


Fig.4 Lowercase superscripts (a, b) indicate significant differences among groups within each experimental time whereas superscripts in uppercase show significant differences among time. Each value is the mean ± SEM. of five individual observations. *p < 0.05.

The presence of an oxygen-rich environment has led to the development of an endogenous antioxidant system that opposes reactive oxygen species (ROS) and reactive nitrogen species (RNS) (Sen and Packner, 2000). Reducing the O_2 metabolism products is controlled by enzymatic (SOD), (CAT) and (GSH-Px) cellular defence mechanisms (Wohaieb et al., 1987; Wickens, 2001; Uçar et al., 2012).

Copper sulphate pentahydrate exposure caused to inhibition of CAT activity in fish liver tissue. The decrease at CAT activity was observed depending on concentration and time. It is thought that these changes may occur when H_2O_2 is high and adaptation cannot be achieved. It can also be assumed that the decline in CAT activity is due to the suppression of protein synthesis by free radicals (Alak, 2017b).

Superoxide dismutase and catalase are the first and most important step in defending against to toxicity (Pandey et al., 2003; Çınklıoğlu, 2007). It is known that enzymatic antioxidants such as CAT, which are involved in the detoxification of H_2O_2, are found to be much more and more active than

other tissues in the stomach, bone marrow, mucous membranes, kidney and liver (Seriner and Bilgin, 2012). Contrary to the results obtained, Peixoto et al., (2006) reported that pesticide application of tilapia (*Orechromis niloticus*), Sayeed et al., (2003) spotted sneakhead (*Channa punctatus*) in the liver increased CAT activity.

In the present study decrease at CAT enzyme activity of liver obtained. Peixoto et al., (2006) reported that some pollutants caused inhibition but some of them induction at catalase enzyme activity, so this enzyme is not suitable as an indicator for toxicological studies. These reductions in SOD and CAT activities in liver tissue can be attributed to the inhibition of superoxide radical formation (Yonar, 2013). The findings about the CAT of present study seem similar as previous references (Pedrajas et al., 1995; Oruç et al., 2004; Peixoto et al., 2006).

The decrease in SOD enzyme activities in the liver tissues of experimental groups is thought to be due to the increase in reactive oxygen species (ROS) resulting from interaction with copper sulphate pentahydrate (Esenbuğa, 2013). SOD is the first reaction to free radicals, so the reduction may be the result of adaptation to pesticides or effect of inhibition of free radical formation by basal activity of the enzyme (Song, 2004).

Antioxidant enzyme activities, glutathione redox level and lipid peroxidation are rarely preferred biomarkers (Oruc et al., 2004). In particular, changes in intracellular GSH levels are considered as an important indicator of oxidative stress caused by pollutants in fish (Zhang et al., 2005; Çınklıoğlu, 2007).

Exposure to different dosages of copper sulphate pentahydrate decreased rainbow trout's liver GPx activities compared with the control groups and the differences are found as significant at level of $p<0.05$. The substrate of GPx enzyme is Glutathione (GSH). Reductions at the GSH level lead to increased production of free radicals and disorders in the cellular dimension. GSH is important in assessing oxidative stress level and inhibits hydrogen peroxide (Jurma et al., 1997). Alterations at the GSH level with the effect of pollutants can be explained with the enzymes which roles at GSH synthesis by the regulations and activations that can be carried out to replace the GSH level (Çınklıoğlu, 2007). In this study, it is thought that the decreases in GPx activities observed among the treatment groups are due to the increase of O_2 (Matkovics et al., 1987; Yılmaz, 2010).

Highest MDA levels were obtained at the highest dosage treated group as the seen Figure 4-8 and the differences among the groups are calculated as important ($p<0.05$). A lot of researches which done with different fish species, different tissues and different pollutants, had found parallel results (Dorval and Hontela, 2003; Durmaz et al., 2005; Oruç and Usta, 2007; Barım and Karatepe, 2010). It is notable that MDA levels were significantly increased in groups treated with copper sulphate pentahydrate. However, higher dose application of higher MDA value suggests that free radical damage may be more dominant in this group (Kaya, 2005).

In the present research, rises were obtained after the chronic treatments lipid peroxidation levels depending on the concentrations and time. Pesticides increase oxidative stress leading to free radical production and LPO (Kehrer, 1993).

Under the influence of pesticides, it is understood that the inhibition of antioxidant enzymes, in which ROS is elevated and which leads to oxidative stress. However, increasing MDA level shows the deformation of membrane structure (Akhgrari et al., 2003; Fetoui et al., 2009).

Conclusion

According to the present data; copper sulphate pentahydrate inhibited the enzyme activity and inducted the MDA levels of rainbow trout's liver tissue depending on the concentrations. With this information, it is thought that the tissues and parameters can be used for aquatic organisms, especially fish, in interpreting the toxic effects of pesticides in future researches.

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Abstract ID: AQD-052

First Identification of Toll-Like Receptor (TLR) Repertoire in Asian Seabass (*Lates calcarifer* Bloch, 1790)

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Innate immunity represents primary defense mechanism through pathogen recognition receptors (PRRs) detecting pathogen-associated molecular patterns (PAMPs) which are molecules related to a group of pathogen. Following recognition of PAMPS by PRRs, they activate signaling transduction pathways resulting in production of type I interferons (IFNs), inflammatory cytokines and chemokines. PRRs are categorized into 3 major classes: RIG-like receptor (RLR), NOD-like receptor (NLR), Toll-like receptor (TLR) family which is one of the important element of innate immune system.

Aquaculture species encounters potential diseases-causing pathogens leading to high mortality in farms. Asian seabass is an important aquaculture species, but a few members of RLR and NLR family and only TLR22 have been characterized until now. The aim of this study is to provide first insight into TLR repertoire in Asian seabass to understand the underlying molecular regulation of pathogen recognition for effective measurements. Firstly, members of TLR family in Asian seabass were identified by genome mining. Then phylogenetic tree was constructed by phylogeny.fr online program to show evolutionarily relationship of them with teleost and mammalian TLRs. Finally, conserved domains were examined for the predicted TLRs by using SMART online program.

Study was concluded with identification of all members of TLR gene family in Asian seabass. Phylogenetic analysis displayed that Asian seabass predicted TLRs made group with their counterparts from other teleost and mammals and also, most of predicted TLRs showed an expected conserved structure. Results of this study showed that TLR family were conserved and also extended due to selective pressure caused by pathogen in distinct habitat. After this study, validation of members of TLR family and functional studies on them in Asian seabass can be conducted and ligand of these receptors can be identified. Therefore, our study provides main data for the development of vaccine, food rations and the selection of broodstock.

Keywords: Immunity, Genome, TLR, Data mining, Asian seabass

Abstract ID: AQD-065

Effect of Two Geophyte Plants Supplement on Antioxidant Activities of Rainbow Trout (*Oncorhynchus mykiss*, Walbaum)

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Plants are the main source of natural antioxidant compounds. Antioxidants protect cells from the harmful effects of free radicals, but have antimicrobial, antiviral, antimutagenic, antiallergic and anticarcinogenic effects. In recent years, some plant species with antioxidant and free radical removal properties have been used in the production of natural medicines. Various plants, especially medicinal plants, are used as feed additives for fish welfare in aquaculture. In this study, we investigated the effects of two important geophyte plants *Prospero autumnalis* and *Cyclamen graeculum* on some antioxidant enzyme activities in muscle and liver of rainbow trout (*Oncorhyncus mykiss* L. Walbaum).

P. autumnalis and *C. graeculum* specimens were dried in shade at room temperature and extractions were prepared using ethanol solvent in Pamukkale University, Faculty of Science, Department of Biology laboratory. Ethanol extracts of the two plant species were added to the feed of Oncorhyncus mykiss with an average weight of 14.44 ± 2.03 g as follows: *C. graecum* (C) and *P. autumnale* (P) extract without 0% control (C), and with 0.05% (C0.05), 0.1% (C0.1) and 0.2% (C0.2) *C. graecum* and 0.05% (P0.05), 0.1% (P0.1) and 0.2% (P0.2) *P. autumnale* extract were added. Experimental feeding trails of fish which fed three times each day continued for 60 days. At the end of sixty days, catalase (CAT), Superoxide Dismutase (SOD) and Glutamate Pyruvate Transaminase (GPT) enzyme values in muscle and liver of fish were measured in spectrophotometer according to absorbance values at different wavelengths.

Muscle CAT activity of control and C 0.05 group was found to be higher than other groups. C 0.05 group was found to be higher in liver CAT activity than other groups. Control and C0.05 groups were significantly higher in muscle and liver SOD activities and in muscle GPT activity compared to other groups. The liver GPT activity of the fish fed with P0.05 was found to be the lowest level compared to the fish fed with other feeds. Regardless of the control feed, the muscle and liver CAT and SOD activities of all *C. graecum* groups were higher than the *P. autumnale* groups.

Keywords: *Prospero autumnale*, *Cyclamen graeculum, Oncorhyncus mykiss*, Antioxidant activity,

Abstract ID: AQD-066

The effects of normal feed and green tea extract (*Camellia sinensis*) on the growth performance and feed utilization of rainbow trout after the prolonged fasting period

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This study was designed to determine the effects of green tea supplemented feeds on the growth performance and feed utilization of rainbow trout after the prolonged fasting period. The fresh green tea leaves were collected from Rize (Rize Province, Turkey) and taken to the laboratory of the Faculty of Agriculture and Natural Sciences, Recep Tayyip Erdogan University. The green tea leaves were dried in the oven and pulverized with a grinder. Then, 300 mL of ethanol was added to 100 g of the sample. The samples which were kept in ethanol solution for 24 hours were filtered on Whatman filter paper. Then, the organic solvent was removed using a rotary evaporator. The extracts were stored at 4°C until used. The prepared extract was added into the feed as 50 and 100mg/kg. The average weight of the fish at the beginning of the experiment was 100 g. After a 150-day fasting period, the average weight of the fish was 66 g. Then, the fish were fed with green tea supplemented feeds twice a day for 30 days. At the end of the experiment, differences in growth, weight gain (WG), specific growth rate (SGR), feed conversion ratio (FCR) and feed efficiency rate (FER) of fish were evaluated. The growth performance and feed utilization of fish fed with green tea supplemented feed was higher than those fed with normal feed ($p<0.05$). Finally, this study showed that green tea, especially at 100 mg/kg feeds is effective in fish growth and feed utilization.

Keywords: Rainbow trout, green tea, growth parameters, feed utilization

Abstract ID: BIO-030

Preliminary inventory of the aquatic macro fauna of Ain Skhouna wetland (Saida, Algeria)

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Chott Ech Chergui is one of the largest saline wetlands in North Africa (8555 km^2) at the junction of Mediterranean and desert influences. We have been interested in the aquatic macro fauna of this wetland very little studied and poorly known. Six field trips were made between winter and early summer of 2019 to target and delineate sites with high aquatic biodiversity. Nets, sieves and dip nets were used to harvest several specimens. A first observation reveals the strong presence of aquatic invertebrates represented mainly by gastropods, annelids (leeches), insects (water bug, water cockroach, dragonfly, water mites), vertebrates represented by fish (Nile Tilapia), reptiles (freshwater turtle, water snake), and amphibians (frogs). Molecular identification will be performed for identified and unidentified species to evaluate endemism degree. Field trips will cover the remaining seasons of the year in order to draw up a first fauna inventory of this wetland.

Keywords: Chott Ech-Chergui, Ain Skhouna, wetland, Ramsar, macrofauna, aquatic

Abstract ID: BIO-064

Hirudinea Fauna of Some Lakes of Balıkesir/Turkey

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The freshwater leeches play important roles in the wetlands and some of them are used for medicine purposes. Although the studies on the leeches are increased by day by in Turkey, many wetlands have not yet been studied yet in terms of leeches. This study was carried out to determine the Hirudinea fauna of Lake Karagöl (Sındırgı-Balıkesir) and Lake Gölcük (Bigadiç-Balıkesir).

Inactive leeches were collected under stones, whereas the others were collected in the water when they swim. The all specimens were transferred to the laboratory alive and were identified under stereo microscope according to Sawyer (1986), Neubert and Nesemann (1999) and Sağlam (2004).

It was determined *Dina punctata, Haemopis sanguisuga, Helobdella stagnalis, Hirudo verbana* and *Placobdella costata* in Lake Karagöl and *Dina lineata, Dina punctata, Glossiphonia concolor* and *Placobdella costata* in Lake Gölcük.

In conclusion *Dina punctata* and *Glossiphonia concolor* were recorded for the first time in Turkish Hirudinea fauna. It was observed that the Lake Gölcük was suffered from the anthropogenic activities.

Keywords: Lake Karagöl, Lake Gölcük, leech, Dina punctata, Glossiphonia concolor.

Abstract ID: BIO-034 (Full-Text)

Determination of Reproductive Properties of *Capoeta trutta* (Heckel, 1843) in Atatürk Dam Lake

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The aim of this study was to investigate the reproduction period, egg diameter and sexual maturity of *Capoeta trutta* (Heckel 1843) living in Atatürk Dam Lake. Fish caught in Atatürk Dam Lake between April 2012 and March 2013. The body weights (W), gonad weights and total lengths (TL) were measured, and then age determinations were made from dorsal fin rays by a single reader.

To determine the reproductive period, monthly gonadosomatic index values (GSI), GSI = [Gonad weight / (Body weight – Gonad weight)] * 100 formula was used. The condition factor (F) of Fulton was calculated from the formula K=[(Body weight - Gonad weight)/ fish length^3]*100. The first sexual maturity length was calculated by P=1/(1 exp [-r (L-Lm)]) equation. Regression analysis was used to determine the relationship between fecundity-body weight and fecundity-total length.

In this study, a total of 420 (175 male, 245 female) *C. trutta* samples were examined. Samples were distributed between I-X age groups. The male/female ratio was determined to be 0.7:1.0 It was determined that gonadosomatic index values of *C. trutta* individuals reached maximum in May and reproduction periods were between May-August. Egg diameter values ranged from 0.50 mm to 1.93 mm. Sexual maturity length was found as 24.82 cm for females and 22.95 cm for males. Fecundity values ranged from 55985 (Lt = 45.60 cm and W = 1414.39 g) to 3070 (Lt = 27.30 cm and W = 205.63 g). The relationships between fecundity-total length and fecundity-total weight of *C. trutta* were determined respectively as F = 0.0279 * L$^{3.719}$ (N = 57, r = 0.79) and F = 47.066 * W-6290.8 (N=57, r = 0.91).

Keywords: Atatürk Dam Lake, Capoeta trutta, sexual maturity, fecundity, GSI, egg diameter

INTRODUCTION

Capoeta trutta (Heckel, 1843) belongs to the Cyprinidae family and is commonly found in the Euphrates and Tigris River systems. The body of *C. trutta* is flattened from the sides and covered with medium-sized scales. The most important feature that distinguishes this species from the other is that the last bone ray of the dorsal fin is well developed. In addition, the presence of irregular black spots on the upper part of the body is a distinctive feature for this species. The species and subspecies of Capoeta are consumed as food by people in the regions of Tigris-Euphrates River systems (Geldiay and Balık 2009).

In our country, many biological studies related to this species have been conducted in different water reservoirs. Some of those; Polat, 1987; Öztürk et al., (1997); Bozkurt, (1998); Örün and Erdemli, (2002); Çökmez, (2005); Oymak et al., (2008); Kalkan, (2008); Düşükcan ve Çalta, (2012); Gündüz et al., (2014); Gündüz et al., (2018).

In this study; It was aimed to determine the reproductive characteristics of *C. trutta* for a sustainable fisheries management in Atatürk Dam Lake and to create a database for further studies.

MATERIALS AND METHODS

The study was conducted between April 2012 and March 2013 at Atatürk Dam Lake (Figure 1). The Atatürk Dam is located on the Euphrates River between Adıyaman and Şanlıurfa, built for energy and irrigation purposes. Atatürk Dam is the 6th largest dam in the world in terms of fill volume. It is Europe's and Turkey's largest dam (URL, 2019).

Fish samples were caught monthly using gill nets (mesh sizes between 36-100 mm). In the laboratory, the total length (TL) of each individual was determined on a measuring board with 1 mm division, body weights (W) 1 g and gonad weights were determined on a digital scale with a sensitivity of 0.001 g. Its sex was carried out as a result of the visual inspection of the gonads.



Figure 1. Atatürk Dam Lake

Age estimations were made using dorsal fin ray (Polat 1986; Öztürk et al., 1997). To determine the reproduction period; GSI = [Gonad weight / (Body weight – Gonad weight)] * 100 formula (Avşar, 2005) was used. The conditioning factor (F) of Fulton was calculated from the formula K = [(Body weight – Gonad weight) / Fish length^3] * 100 (Avşar, 2005). Egg diameters were measured using ocular micrometer [(long axis length + short axis length) / 2] formula (Çelik and Bircan, 2004). Gravimetric method was used to determine fecundity. For this purpose, a total of 1 g of eggs were taken from the beginning, middle and end of the gonads of female individuals whose eggs could be countable, and egg counts were made by keeping them in 4% formaldehyde (Bagenal, 1978). Regression analysis was used to determine the relationships between

fecundity-body weight and fecundity-total length (Avşar, 2005). The first sexual maturity length of *C. trutta* was determined using the equation P = 1 / (1 + exp [-r (L-Lm)]) and logistic curves were drawn (King, 1995;). In the formula; P: The ratio of mature fish in each size group, L: Total length, Lm = First sexual maturity length, r: The slope of the obtained logistic curve.

Microsoft Office Excel 2010 and SPSS 22 package program was used for statistical analysis of the obtained data. The statistical results obtained were interpreted according to Fowler and Cohen (1992).

RESULTS

Sex and Sex Ratio

In this study, 420 *C. trutta* individuals were obtained from Atatürk Dam Lake. 175 (41.67%) of these individuals were male and 245 (58.33%) were female. The male/female ratio was determined to be 0.7:1.0. The male/female ratio was found to be statistically different from the general population ($X^2_{5,83} > X^2_{3,84}$) from 1:1 ($p<0.05$).

Gonadomatic Index

The average gonadosomatic index values of *C. trutta* examined in both sexes reached to the highest level in May (7.70 ± 1.09% in males; 14.36 ± 1.05% in females) and decreased rapidly after this month (Figure 2). It was found that the GSI values of all male subjects ranged from 0.15% to 16.16%, and that of all female individuals ranged from 0.14% to 20.92%.The spawning period of *C. trutta* individuals were found between May and August (Figure 2).

Gonadosomatik index values of both males and females were found to be statistically significant April, May, June, July from other months ($p<0.05$).

Condition Factor

In the *C. trutta* population living in Atatürk Dam Lake, the average condition factor values were between 0.927 ± 0.029-1.227 ± 0.143 in males and 0,975 ± 0,021-1,115 ± 0,018 in females. It was observed that the condition factor values was low during the march, april, may and june. After spawning begun, the condition factor increased (Figure 2).

According to Duncan test results, while condition factor values of males were found to be significant in June (minimum mean value) and August (maximum mean value) from other months, condition factor values of females were found to be significant in June, October (minimum mean values) and December (maximum mean value) from other months ($p<0.05$).

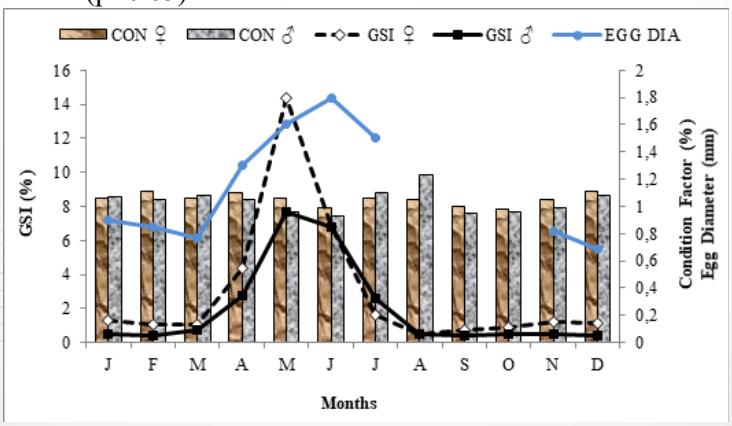


Figure 2. The changes of GSI, Condition Factor and Egg Diameter values of *C. trutta* inhabiting Atattürk Dam Lake according to sexes and months

Egg Diameter

The smallest mean egg diameter was measured in December (0.69 mm; smallest egg diameter 0.50 mm) and the largest mean egg diameter was measured in June (1.79 mm; largest egg diameter 1.93 mm) (Figure 2). Eggs of different sizes and colours were detected in the ovary during the study. This colour change was found to be greenish-grey and dark-white (0.50 mm) and mature eggs in orange-yellow colour (1.93 mm).

Fecundity

The fecundity of 57 individuals in the *C. trutta* population of Atatürk Dam Lake were calculated during spawning period. The absolute fecundity of *C. trutta* was found to increase with age and the mean number was 20671.51 ± 1738.23. According to the mean value of all age groups, relative fecundity was calculated as 542.50 ± 37.80 units/cm and 3.,21 ± 1.42 units/g (Table 1). There was a strong positive correlation between body weight and number of eggs of *C. trutta* in Atatürk Dam Lake (F = 47.066 * W-6290.8 (r = 0.91) and between total length and number of eggs F = 0.0279 * $L^{3.719}$ was found to have a moderate relationship (r = 0.79) (Figures 3A and 3B).

Table 1. Total number of eggs of *C. trutta* population living in Atatürk Dam Lake by age, total length and body weight.

Age	N	TL (cm)±SH	W(g) ±SH	Average egg number	F/cm	F/g
IV	2	26.90±0.40	212.84±7.23	5819.49±2756.72	217.91±105.73	26.94±12.03
V	2	28.95±1.35	284.14±1.87	9093.27±372.50	314.19±1.18	31.99±1.10
VI	10	31.88±1.00	387.96±28.65	12192.29±1052.51	380.52±27.11	31.77±2.37
VII	16	34.28±0.77	447.94±20.42	14836±1350.78	428.34±36.14	32.58±2.36
VIII	14	37.76±0.78	598.38±31.67	19664±2588.73	512.88±63.33	32.00±3.59
IX	7	41.14±0.71	796.50±28.64	31972.28±3047.45	779.59±77.28	40.14±3.69
X	6	43.81±0.57	1109.95±69.15	48341.66±2609.29	1103.2±57.10	44.09±2.10
Total	**57**	**36.11±0.67**	**572.86±33.81**	**20671.51±1738.23**	**543.50±37.80**	**34.21±1.42**

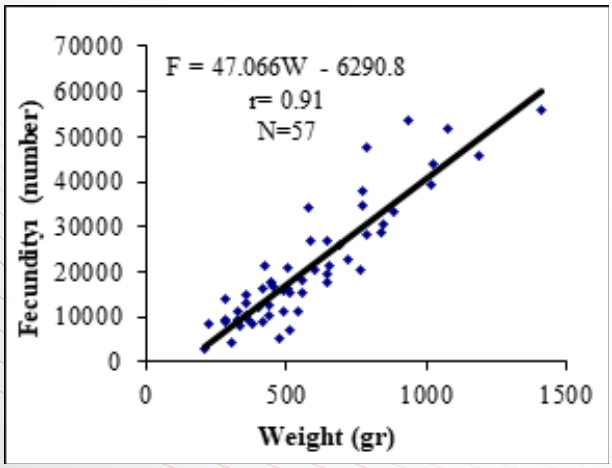


Figure 3A. Fecondity-body weight relationship of *C. trutta* population

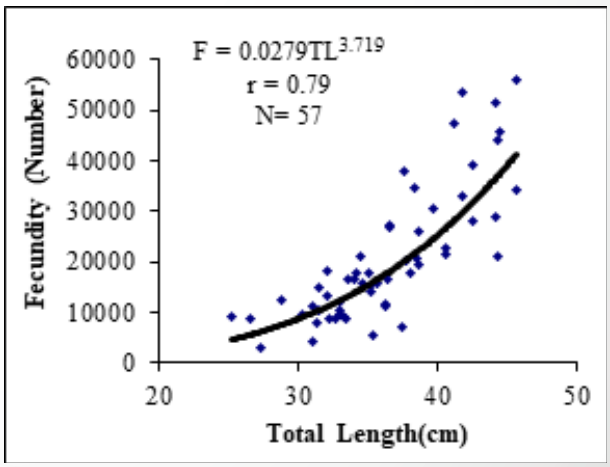


Figure 3B. Fecondity-body length relationship of *C. trutta* population

First Maturity Length

The first maturity length of *C. trutta* was determined for male and female individuals as 22.95 cm and 24.82 cm, respectively. It was found that males reached mature sex earlier in length (Figure 4).

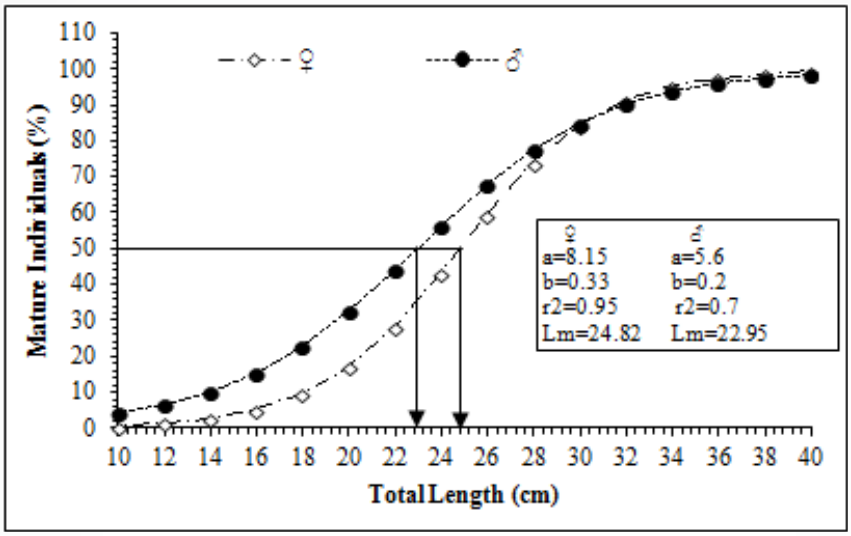


Figure 4. First sexual maturity lengths of *C. trutta* population.

DISCUSSION AND CONCLUSION

A total of 420 *C. trutta* individuals were obtained during the study at Atatürk Dam Lake. It was found that 175 of these individuals were male (41.67%) and 245 of them were female (58.33%) and the male / female ratio was 0.7: 1.0. Sex ratio's were determined by Oymak et al., (2008) 1: 1.03 in the Atatürk Dam Lake; Kalkan (2008) 1: 1.02 at Karakaya Dam Lake; Bilici (2013) 1: 0.47 in the Tigris River. The sex ratio in fish varies from species to species, between populations of the same species and in the same population year to year (Nikolsky, 1963).

It was determined that the GSI values of the *Capoeta trutta* population in the Atatürk Dam Lake reached their maximum in May, and their spawning period were determined as May-August. In different studies, although the reproduction period of *C. trutta* was reported in different months, it is generally reported as summer months, as in this study (Table 2). It is expected that the reproduction period will be different due to the differences in water temperature from environmental factors.

The condition factor values of *C. trutta* population and the values obtained from different studies are given in the Table 2. The difference in the condition factor may be related to gender, age, season, sexual maturity, reproduction, habitat, nutritional conditions, nutrient richness and variety (Çetinkaya et al. 2010).

The average egg diameter reached its highest value in June (1.79 mm) during the spawning period. The egg diameter of *C. trutta* was reported to be between 0.09 and 2.20 mm in different studies (Table 2). Egg diameter can change according to fish species and size. The individuals living in different environments of the same species can also spawn different-sized eggs (Bircan and Polat, 1995).

Table 2. Reproduction biology results of *C. trutta* population in different studies.

Reference	Reproduction period	Condition Factor		Fecundity	Egg Diameter	Sexual Matury Length	
		♂	♀			♂	♀
1	June	1.36-1.67 (♂+♀)		1259-20935			
2	May-Aug	1.14-1.36	1.12-1.40		0.41-1.76	20.23*	19.93*
3	June-July			104440-61425	0.68-1.11		
4	March-June	1.22-1.38	1.15-1.33		0.37-1.04		
5	May-June			6871-33252	0.42-1.69	19.90*	19.90*
6a	May-June	1.16-1.51	1.05-1.41	2870-29930	0.60-1.10		
6b	June-July	1.08-1.45	1.16-1.38	5192-56000	0.60-1.20		
6c	June-Aug	1.18-1.51	1.17-1.52	3381-45125	0.50-2.20		
7	May-June	0.82-1.09	0.87-1.16	1362-15428	0.21-1.55	19.35	20.77
8	May-Aug	0.92-1.22	0.97-1.11	5819-48341	0.69-1.79	22.95	24.82

1.Polat (1987); 2.Bozkur t(1998), 3.Örün and Erdemli (2002), 4. Çökmez (2005); 5.Oymak et al. (2008); 6.Düşükcan and Çalta (2012), 7. Gündüz et al (2018), 8. This study

* Fork length.

It has been determined that the fecundity of *C. trutta* in Atatürk Dam Lake increases depending on age. While lowest mean fecundity was detected IV. age group, highest mean fecundity was calculated X. age group. In some studies, fecundity values was given Table 2. Nikolsky (1963), stated that these differences in the number of eggs may vary depending on fish age, length, weight, egg size, nutrition, season and habitat conditions.

In this study, reaching length to maturity was determined as 22.95 cm in male and 24.82 cm in female individuals. The sexual maturity length values obtained from in some studies in different regions and in different years are given in the Table 2. The length to reach sexual maturity may vary according to the species and physical chemical and biological properties of the aquatic environment in which the species lives. Species difference, height, physiological status of fish, temperature, nutritional status and nutritional quality and other characteristics of water are effective on reaching sexual maturity (Lagler et al 1977).

As a result, in order to have a sustainable stock of *C. trutta* population in Atatürk Dam Lake, hunting prohibitions in reproduction period should be followed and individuals under sexual maturity should not be caught.

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Abstract ID: BIO-071 (Full-Text)

Condition Factor, Length–Weight and Length–Length Relationships of *Acanthobrama marmid* Heckel, 1843 From Murat River (Palu-Elazığ), Turkey

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Condition factor, length–weight and length–length relationships were determined for 361 (154 female and 207 male) *Acanthobrama marmid* caught between January 2018 and January 2019 from Murat River. The total length and the weight of the fish changed between 8.3-20.3 cm and 4.9-68.54 g, respectively. The condition factor values were ranged between 0.570 and 0.954 for all individuals. Length-weight relationships (LWRs) of *A. marmid* were calculated as $W=0.0071*L^{3.026}$ for females; $W=0.0080*L^{2.983}$ for males and $W=0.0076*L^{3.003}$ for all individuals. The growth type of *A. marmid* was isometric for female, male and all individuals. Regression analysis showed that length has significantly correlation with weight ($R^2=0.97$, $P<0.001$). *t*-test results was used for the importance condition of the regression coefficients ($t=101.678$, $P<0.01$). Length-length relationships (LLRs) were calculated as TL=0.3747+1.0901FL, FL=0.2518+1.0627SL and SL=-0.5430+0.8266TL for all individuals. LLRs were highly significant with R^2 values greater than 0.96.

***Keywords*:** *Acanthobrama marmid,* condition factor, LWRs, LLRs, Murat River

INTRODUCTION

Cyprinidae is the biggest of fish family in Turkey and they are widespread in freshwater. *A. marmid* (Heckel, 1843) is fish located in the Tigris River in Turkey and their descendants in Iran (Coad, 2013). Many studies are available in different regions of Turkey regarding the growth characteristics of *Acanthobrama marmid* (Ünlü et al., 1994; Başusta (Girgin), 2000; Başusta & Çicek, 2006; Çoban & Yüksel, 2013; Alkan-Uçkun & Gökçe, 2015, Serdar et al., 2017).

The value of condition factor is used to measure the condition or health of a species and permits the understanding of general condition, growth and reproduction of fish (Pauly, 1993). Length–weight relationships (LWRs) and length–length relationships (LLRs) are important tools in fishery research, management and assessment (Ak et al., 2009). LWRs and LLRs of fishes are used to estimate the condition of fish (weight and biomass) when only length measurements are available and are helpful about compare of life of species between habitats (Binohlan & Pauly, 1998).

The purpose of this study is to state the condition factor, length-weight and length-length relationships of *Acanthobrama marmid* from Murat River.

MATERIALS AND METHODS

The Murat river is one of the rivers that are longer than the two branches of the Euphrates in Eastern Anatolia. It's length is 722 km. Murat River, which is born from Aladağ in the north of Lake Van and has a flow rate of 220 m^3/sec, flows into the Palu and Keban Dam Lake. The coordinate of Murat River (Palu-Elazığ) sampling station (38°40'05.1"N, 39°50'59.5"E) is given in Figure 1. Fishes were caught by gillnet by researcher and local fishermen during January 2018 and January 2019. Fishes were fixed with 5% formaldehyde. Fish samples were measured for total length, fork length, standard length, weight and sexes were identified by macroscopic observation of gonads; sex ratios were determined by chi-square test (differed from 1:1).



Figure 1. Sampling stations of Murat River (Palu, Elazığ)

The condition factor values of fish were obtained by the formula $CF=(W/TL^b)*100$ (Le Cren, 1951).

LWRs were calculated with the equation $W = a*L^b$, (W is weight, L is total length, a is the intercept, and b is the slope) (Ricker, 1975). The degree of relation was calculated with the determination coefficient, R^2 (King, 1995).

LLRs were calculated with linear regression analysis using FL=a+bSL, SL=a+bTL and TL=a+bFL equations (Zar, 1999).

RESULTS

The total length and weight of females ranged from 8.3-20.3 cm (mean±sd=13.94±0.18 cm) and 4.9-68.54 g (mean±sd =22.55±0.90 g); that of the males ranged from 8.5-19.8 cm (mean±sd =14.17±0.15 cm) and 5.0-63.48 g (mean±sd =23.108±0.78 g) (Table 1). The total length-frequency was presented in Figure 2. The length class interval 11-13 cm was the most aboundant for all individuals.

Amongst the 361 specimens of *A. marmid* used for the length-weight relationship, 154 were females (42.66 %), while 207 were males (57.34 %). The sex ratio of female:male was of 1:1.34.

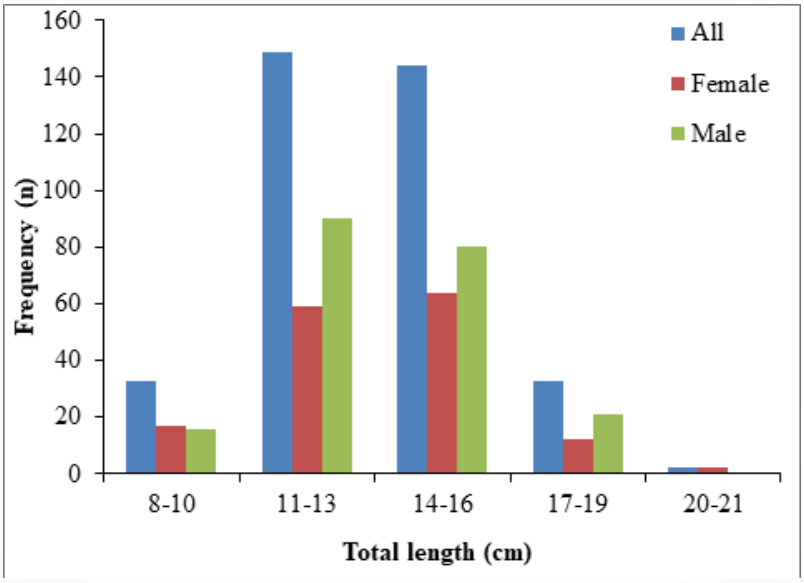


Figure 2. Total length-frequencies of *Acanthobrama marmid* in Murat River

Condition factor was (mean±sd) 0.767±0.0054 for females, 0.764±0.0047 for males and 0.765±0.0035 for all individuals ($P<0.001$).

Length-weight relationships of *A. marmid* were found as $W=0.0071*L^{3.026}$, $R^2=0.97$, SE of $b=0.0028$ and 95 % confidence intervals of $b=2.879$-3.087, t-test $P<0.05$ for females; $W=0.0080*L^{2.983}$, $R^2=0.96$ SE of $b=0.0024$ and 95 % confidence intervals of $b=2.882$-3.081, t-test $P<0.05$ for males and $W=0.0076*L^{3.003}$, $R^2=0.97$ SE of $b=0.0018$ and 95 % confidence intervals of $b=2.879$-3.087, t-test $P<0.05$ for all individuals (Figure 3); (Table 1). The growth type of *A. marmid* was isometric for female, male and all individuals. Regression analysis showed that length has significantly correlation

with weight ($R = 0.99$, $R^2 = 0.97$, $F_{1,359} = 88590.4$, $P < 0.001$). *t*-test results was used for the importance condition of the regression coefficients (t=101.678, P<0.01).

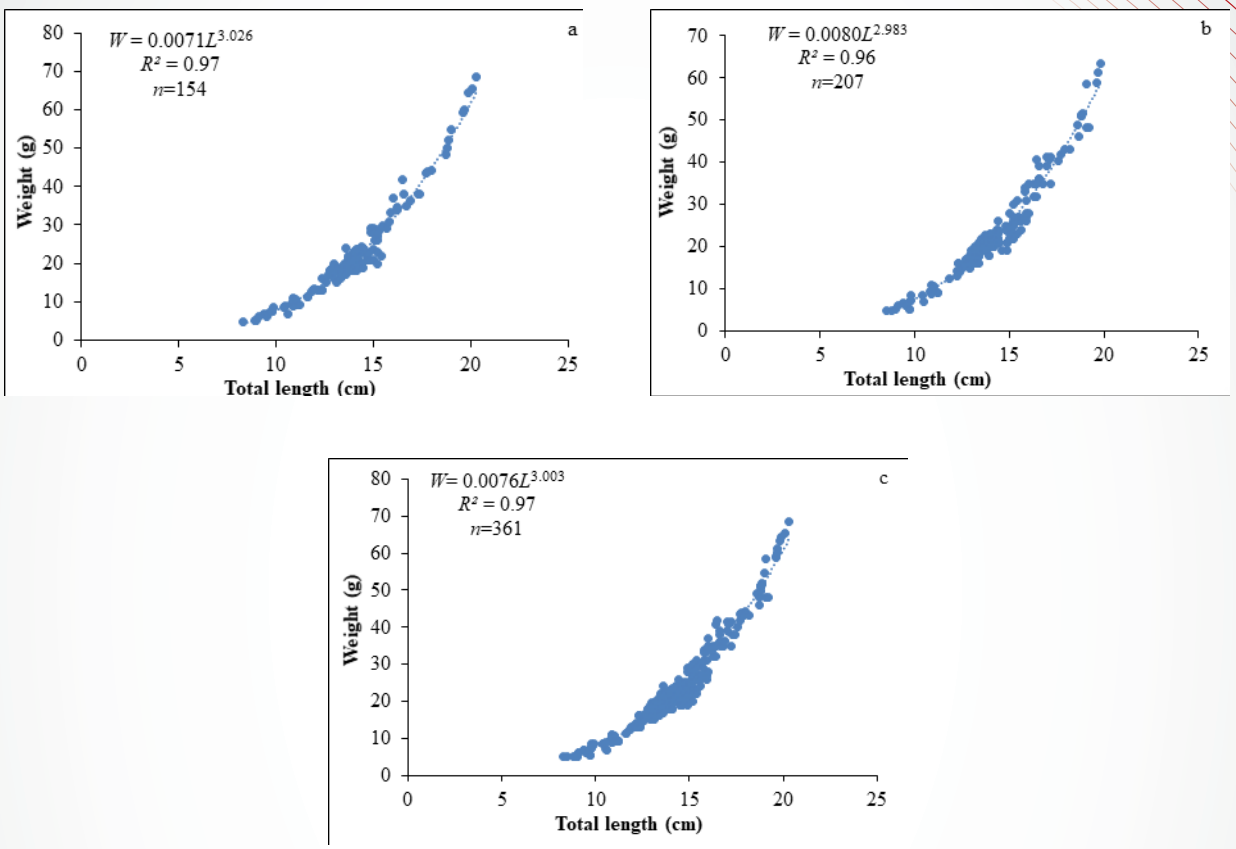


Figure 3. Length-weight relationships in females (a), males (b) and all individuals (c) of *Acanthobrama marmid* in Murat River

The length and weight measurements, number of individuals (n), regression parameters a and b of the *LWRs*, 95% confidence intervals of b, coefficients of determination (R^2) and condition factor (*CF*) of the *A. marmid* were given in Table 1.

Table 1. Length-weight relationships and condition factor of *A. marmid* in Murat River

Sex	*n*	Length range (cm)	Weight Range (g)	*a*	*b*	*95% CI of b*	R^2	*CF*
Female	154	8.3-20.3	4.9-68.54	0.0071	3.026	2.879-3.087	0.97	0.570-0.954
Male	207	8.5-19.8	5.0-63.48	0.0080	2.983	2.882-3.081	0.96	0.574-0.925
All	361	8.3-20.3	4.9-68.54	0.0076	3.003	2.879-3.087	0.97	0.570-0.954

(*n*: number of individuals, *a*: intercept, *b*: slope, *CI*: confidence limits, R^2: coefficient of determination, *CF*: condition factor).

Regression analysis between the total, fork, standard length measurements for *A. marmid* sexes separately were shown in Table 2. Length-length relationships were highly significant with R^2

values greater than 0.96.

Table 2. Length–length relationships of *A. marmid* in Murat River.

Sex	Equation	*a*	*b*	R^2
Female	TL= a + bFL	0.3091	1.0963	0.96
	FL= a + bSL	0.7781	1.0150	0.98
	SL= a + bTL	-0.4050	0.8524	0.96
Male	TL= a + bFL	0.3934	1.0882	0.97
	FL= a + bSL	0.1037	1.0766	0.98
	SL= a + bTL	0.0343	0.8197	0.97
All	TL= a + bFL	0.3747	1.0901	0.97
	FL= a + bSL	0.2518	1.0627	0.98
	SL= a + bTL	-0.5430	0.8266	0.96

DISCUSSION

In this study carried out in the Murat River, min-max total length and weight of 361 (154 female, 207 male) *A. marmid* were obtained as; 8.3-20.3 cm and 4.9-68.54 g. Başusta (Girgin) (2000) min-max total length and weight of *A. marmid* found 11.0-21.50 cm and 13.0-115.0 g in Keban Dam Lake; Başusta & Çiçek (2006) 9.2-28.6 cm from Atatürk Dam Lake; Çoban & Yüksel (2013) 8.8-27.8 cm and 6.2-182.0 g inhabiting Uzunçayır Dam Lake; Alkan Uçkun & Gökçe (2015) 9.6-16.3 cm and 9.99–67.48 g in Karakaya Dam Lake; Serdar et al. (2017) 6.1-11.7 cm and 2.4-20.5 g in the Karasu River.

The sex ratio of 1:1.34 (female:male) observed was not significantly different from the expected 1:1 ratio. The sex ratio of fish populations changes based on spawning season, life stage of the fish, spawning ground, and migration (Nikolsky, 1963).

Çoban & Yüksel (2013) found condition factor values 0.66-1.30 for females and 0.61-1.22 for males in Uzunçayır Dam Lake. Gündüz (2014) reported the average condition factor values changed in males as 0.785-1.010 and in females 0.940-1.053. Alkan Uçkun & Gökçe (2015) it was calculated as 0.54-2.28 with an average of 1.10 ± 0.24. In this study, the max-min condition factors were 0.570-0.954 for females and 0.574-0.925 for males. The fact that the condition factor is high shows that the environmental conditions are quite suitable for population dynamics studies (Blackwell et al., 2000). In this study, condition factor (*CF*) showed insignificant variation for female and male individuals of *A. marmid* ($P>0.05$), but it can be said that the environmental conditions are not suitable for *A. marmid* in this region since the condition factor value is less than 1.

The parameter *b* of length–weight relationships for all groups were within the expected ranges of 2.5-3.5 (Froese, 2006). Başusta (Girgin) 2000, Başusta & Çiçek (2006), Gündüz (2014) and Serdar et al. (2017) reported positive allometry for *A. marmid*. Negative allometric growth has also been reported from Çoban & Yüksel (2013) and Alkan Uçkun & Gökçe (2015). In this study, the value for all individuals was found as $b=3.003$ (95 % CI of $b=2.879$-3.087). The growth type of *A. marmid* was isometric for all individuals. The differences in the *b*-values may be attributed to seasonal changes

in the water temperature and the maturity stage (Weatherley & Gill, 1987). Comparison of *LWRs* between the present study and other studies is shown in Table 3. The coefficient of determination (R^2) was found to be >0.96 highly significant value of the result. These high values of R^2 show that the length-weight relationships are linear observed range of values. Regression analyses are shown that fish length have high significant correlation with weight (p<0.001).

Table 3. Total length-weight relationship values for *A. marmid* from different regions

Habitat	*n*	Sex	*a*	*b*	R^2	Author
Keban Dam Lake	127	Female	0.000001	3.363	-	Başusta (Girgin), 2000
	85	Male	0.000005	3.086	-	
	212	All	0.000002	3.254	-	
Atatürk Dam Lake	62	All	0.00563	3.168	0.96	Başusta & Çiçek, 2006
Uzunçayır Dam Lake	264	Female	0.0120	2.926	0.93	Çoban & Yüksel, 2013
	340	Male	0.0090	3.009	0.95	
	604	All	0.0100	2.973	0.94	
Karakaya Dam Lake	342	Female	0.0290	2.678	0.77	Alkan Uçkun & Gökçe, 2015
	244	Male	0.0300	2.631	0.79	
	586	All	0.0260	2.675	0.78	
Uzunçayır Dam Lake	211	Female	0.0090	3.093	0.92	Gündüz, 2014
	204	Male	0.0060	3.169	0.95	
	415	All	0.0060	3.169	0.92	
Karasu River (Erzincan-Erzurum)	196	Female	0.0050	3.35	0.97	Serdar et al., 2017
	169	Male	0.0058	3.27	0.96	
	365	All	0.0055	3.30	0.97	

Length-length relationships in fish are useful for comparative studies using different length measures (Başusta et al., 2013; Ozcan & Serdar, 2018a; Ozcan & Serdar, 2018b). *LLRs* were significant (P<0.001) for all individuals with all R^2 values greater than 0.96. These results are in agreement with those of Serdar et al., (2017) work done in the Karasu River.

CONCLUSIONS

The results of this study could give useful insight for management plan and conservation of *A. marmid* in Murat River.

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Impact of The Growth and Development of Broccoli (*Brassica oleraceae* L.) Seedlings on the Water quality of a Small Scale Aquoponic System

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Aquaponic is a recirculating system that combine fish (aquaculture) and plant (hydroponics). This study presents data obtained through trial on small-scale aquaponics system. The aim of the study is to determine the impact of aquaponics on some physical properties of the water quality.

The trial was conducted on Goldfish (*Carassius auratus*) (20 fish in each three aquarium) and Broccoli (*Brassica oleraceae* L.) seedlings over a period of 48 days in small scale ebb flow aquaponics. An eighty-litre aquarium containing 20 specimens was used as a control to compare the impact of the system on the water quality. Temperature, dissolved oxygen (DO), pH, salinity and electrical conductivity (EC) were measured daily by Hach HQ40D portable meter. Turbidity was measured daily by Hach 2100Q portable turbidity meter.

Mean (± S.D.) values of water temperature, DO, pH, EC, and turbidity during the trial were 22.7±0.9°C, 6.6±0.6 mg/L, 7.5±0.2, 372±58 µS/cm, 1.6± 0.8 NTU in fish tanks of the aquaponic system, respectively. Mean (± S.D.) values of water temperature, DO, pH, electrical conductivity, and turbidity during the trial were 21.5±0.8°C, 7.0±0.4 mg/L, 7.7±0.2, 355±55 µS/cm, and 0.8± 0.5 NTU in control aquarium, respectively. There was not any significant differences between aquaponic aquariums. Water temperature of aquaponics was significantly higher than control aquarium ($p \leq 0.0001$), most probably due to the recirculation of water in the system. pH was significantly higher in control aquarium ($p \leq 0.0001$). There was no adverse effect on fish in aquaponic system.

Our results revealed that aquaponic system has a positive impact on pH which is important for fish health since sudden changes in pH can be harmful to fish and rising pH can also increase the toxicity of chemicals such as ammonia. According to the results the Broccoli is suitable for aquaponic system with gold-fish culture.

Keywords: Aquaponic, Broccoli, Goldfish, Turkey, Water Quality

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Abstract ID: ECO-083

Investigation of Some Heavy Metal Parameters in İznik Lake and Related Streams

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In this study, the surface water of Lake Iznik lake and directly or indirectly linked to the stream and point sampling studies performed in iron (Fe), chromium (Cr), manganese (Mn), aluminum (Al), cadmium (Cd), lead (Pb), mercury (Hg), zinc (Zn) and nickel (Ni)to evaluate the accumulation.

In a study conducted in 2014 determined on a seasonal lake and lake with 19 stations directly or indirectly linked to 14 different points of iron (Fe), chromium (Cr), manganese (Mn), aluminum (Al), cadmium (Cd), lead (Pb), mercury (Hg), zinc (Zn) and nickel (Ni) parameters were examined. Examples of complete chemical analyzes are spinning in the Egirdir Fisheries Research Station Chemistry Laboratory was conducted using the spectrophotometric method by graphite furnace atomic absorption spectrophotometer. The obtained data were analyzed in the light of existing criteria and literature.

According to the Regulation on Surface Water Quality (YSKY, 2016), when the internal water resources are evaluated according to classes, it is found that the values obtained are below the limit values. However, it is concluded that there is metal input from the lake and some points connected to the lake and the effects around the lake should be controlled by effective control systems and their effects should be reduced.

Keywords: İznik Lake, heavy metal, lead, zinc, nickel

Abstract ID: ECO-001 (Full-Text)

Investigation of Water Quality and Some Heavy Metals of Sediment in Deriner Dam Lake, Artvin, Turkey

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In this study is to investigate the water quality criteria and some heavy metals (Cu and Pb) to reveal the current situation in terms of pollution in the Deriner Dam Lake. The water quality and metal values (Cu and Pb) were from 6 stations, range of 0-100 m, in spring season, in 2017. Temperature, pH, and oxygen were measured using YSI-556 prop in situ. Metal concentrations were determined using an inductively coupled plasma-mass spectrometer (ICP-MS) analysis in ACME Lab., (Vancouver, BC. Canada). Determining the level of pollution, It should be compared to the reference values Worldwide avarage shale value (WASV), Continental crust values (CCV), Toxicity referance values (TRV) and Sediment guidance values (SGV) commonly used in pollution studies. The sand fractions were generally dominant (>49%) in the surface sediments. Also, values of pH, temperature, and oxygen were ranged from 7.84 to 8.24, from 7.49 to 16.98 °C, from 6.45 to 7.58 mg/L, respectively. Metal concentrations in sediments were varied from 325.12 to 575.25 µg g^{-1} for Cu, from 129.99 to 196.95 µg g^{-1} for Pb. The highest metal values were seen at D4 and D5 stations, which represent road construction sites, ready-mixed concrete facilities and river entrances. Mean values of Cu and Pb in sediments were higher than the reference values WASW, CCV and TRV. According to classification of SGV, mean values of Cu and Pb determined as class C- highly contaminated. Based upon the results from this study Cu and Pb can be considered as major contributor to ecological toxicity in Deriner Dam Lake.

Keywords: Water quality, Heavy metal, Sediment, Pollution

INTRODUCTION

The Deriner Dam Lake is located on the Coruh basin in the center of the Artvin city, including the area where many incinerators are discharged. Despite having a small area with an area of 7436 km, Artvin province is exposed to significant floods during certain periods of the year due to both the heavy rainfall, especially the coastal part, and its topography is steep and rough. Floods, which are seen to be significant, cause high erosion in the region. The sediment brought by Coruh River annually is 5.8 million m^3. For this reason, the river basin is one of the most exposed areas in Turkey (Hasimoglu, 2015). Lakes are inland bodies of water that lack any direct exchange with an ocean. Lake ecosystems are made up of physical, chemical and biological properties contained within these water bodies. Lakes may contain fresh or salt water. Lakes of all types share many ecological and biogeochemical processes and their study falls within the discipline of 'limnology'. Lakes are superb habitats for the study of ecosystem dynamics: interactions among biological, chemical and physical processes are frequently either quantitatively or qualitatively distinct from those on land or in air. Water does contain different types of floating, dissolved, suspended and microbiological as well as bacteriological impurities. Some physical test should be performed for testing of its physical appearance such as temperature, pH, turbidity, TDS, etc., while chemical tests should be perform for its BOD, COD, dissolved oxygen, alkalinity, hardness and other characters. And, the water quality in lakes depend on theese features (Bhateria and Jain, 2016; Spellman and Drinan, 2012). Besides these features, one of the most important sources of heavy metal pollution in aquatic environments is terrestrial erosion. In this way the metal compounds enter the water column and accumulate in the sediment layer after sedimentation. These pollutants with different roots accumulating in the sediments can migrate back to the water column after sedimentation by physical, chemical and biological processes. Thus, sediments are a source of environmental pollutants in aquatic environment. Therefore, the role of sediment analysis is great in determining the pollution that exists in aquatic environments (Abrahim and Parker, 2008). In this study, the concentrations of metal deposited in the sediment layer, Sediment Quality Guide (SOQ), World Average Shale Values (WASV), Continental Crust Values (CCV), Toxicity Reference Values (TRV) and Sediment guidance values for fresh water (SGV) current situation will be examined by reference values accepted in world literature.

MATERIALS and METHODS

This study is a survey of heavy metal pollution and water quality in the southwestern Black Sea region of Artvin province. In this context, the research was carried out in Deriner Dam Lake and Ardanuç Stream, which is a branch of the Coruh river that feeds this lake (Figure 1). Metal concentrations (Cu and Pb) were determined in a total of 6 stations, 4 of which were lake (D1,D2,D3 and D4) and 2 of which stream (D5 and D6) that was lake feeding (Table 1). The water quality and metal values were from depth changing between 0 and 100 meters, spring season, 2017.

Table 1. The coordinates of study area

Location	Stations					
	D1	D2	D3	D4	D5	D6
Latitude	41°10'03,87"	41°09'30,06"	41°08'23,53"	41°53'44,47"	41°50'12,60"	41°45'25,50"
Longitude	41°52'42,46"	41°53'40,30"	41°07'10,88"	41°52'24,80"	41°46'13,80"	41°41'26,10"

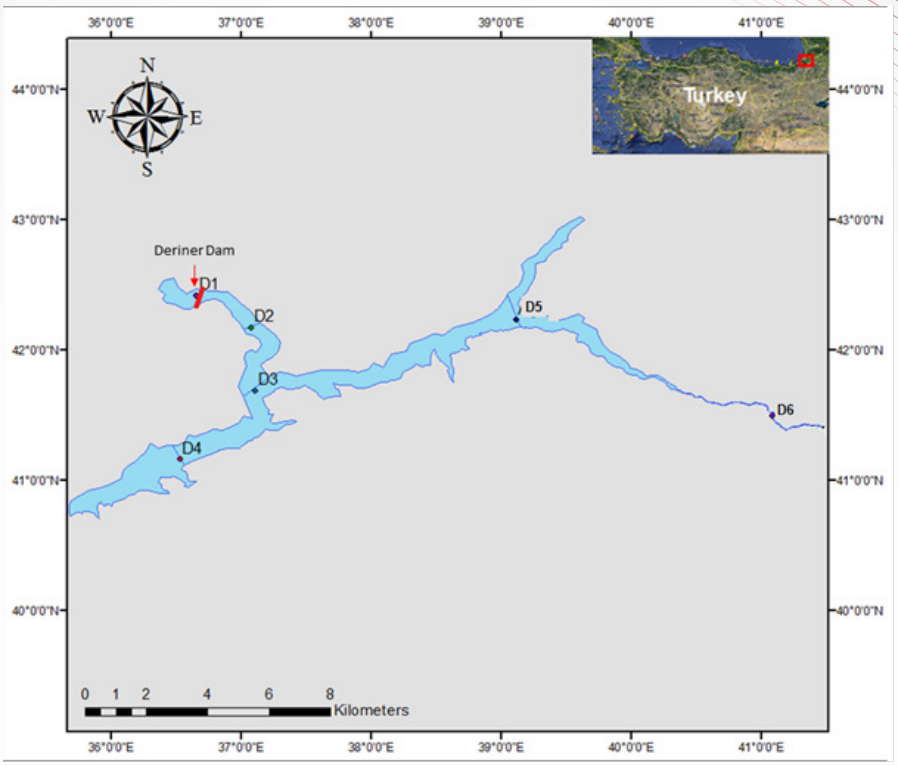


Figure 1. Map of the study area

A sediment core sampler was used to collect sediment samples from 6 different stations. The stations were chosen so as to cover the metal pollution affected area. The samples were placed in polyethylene bags using a clean plastic spatula to prevent contamination. After collection, all samples were placed in refrigerator, and transported to the laboratory where they were stored at – 18 ˚C until being analyzed (Csuros and Csuros, 2016). Prior to analysis, samples were dried at 45 ˚C. For general physical properties of the sediment around Deriner Dam Lake, sediment samples were sieved using distilled water in an AS 200 vibratory sieve shaker (Retsch, Germany). Sediment size analysis was performed using wet sieve analysis method. For metal analysis, sediment samples were sieved to pass <63 µm because metals exhibits usually a higher affinity to small grains (Morillo et al., 2004). Physicochemical parameters such as temperature, pH and oxygen, which are directly related to the mobility of the metals, were determined in situ and measured using a Hach Lange HQ40D multi meter. Metal concentrations were determined using an inductively coupled plasma-mass spectrometer (ICP-MS) analysis in ACME Lab. (Vancouer, BC. Canada). The accuracy of the analysis was ranged from 95.81% to 130.50%. The volume fraction of porosity (n) can be defined as the reaction of void space (VV) relative to the apparent total bulk volume (VT) of the sample. Porosity is described in percentage (Klobes et al., 2006).

$$n=(VV/VT)*100 \quad (1)$$

Determining the level of pollution, the metal values will be compared to the reference values Worldwide avarage shale value (WASV), Continental crust values (CCV), Toxicity referance values (TRV) and Sediment guidance values (SGV) commonly used in pollution studies.

RESULT and DISCUSSION

Physicochemical properties were given in Table 2 in sediment around Deriner Dam Lake. The sand fractions were generally dominant (>60%) in the surface sediments. Also, values of porosity, pH, temperature, salinity and oxygen were ranged from 35.5 to 57%, from 7.17 to 8.14, from 12.2 to 14.7 ˚C, from 6.45 to 8.35 mg/L, respectively (Table 2).

Table 2. General properties of sediment and pore water around Deriner Dam Lake

Area	Physicochemical properties								
	Depth	Gravel	Sand	Clay	Porosity	Temperature	pH	Oxygen	Oxygen
	m	%	%	%	%	˚C		%	mg/L
D1	34	1.7	72.6	25.7	40	14.4	7.47	65.4	8.05
D2	43	3.5	69.3	27.2	43	12.2	8.14	77.3	8.5
D3	55	5.8	78.1	16.1	33.5	13.7	7.41	71.3	7.38
D4	60	1.7	65.6	32.7	56	13.2	7.29	65.7	6.45
D5	1.5	7.1	84.8	8.1	57	14.1	7.43	75.4	8.35
D6	2.4	8.9	68.7	22.4	51.5	14.7	7.17	70.6	8.08

Considering the distribution of the material in general, the gravel was founded 1%, the fine gravel was founded 2%, the very large sand was founded 2%, the coarse sand was founded 7%, the medium sand was founded 9%, the fine sand was founded 38%, the very find sand was founded 16% and the clay was founded 25% in the study area (Figure 2).

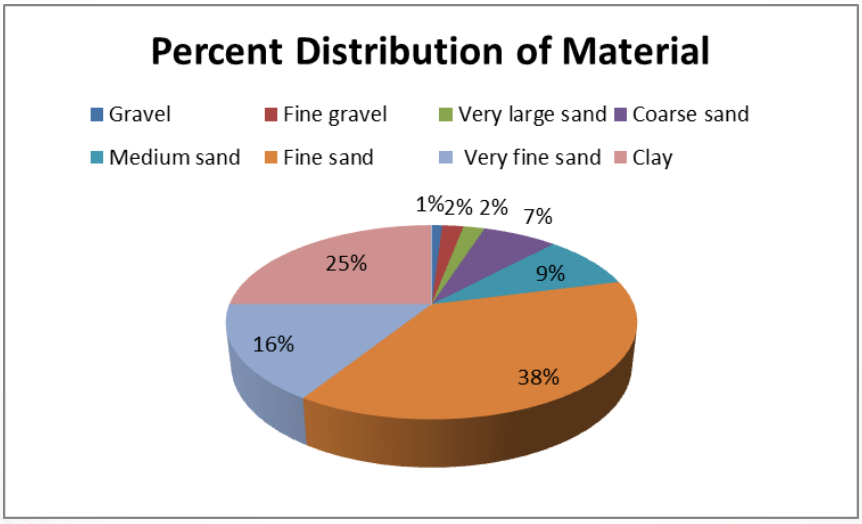


Figure 2. The proportional material in Deriner Dam Lake

Metal concentrations in samples collected from the study area were given in Figure 3. Metal concentrations in sediment were varied from 305.5 to 367.2. ppm for Cu, 130.7 to 196.9 ppm for Pb. The highest metal concentrations were determined in D5 and D6 stations (Figure 3). The means of Cu and Pb were founded as 328.5 ppm and 150.6 ppm, respectively.

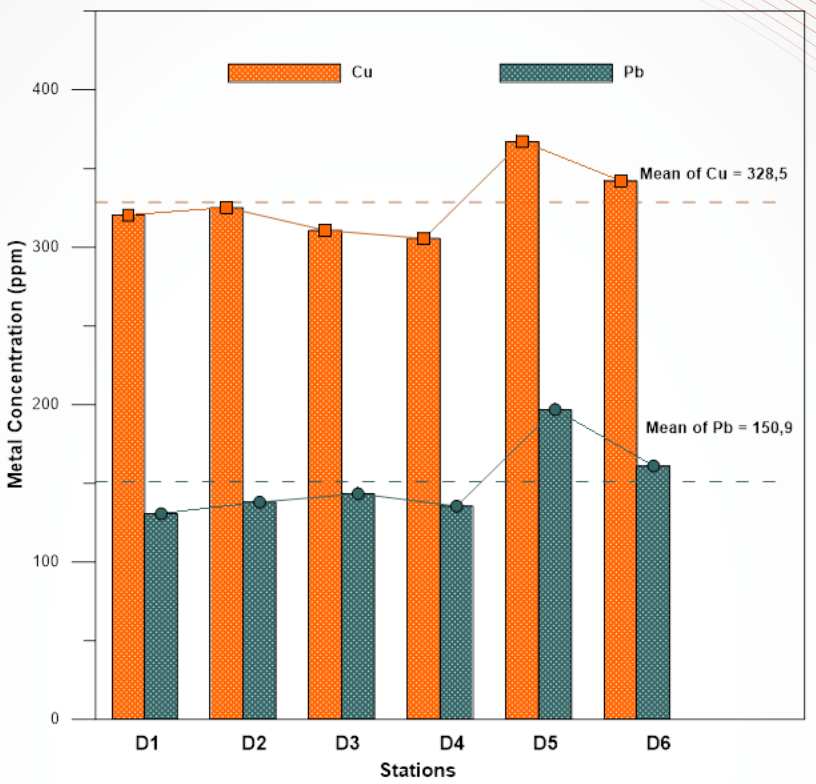


Figure 3. Change of metal values according to stations

When the metal concentrations were compared with the reference values accepted in the world literature, the values of presented this study were determined at higher levels. According to the sediment guidance values for freshwater provided by the United States Environmental Protection Agency (US EPA, 1997) sediments were classified into three classes: low risk, moderately contaminated, and highly contaminated (Table 3). According to this classification, the metal values obtained as a result of the study are considered to be included in the class C (higly contaminated).

Table 3. Classification of metal concentration according to pollution limits

Metal	Mean value	WASV	CCV	TRV	SGV for fresh water		
					Class A low risk	Class B moderately contaminated	Class C highly contaminated
	ppm	ppm	ppm	ppm			
Cu	328.5	45	55	16	<32	32-150	>150
Pb	150.6	20	12.2	31	<36	36-130	>130

WASV: Worldwide average shale value; CCV: Average crust value; TRV: Toxicity reference value SGVs: Sediment guidance values for fresh water sediment;

CONCLUSIONS

Metals are directly or indirectly affected by some of the reactions during storage in the sediment layer. The geochemistry of the bottom sediments affects the water column chemistry in this way and heavy metals stored in the polluted sediments therefore form a toxic effect not only on the benthic organisms but also on the living environment in the water column. For these reasons, it is important to examine the metal content of sediment especially in limnetic ecosystems. According to the results, the highest metal concentrations and environmental risks in Deriner Dam Lake, were observed in D5 and D6 stations for Cu and Pb. Stations D5 and D6 represent the points, feeds Deriner dam lake, of the Ardanuç stream that transporting all the terrestrial pollutants reservior of the Ardanuç district. Toxic metal concentration can vary depending on many factors, such as pH, dissolved oxigen, temperature,and redox conditions. These factors are also related to activity of meteorology. At the region, in spring, the changes in meteorological conditions are fast and strong. This confirms the role of rain in removing metal-contaminated airborne dust (Melaku et al., 2008). Furthermore, when considering the four stations that the Deriner dam has in its own context, it is observed that the high metal concentrations are at the D3 and D1 stations, which are denoted by the clay material intensively. For example, there are many concrete facilities, gas stations, asphalt facilities, road works on the lake and river branch that feeds the lake.The high pollution levels around Deriner Dam Lake reveal the high natural mineralogical structure of the lake and its surroundings, indicating that the anthropogenic impact on the region should be considered. Today, the quality of the aquatic environment is being threatened by different types of pollutants from natural and anthropogenic sources; however, human activity is the main reason for the pollution (Ozseker and Eruz, 2017). Considering the environmental impact of mines, it is known that wastewater that flows to the waterways from mining operations changes the natural characteristics of surface water and forms layers of different sediments in the aquatic environment, which adversely affects the aquatic ecosystem. Depending on the anthropogenic effects, wastewaters from mining operations and Cu waste cause high levels of environmental pollution resulting from environmental conditions, such as rain, and erosion causes high levels of metal concentration in the region (Ozseker, 2019). Based upon the results from this study Cu and Pb can be considered as contributor to toxicity around the Deriner Dam Lake.

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Abstract ID: ECO-031 (Full-Text)

Zooplankton of Tatar Dam Lake Tunceli - Turkey

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Zooplankton of Tatar Dam Lake has been investigated monthly between January and December 2016. The samples were taken from 5 stations. Tatar Dam is located within the boundaries of Kovancılar and Karakoçan districts of Elazığ province and Mazgirt district of Tunceli province. Tatar Dam is an energy production facility with 5379 km^2 drainage area. Its total volume is 299,57x10^6 m^3.

A total of 49 zooplankton species were recorded in Tatar Dam Lake during the survey. When the number of species in zooplankton groups in Tatar Dam Lake is examined, it is observed that the number of taxa of rotifers in each station is higher than the number of taxa of the other groups, whereas Copepoda group has the least number of species.

Rotifera were represented at 1st station with a maximum 22 species, while the minimum species was recorded at 5th station with 14 species. The number of Cladocera species ranged from 9 to 13. *Polyarthra dolichoptera* from Rotifera group was the most found species in terms of frequency of occurrence among zooplankton species. *Bosmina longirostris,* the most observed species of Cladocera group in the lake, is the most recorded species in many reservoirs. *Cyclops vicinus* was the most recorded copepod in Tatar Dam Lake.

The lowest water temperature value of the surface water of Tatar Dam Lake was measured as 4.9 ^{0}C at the 1st station in February and the highest water temperature value was 26.8 C^0 at the 3rd station in August. The mean water temperature value was 15.6 ±0.9 C°.

The lowest pH value of water was measured as 8.0 at the 1st station in April and the highest pH value was 8.9 at the 4th and 5th stations in April. Also the lowest dissolved oxygen value in surface water was 8.4 mg/L at the 5th station in January and the highest dissolved oxygen value was 12.9 mg/L at the 1st station in July, the average dissolved oxygen value was 10.3 ± 0.2 mg/L. Moreover the lowest conductivity value was 229 µmho/cm at the 2nd station in February and the highest conductivity value was 427 µmho/cm at the 2nd station in July.

Keywords: Zooplankton, Rotifera, Cladocera, Copepoda, Tatar Dam Lake

INTRODUCTION

Limnological studies have an important place in revealing physical, chemical and biological events in lakes and rivers. These studies contribute to the management of fisheries, the investigation of water quality, the monitoring of pollution in lakes and rivers, the protection of ecosystems, and the regulation of human and environmental health (Crul, 1995).

As in all ecosystems, in aquatic ecosystems, the feeding of one living creature over the other and being a nutrient for another organism positively affects the efficiency of this ecosystem. Phytoplanktonic organisms in aquatic ecosystems make organic matter by using solar energy in photosynthesis and constitute the first step of the food chain in these ecosystems and these are called producers. Zooplanktonic organisms, on the other hand, have a special importance because they constitute the main nutritional ring between phytoplanktonic organisms and higher forms within the food chain established in aquatic ecosystems and are the most important part between the two food chains (Gündüz, 1984).

By determining the zooplankton fauna Tatar Dam in Tunceli province updated, the zooplankton fauna is thought to contribute to such studies in Turkey. Since there has been no previous research in the reservoir, the lake has been scientifically examined for the first time.

MATERIALS and METHODS

Tatar Dam is located within the boundaries of Kovancılar district and Karakoçan district of Elazığ province and Mazgirt district of Tunceli province (Figure 1.) The dam site is located on Peri Water, approximately 20 km northwest of Kovancılar district and approximately 2500 m upstream of Nişankaya road bridge. It is an energy production facility.

Monthly samples were taken between June 2013 and May 2014 to determine the zooplankton fauna of Tatar Dam Lake. 5 stations which are thought to represent the best lake have been determined for taking samples (Figure 1).

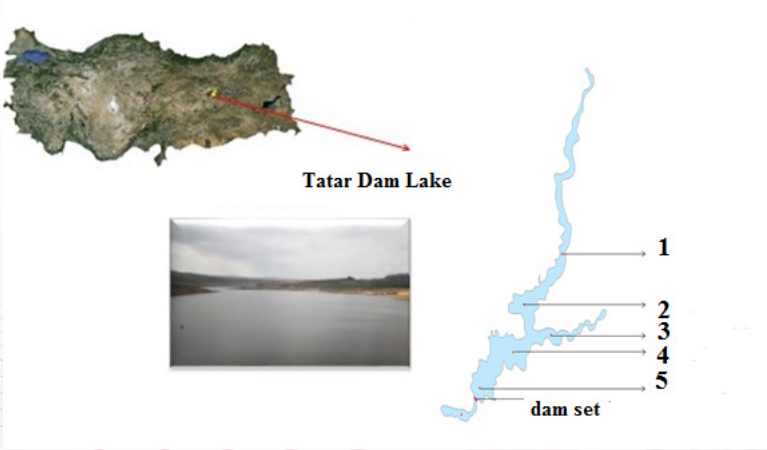


Figure 1. Working area and designated stations

Five samples were collected from each station with a plankton net of 55µ mesh and placed

into 250 ml jars and brought to the laboratory as soon as possible and the samples were stored in 4% formaldehyde. Water samples were examined under Nikon brand microscope and species were identified. Species were counted by Leitz inverted microscope. For species identification, Edmondson (1959), Kolisko (1974), Koste (1978a, b), Flössner and Krebstiere (1972), Negrea (1983), Dussart and Defaye (2001), using the relevant resources of Rotifera . Copepoda and Cladocera species were identified.

In the samples, a 10 ml volume Hydrobios zooplankton counting chamber was used to indicate the number of zooplanktons per unit volume. Leitz brand inverted microscope was used to determine the number of individuals, the jar was shaken each time for counting, and 1 ml was taken by pipette and zooplankton species were identified and counted. This process was repeated 3 times for each station. The number of organisms in m^3 was calculated by first comparing the results with the volume of the jars and then with the amount of water filtered through the plankton net. Dissolved oxygen, temperature and pH values of Tatar Dam Lake has been measured with compound meter in situ.

RESULT

A total of 49 zooplankton species were recorded in the Tatar Dam Lake during the survey. 28 species are Rotifera, 16 species Cladocera and 5 species Copepoda. During the research, zooplankton was diagnosed at each station every month. The list of zooplankton species recorded in the reservoir is given below.

Rotifera

Ascomorpha ecaudis Petry, 1850
Ascomorpha saltans Bartsch, 1870
Asplanchna girodi de Guerne 1888
Asplanchna priodonta Gosse, 1850
Asplanchna sieboldi (Leydig, 1854)
Brachionus angularis Gosse, 1851
Brachionus calyciflorus Pallas, 1766
Colurella colurus (Ehrenberg, 1830)
Filinia longiseta (Ehrenberg, 1834)
Filinia opoliensis (Zacharias,1898)
Filinia terminalis (Plate, 1886)
Habrotrocha bidens (Gosse, 1851)
Kellicottia longispina (Kellicott, 1879)
Keratella cochlearis (Gosse, 1951)
Keratella tecta (Gosse, 1951)
Keratella quadrata (Müller, 1786)
Lecane luna (Müller, 1776)
Philodina roseola Ehrenberg, 1832
Polyarthra dolichoptera Idelson, 1925
Polyarthra remata Skorikov, 1896
Proales similis Beauchamp, 1907
Rotatoria neptunia (Ehrenberg, 1830)
Synchaeta oblonga Ehrenberg, 1832
Synchaeta pectinata Ehrenberg, 1832
Trichocerca capucina (Wierzejski and Zacharias, 1893)
Trichocerca similis (Wierzejski,1893)
Trichotria tetractis (Ehrenberg, 1830)
Trichotria pocillum Müller ,1776

Cladocera

Bosmina coregoni Baird, 1857
Bosmina longirostris (Müller, 1785)
Ceriodaphnia reticulata (Jurine, 1820)
Chydorus sphaericus (Müller, 1776)
Daphnia cucullata Sars, 1864
Daphnia galeata Sars, 1864
Daphnia longispina Müller,1875
Daphnia magna (Straus, 1820)
Daphnia obtusa Kurz, 1874
Daphnia pulex Leydig, 1860
Daphnia pulchella Sars, 1903
Diaphanosoma brachyurum (Liévin, 1848)
Graptoleberis testudinaria (Fischer, 1848)
Leptodora kindtii (Focke, 1844)
Macrothrix laticornis (Fischer, 1851)
Sida crystallina (Müller, 1776)

Copepoda

Acanthocyclops denticornis (Wierzejski, 1887)
Cyclops abyssorum Sars, 1863
Cyclops vicinus Uljanin 1875
Nitokra hibernica (Brady, 1880)
Megacyclops viridis (Jurine, 1820)

The taxa numbers of zooplankton species obtained from 5 stations in Tatar Dam Lake were determined and given with pie graphics (Figure 2).

When the number of species in zooplankton groups in Tatar Dam Lake is examined, it is observed that the number of taxa of rotifers in each station is higher than the number of taxa of the other groups, whereas the Copepoda group has the least number of species. Rotifers were represented at station 1 with a maximum of 22 species, while at least station 14 was recorded at station 5. The number of Cladocera species ranged from 9 to 13. Copepoda reached the maximum number of species at station 1 with 5 species and at least station 2 was identified at station 2.

The total number of zooplankton species recorded in Tatar Dam Lake by months is given in Figure 3.

When the figure was examined, although the highest number of individuals was reached in the spring months except the first station, the autumn months at station 1 attracted attention as the months in which the number of individuals was high. Dissolved oxygen, temperature and pH values of Tatar Dam Lake Has been measured and given in Figure 4.

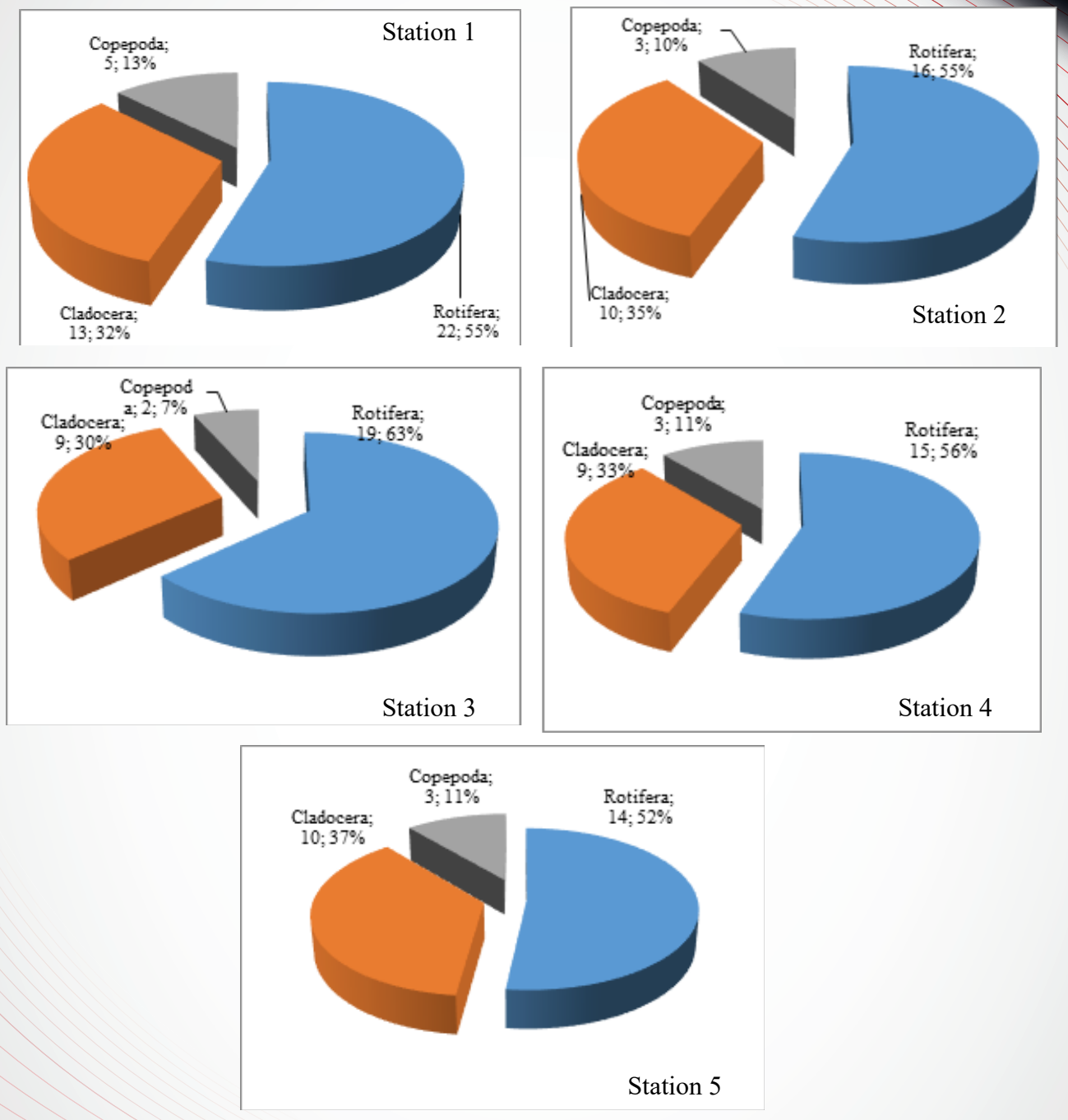


Figure 2. Number and percentage of species in zooplankton groups at stations in Tatar Dam Lake.

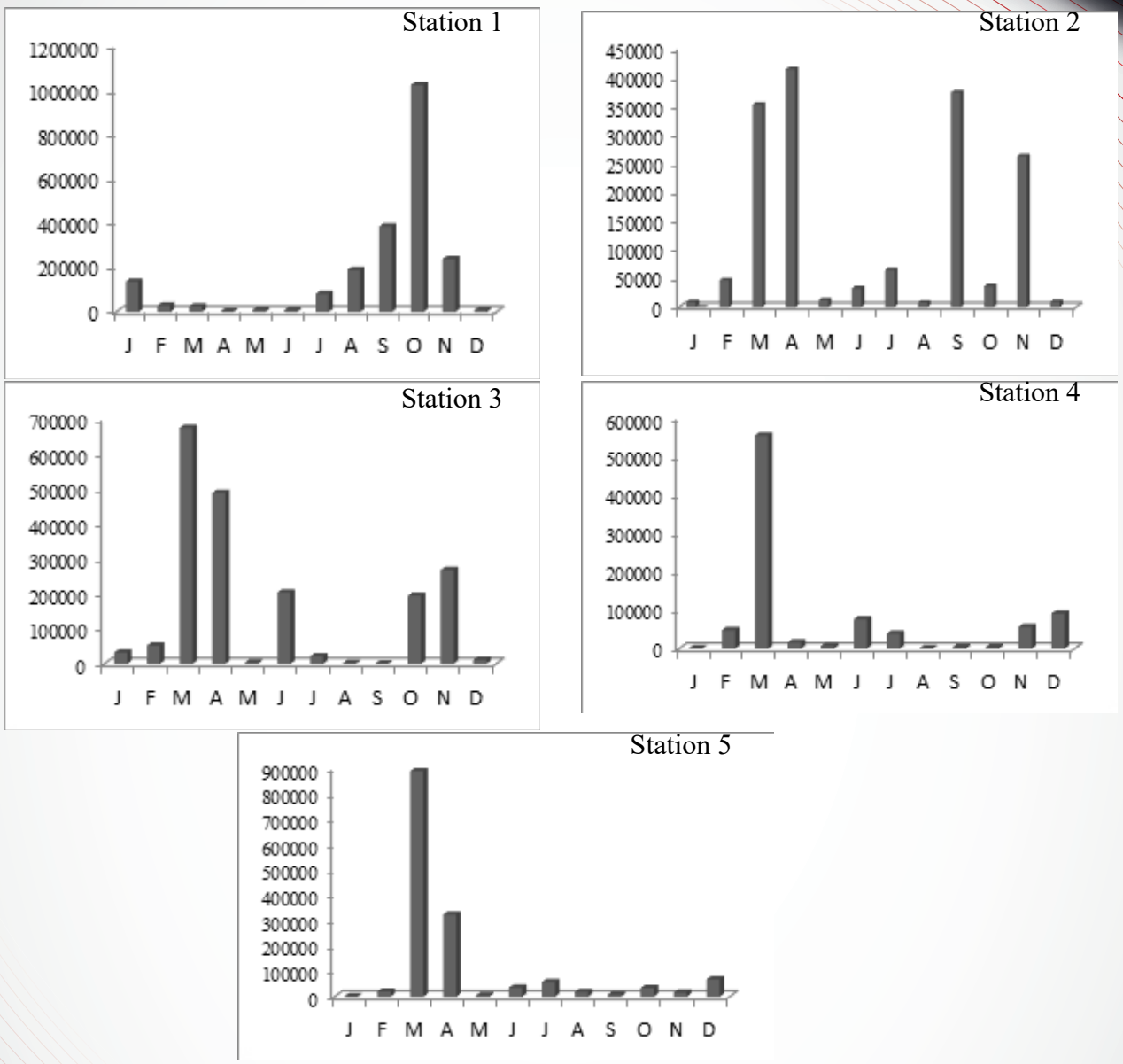


Figure 3.The total monthly number of zooplankton species recorded in Tatar Dam Lake

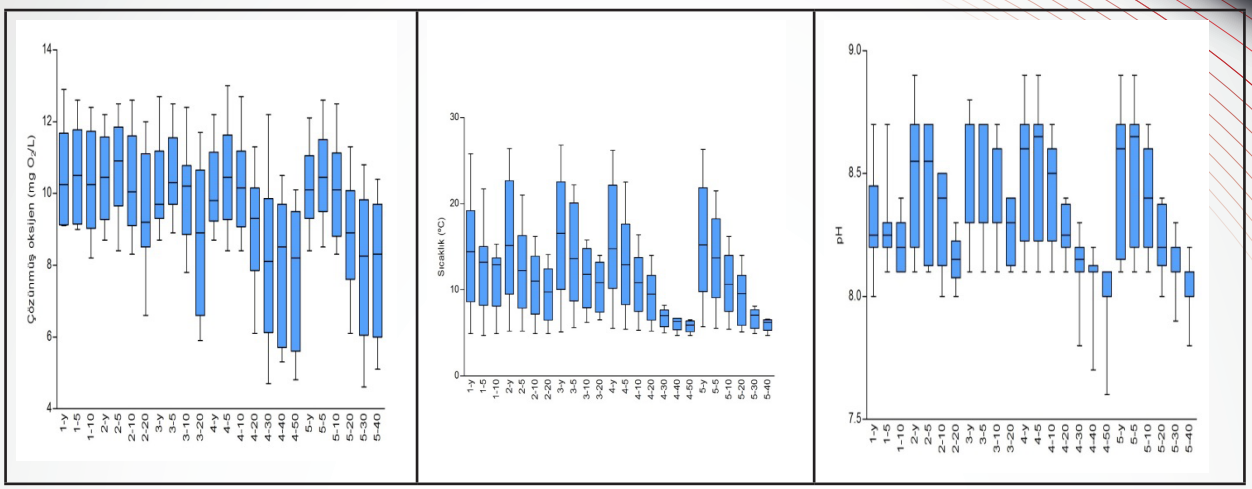


Figure 4. Dissolved oxygen, temperature and pH values of Tatar Dam Lake

The lowest dissolved oxygen value in surface water was 8.4 mg/L at the 5th station in January and the highest dissolved oxygen value was 12.9 mg/L at the 1st station in July, the average dissolved oxygen value was 10.3 ± 0.2 mg/L

The lowest water temperature value of the surface water of Tatar Dam Lake was measured as 4.9 ^{0}C at the 1st station in February and the highest water temperature value was 26.8 C^0 at the 3rd station in August. The mean water temperature value was 15.6 ±0.9 C°.

The lowest pH value of water was measured as 8.0 at the 1st station in April and the highest pH value was 8.9 at the 4th and 5th stations in April.

DISCUSSION AND CONCLUSION

Of the 49 zooplankton species recorded in the Tatar Dam Lake, 28 species were individuals belonging to the Rotifera group. In many studies conducted in dam lakes, rotifers are the first group among all zooplankton groups in terms of number of species and frequency of occurrence. Göksu (Bekleyen, 2003), Kepektaş (Saler, 2009), Beyhan (Bulut and Saler, 2014), Hancağız (Saler and İpek Alış, 2014), Kalecik (Bulut and Saler, 2013), located in the same region with Tatar Dam Lake. Karkamış (İpek Alış and Saler 2016), Özlüce (İpek Alış and Saler 2016), Boztepe Recai Kutan (Saler et al., 2017) and Rotifera in the dam lakes were represented by the highest number of species.

The highest number of zooplankton individuals in the Tatar Dam Lake was in the spring months except Station 1. The lowest zooplankton density was recorded in winter. Kesikköprü, (Yiğit, 2006), Hasan Uğurlu Suat Uğurlu (Bozkurt and Akın, 2012), Sürgü (İpek Alış, 2013), Uzunçayır (Saler et al. 2014), Kemer (Tuna and Ustaoğlu, 2016), such as the zooplankton in the dam lakes. distribution is similar to Tatar Dam Lake. In these dam lakes, spring was the most productive period in terms of the number of zooplankton species, while winter months were the period when zooplankton was least encountered.

Polyarthra dolichoptera from Rotifera group was the most recorded species in terms of occurrence among zooplankton species. The species was recorded during all seasons at each station during the survey. Kesikköprü (Yiğit 2006), Hancağız (İpek Alış and Saler, 2014), Kalecik (Bulut and

Saler 2014), Beyhan (Bulut and Saler, 2014) were the most common species of P. dolichoptera in the reservoirs.

Bosmina longirostris, which is the most observed type of Cladocera group in the lake, was the most recorded cladoser species in the reservoirs of Göksu (Bekleyen (2003), Hasan Uğurlu Suat Uğurlu (Bozkurt and Akın, 2012), Beyhan (Bulut, and Saler, 2014).

Cyclops vicinus was the most recorded copepod in the Tatar Dam Lake. Göksu (Bekleyen, 2003), Beyhan (Bulut and Saler, 2014), Kılavuzlu (Bozkurt, 2016), this species was the most recorded Copepoda species in dam lakes.

ACKNOWLEDGEMENTS

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Abstract ID: ECO-059 (Full-Text)

The Seasonal Distribution of Zooplankton in Zab River, North Iraq

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The Great Zab is an approximately 400-kilometre long river flowing through Turkey and Iraq. It rises in Turkey near Lake Van and joins the Tigris in Iraq south of Mosul. This study was conducted for determination of seasonal distribution of zooplankton in Zab River of North Iraq.

The zooplankton samples were collected from eight stations from Zab River by a plankton net (Hydrobios Kiel, 25 cm diameter 55 µm mesh size) seasonally from Spring 2018 to Winter 2019. Total 46 zooplankton species have been identified, 41 species from Rotifera, three species from Cladocera and two species from Copepoda. The highest numbers of species among these rivers was recorded in the station 7 with 34 species. The least number of species among these stations were recorded in station 5 with 1 species. Among all zooplankton was represented with Rotifera 89%, Cladocera 7% and Copepoda 4%.

During the study period in all stations rotifer species have been recorded. In spring an important increases in taxa numbers and individual numbers were recorded. The least taxa and number of individuals have been recorded in winter in all stations. Luay (2010) observed zooplankton of Zab River. He recorded peaks number of zooplakton individuals between March to May.

Keywords: Rotifera, Cladocera, Copepoda, Zab River, North Iraq

INTRODUCTION

Iraq inland water bodies occupy about 5 % of surface of the country. They are very important for the fishing economy, the irrigation of agricultural land and for human consumption, both for drinking and industrial purpose (Al-Lami et al., 1996).

Zooplankton is a very important component of the ecological quality of inland waters being a critical link between phytoplankton and higher consumers (Chalkia and Kehayias, 2013).

The significant role of zooplankton in aquatic food web and their grazing in phytoplankton populations have been recognized. Their importance as food to juvenile and adult fish is well known (Ogbeibu, 2001). Zooplankton play a role in the aquatic food web as many of them feed largely on algae and bacteria and in turn fall prey to numerous invertebrates and fish predators. This factor coupled with their high sensitivity to environmental factors, has drawn the attention of several biologists focusing on zooplankton occurrence, composition, distribution and significant role in pollution studies (Ogbeibu and Obanor, 2002).

Generally, several researches in Iraq have been published papers concerning the ecology, identification and biodiversity of zooplankton in southern and central part of Iraq which covered various water ecosystems (Al-Lami and Abbas, 2001 ; Al- Nimrawee, 2005).

Ali (2010), recorded 45 taxa of macroinvertebrate and zooplankton, dominated in Greater Zab River. 14 species of aquatic insects, 9 species of annelid, 7 species of Cladocera, 6 species each of Copepoda and Mollusca and one species each of nematode, Ostracoda and Decapoda.

The aim of the present study is to give basic primary information about the zooplankton of Greater Zab River.

MATERIAL AND METHODS

Greater Zab River is one of the main Tigris River tributaries. It flows 390 km downstream of its original source from Turkey (Aziz, 2008). The GreaT Zab River is the most prominent Tigris River tributaries that contribute the largest flow volume to the Tigris River. During their flows providing water supply for irrigation, drinking, fishing, recreation, and waste disposal for several settlement along its course (Ali, 2010). The climate is characterized by dry and warm summers and cold winters. Coordinates and map of stations are given Table 1 and Figure 1.

In this research zooplankton of Great Zap River were determined between Spring 2018 to 2019 Winter. Zooplankton samples were taken from 8 stations from Zap River. The zooplankton samples were collected with a standard plankton net (Hydrobios Kiel, 25 cm diameter 55 µm mesh size) horizontal hauls and the specimens were preserved in 4% formaldehyde solution in 250 ml plastic bottles. The species were identified according to Kolisko (1974), Koste (1978a, b), Segers (1995), Flössner (1972), Negrea (1983) Einsle (1996).

Table 1. Coordinates of Stations at Great Zab River

Stations	Coordinates
1.station	37º01'04"N 43º50'13"E
2.station	36º56'15"N 43º59'36"E
3.station	36º52'63"N 44º20'19"E
4.station	36º51'40"N 44º07'12"E
5.station	36º51'54"N 44º04'15"E
6.station	36º47'36"N 44º15'42"E
7.station	36º38'23"N 44º11'29"E
8.station	36º56'15"N 43º38'05"E

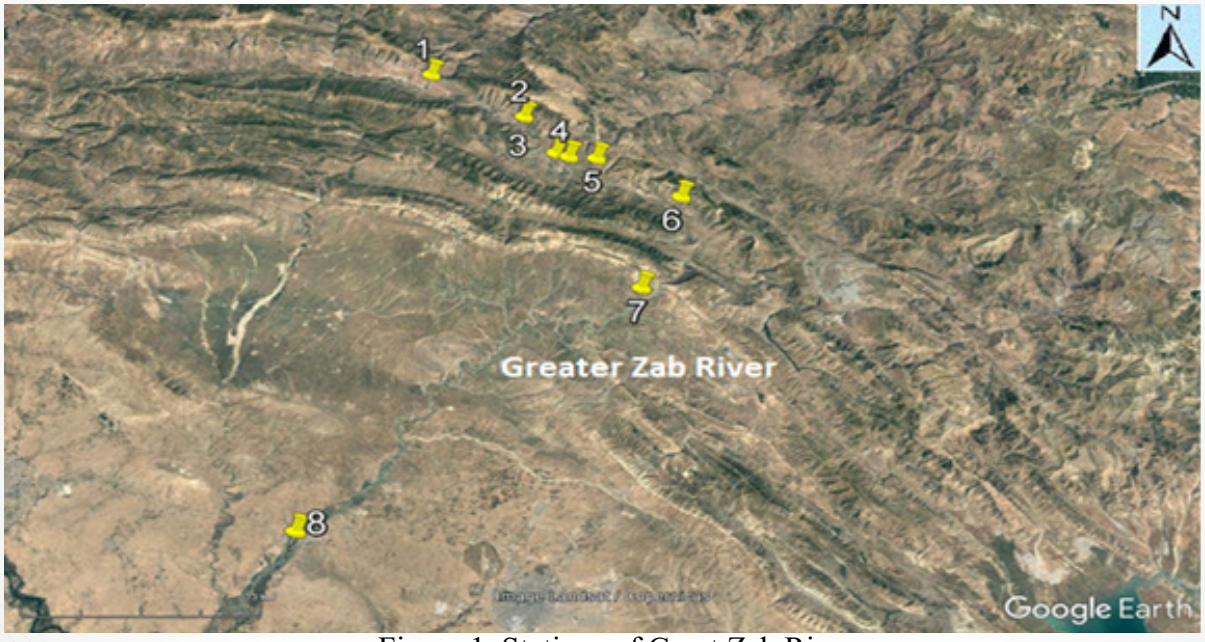


Figure 1. Stations of Great Zab River

RESULTS

In the Study totally 46 zooplankton species were identified (41 Rotifera, 3 Cladocera, 2 Copepoda). The seasonally variation of zooplankton in Zab River by stations is given in Table 2. (Table 2). Seasonally distribution of zooplankton is given in Figure 2. The distribution of zooplankton groups in Great Zab River is given in Figure 3.

Table 2. The seasonally variation of zooplankton in Great Zab River by stations

Species	Spr.	Sum.	Aut.	Win.
Ascomorpha saltans Bartsch,1870	7,8	-	-	6
Aspelta aper (Harring, 1913)	7,	-	3	-
Asplanchna sieboldi (Leydig, 1854)	-	-	7	-
Asplanchna priodonta Gosse, 1850	-	7	7	-
Brachionus quadridentatus Hermann, 1783	-	7	-	-
Cephalodella delicata Wulfert, 1937	3	-	-	-
Cephalodella forficula (Ehrenberg, 1830)	-	6	7	-
*Cephalodella gibba (*Ehrenberg, 1830)	7	2,7	-	6
Cephalodella ventripes (Dixon-Nuttall, 1901)	-	-	8	-
Cephalodella gracilis (Ehrenberg, 1830)	-	-	-	1
Colurella adriatica Ehrenberg, 1831	3	8	-	-
Epiphanes sp.	7	-	-	-
Euchlanis dilatata Ehrenberg, 1832	7	6	4	-
Euchlanis lyra Hudson, 1886	7,8	-	8	-
Floscularia ringens (Linnaéus, 1758)	-	-	-	7
Gastropus sp.	-	-	-	7
Hexarhra fennica (Levander, 1892)	-	-	7	-
Keratella cochlearis (Gosse, 1851)	2,3	7	7	-
Keratella tecta (Gosse, 1851)	7	7	7	-
Keratella testudo (Ehrenberg, 1832)	7	-	-	-
Keratella tropica (Apstein, 1907)	-	2	8	-
Lecane bulla (Gosse, 1886)	-	-	4	-
Lecane luna (Müller, 1776)	-	8	8	-
Lepadella patella (Müller, 1773)	7	-	7	-
Lindia torulosa Dujardin, 1841	7	-	-	-
Mytilina crassipes (Lucks, 1912)	7	-	4	-
Mytilina ventralis (Ehrenberg, 1830)	7	-	-	-
Notholca acuminata (Ehrenberg, 1832)	3,8	-	-	-
Notholca squamula (Müller, 1786)	3,7,8	-	-	-
Notommata copeus Ehrenberg, 1834	7	-	-	-
Notommata glyphura Wulfert, 1935	3	-	-	-
Polyarthra dolichoptera Idelson,1925	7	7	7	7
Pleutrocha petromyzon (Ehrenberg,1830)	7	-	-	-
Proales decipiens (Ehrenberg, 1832)	7	-	-	-
Scaridium longicaudum (Müller, 1786)	-	-	7	-

Table 2. (continued)

Synchaeta lakowitziana Lucks, 1930	7	-	-	-
Synchaeta oblonga Ehrenberg, 1832	7	-	3,7	3,6
Synchaeta pectinata Ehrenberg, 1832	5	-	8	3
Trichocerca capucina (Wierzejski & Zacharias, 1893)	7	7	-	-
Trichotria tetractis (Ehrenberg, 1830)	7	-	-	-
Trichotria pocillum (Müller, 1776)	-	-	4	-
Cladocera				
Bosmina longirostris (Muller, 1785)	8	7	-	-
Daphnia galeata Sars, 1864		-	8	-
Chydorus gibbus	-	-	-	1
Copepoda				
Acanthodiaptamus denticornis (Wierzejski, 1887)	-	7	-	-
Cyclops vicinus Uljanin, 1875	-	-	7	-
Total	28	14	22	9

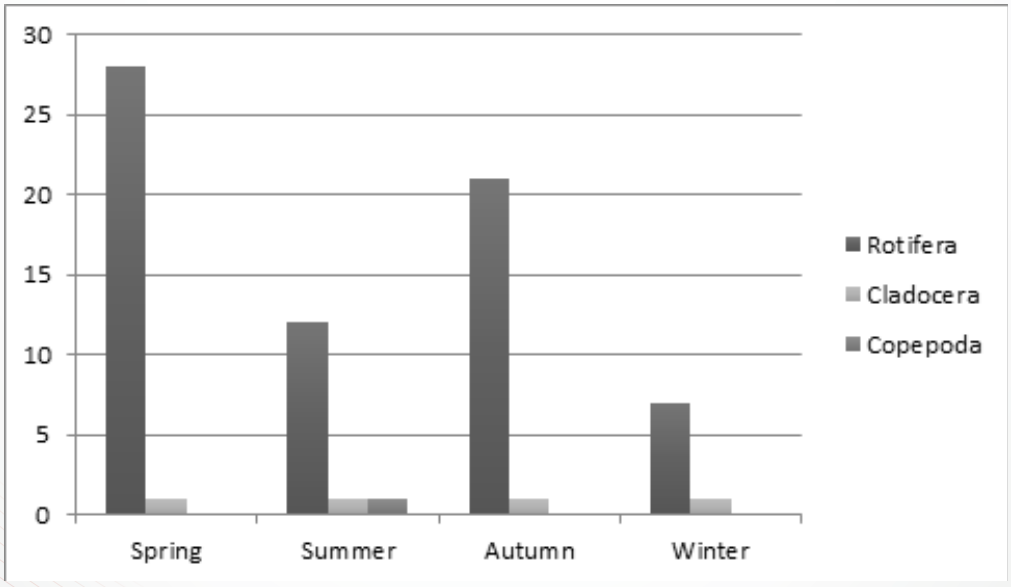


Figure 2. Seasonal distribution of zooplankton

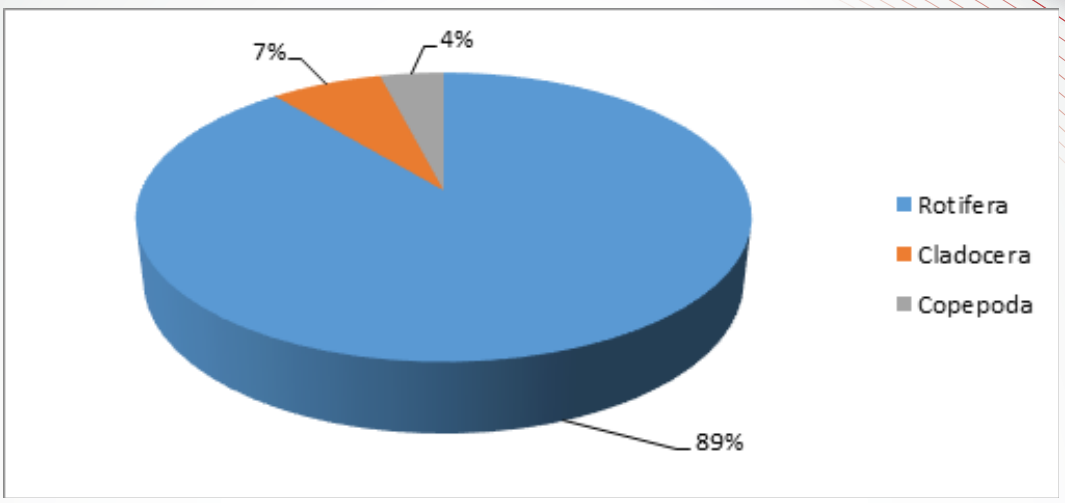


Figure 3. The distribution of zooplankton groups in Zab River

According to the seasonal variation of zooplankton in Great Zab River, the highest number of species was observed in spring season (28 taxa) and the least number of species winter season (8 taxa). *Asplanchna sieboldi, Cephalodella ventripes, Hexarthra fennica,, Lecane bulla, Scaridium longicaudum, Trichotria pocillum* from Rotifera, *Daphnia galeata* from Cladocera, *Cyclops vicinus* from Copepoda were observed only winter season. *Polyarthra dolichoptera* was recorded every season (Table 2).The distribution according to groups of zooplankton is given in Figure 3. Among all zooplankton Rotifera was represented with 89%, Cladocera 7% and Copepoda 4%.

DISCUSSION

When compared with other zooplankton groups, the highest number of species is Rotifera, followed by Cladocera and finally Copepoda. Rotifera among zooplankton groups in consequence of its capacity to reproduce parthenogenesis for a few generations, high productivity and their reaction is quick for natural changes that make them are utilized as a indicator for exchange water quality (Rajashekar et al., 2009; Shekha 2008, Nashaat, 2010). The present study, zooplankton peak reached the highest in spring and autumn. Luay (2010) also reported similar results in the Great Zab River.

As in our study, Ali (2010), recorded two peaks in spring and autumn in zooplankton in Great Zab River.

Zooplankton in this present study was dominated by Rotifera 89 % associated with 41 species; while Cladocera represented by 3 species with 7%; whereas, Copepoda involved 2 species belonging with 4%. These results were similar the consequences of (Sabri et al., 1993; Saadalla, 1998 ; Al-Nemrawee, 2005) in Iraqi fresh waters.

Sheka (2008), reported total of 40 species of zooplankton, which belonged to Rotifera (23 species), Copepoda (10 species) and Cladocera (7 species) from Great Zab. He observed Rotifera as the most dominant species with 23 species .In this study we observed that Rotifera was the most dominant species with 41 species.

Polyarthra dolichoptera from the Rotifera has appeared in all seasons. *Asplanchna sieboldi*, *Brachionus quadridentatus*, *Cephalodella delicata*, *Cephalodella ventripes, Cephalodella gracilis,*

Epiphanes sp., *Gastropus sp.*, *Hexarhra fennica, Keratella testudo, Lecane bulla, Lindia torulosa, Mytilina ventralis, Notholca acuminata, Notholca squamula, Notommata copeus, Notommata glyphura, Pleutrocha petromyzon* , *Proales decipiens, Scaridium longicaudum Synchaeta lakowitziana, Trichotria tetractis, Trichotria pocillum* were observed only season.

Shekha (2008), found *Brachionus quadridentatus*, *Keratella cochlearis, Euchlanis dilatata, Cephalodella gibba, Lecane luna, Trichotria tetractis* from Rotifera in study on the Great Zab River. These species are common in this study.

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Abstract ID: FIM-015

Investigation of Growth Features of Silver Crucian Carp (*Carassius gibelio,* Bloch 1782) Population in Devegecidi Dam Lake (Diyarbakır,Turkey)

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In this study, it was aimed to estimate growth parameters (i.e. condition factor, length-weight relationship, K, L_{∞}, t_0), of Silver Crucian Carp. Experiments were carried out in Devegecidi Dam Lake. Fish sampling carried out monthly, in different stations with a total of 12 trials, between January 2017 and December 2017. Fish ages determined through otholith examination yielded that fish ages were ranged between I and IV. Length-weight relationship and condition factor were calculated with $W=aL^b$ and $C=(W*100)/L^3$ equals, respectively. The growth parameters, L_{∞} and K for the von Bertalanffy growth function (*VBGF*) were derived from the length frequency. Total length (TL) and weight (W) were measured to the nearest 0.1 cm with a measuring board and weighed with 1 g precision digital scale, respectively. A total of 188 *C.gibelio* specimens was caught. The minimum and maximum total length was measured as 12.1 and 26.1 cm, respectively. Total weights varied from 30.5-320 g. Length-weight relationship was found as $W=0.0151L^{3.0668}$ (R^2=0.90). Mean condition factor was calculated as 1.87. The growth parameters were estimated as 24 cm, 1.098 yr^{-1}, -0.0013 for L_{∞}, K, t_0 respectively.

Keywords: *C. gibelio*, Growth parameters, Devegeçidi Dam Lake, Diyarbakır

Abstract ID: FIM-017

The Characteristics of Growth *for Capoeta umbla* (Heckel, 1843) inhabiting Devegecidi Dam Lake, Turkey

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In this study, the growth characteristics for *C.umbla* inhabiting Devegeçidi Dam Lake were determined. Fish sampling carried out monthly, in different stations with a total of 12 trials, during January 2017 and December 2017. A total of 72 specimens (male+female) were present in the samples. Fish ages determined through otholith examination yielded that fish ages were ranged between II and V. Growth in length was expressed using the von Bertalanffy growth equations. Growth parameters were estimated as L_{∞}=32.25 cm, k=0.5807 yr^{-1}, t_0=−0.673 yr for combined sex. Total lengths of the specimens varied from 16.3 to 32.5 cm and total weights varied from 43 to 354.5 g. Length-weight relationships was found as $W=0.0144xL^{2.892}$(n=72, r^2=0.96). The b values of combined sexes were b≤ 3, which represents negative allometric growth (Student's t-test; P <0.05). The mean condition factor was found as 1.033 for sex combined.

Keywords: *Capoeta umbla,* Growth, Age, Condition factor, Turkey

Abstract ID: FIM-021

A Compilation Study of Gillnet and Trammel Net Selectivity Research in Turkish Inland Fisheries

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In this study, it is aimed that to collect of the different gillnet and trammel net selectivity studies results under the same roof. This gears commonly use in Turkey's inland fishermen and also it is very important for small scale fisheries around the world. Estimated modal length (or optimum catch length) were evaluated inclusively according to both caught species by Turkish Statistical Institute (*Turkstat*) data and species which have minimum landing size (*MLS*) regulation by circular that regulated commercial fisheries in Turkey. It is thought that results will very useful for fisheries management authorities of Turkey.

There are *MLS* regulation for 18 different inland fish species in Turkey by the circular (2016/35). This species can sort as *Salmo macrostigma, Salmo caspius, Salmo abanticus, Luciobarbus esocinus, Alburnus tarichi, Tinca tinca, Clarias gariepinus, Capoeta trutta, Luciobarbus xanthopterus, Cyprinus carpio, Capoeta tinca, Sander lucioperca, Barbus grypus, Leuciscus cephalus, Perca fluviatilis, Esox lucius, Silurus glanis* and *Anguilla anguilla.* By the literature research, conducted selectivity studies were towards to only 6 species (*A. tarichi, C. carpio, Capoeta sp., S. lucioperca, E. lucius, L. esocinus*) until today, unfortunately it is fount that there are no any selectivity studies about other 12 species in Turkey. In this context, it can say that minimum mesh sizes could not determine as scientifically for fishing of the announcement *MLS.* 18 different fish species were caught in Turkey's inland fisheries by *Turkstat* data in 2018. 11 of 18 fish species are included in *MLS* regulation, while other 7 fish species are not included. 22 selectivity studies were carried out on 12 different fish species up to now. While Holt (1963) method was used in 11 studies, Share Each Length-class's Catch Total (*SELECT)* method was used other 11 studies. It is seeing that *SELECT* method has been come into prominence as against Holt (1963) in recently studies.

According to the *TSI* 2018 data, there are some fish species catching from Turkey inland resources but not included in *MLS* regulation. Using of gillnets and trammel nets for that fish species can cause negatively affect for other commercial species. This is very important problem that should not be ignored. Selectivity studies should be accelerated upon fish species that have *MLS* relation by circular but not studied gillnet and trammel selectivity to this day. It is very import issue for sustainable fisheries management.

Keyword: Gillnets, trammel nets, small scale fisheries, inland fisheries, selectivity

Abstract ID: FIM-023

The Study of Leech Species in Some Wetlands at the North Region of Azerbaijan

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This study- was carried out between May and August 2017 to determine leech species in some wetlands in the north region of Azerbaijan. In the research, leech samples were collected from a total of six wetlands: in the Shabran district from three streams (Agzybir, Lake Nohurlar, Ambil), in the Khudat district from the one stream (Nabran sources), in the Guba district from two streams (Khinalig) and in the Masally district in a small stream (Korchay). During the study, the leeches collected were transported to the laboratory in 0.5-1.0 L plastic containers with water as alive. 10% alcohol was used to narcotize the leeches. Then the anesthetized leeches were fixed in 70% ethyl alcohol and detected, the pictures were taken and identified.

As a result of field and laboratory studies, five species of leeches were determined (*Hirudo orientalis, Dina stschegolewi, Erpobdella obscura, Haemopis sanguisuga* and *Placobdella costata*). In this investigation, *Hirudo orientalis* were specified in one locality (Nohurlar Lake, Shabran), *Dina stschegolewi* also in one locality (Korchay , Masallı), *Erpobdella obscura* (Ambil and Nohurlar Lake, Shabran), *Haemopis sanguisuga* (Nabran drinking fountain, Khudat and Khynalig rural, Guba) and *Placobdella costata* in two localities (Agzybir port and Lake Nohurlar, Shabran). *Dina stschegolewi* is listed for the first time for Azerbaijan.

Hirudo orientalis, which used for medicinal purposes, should be listed in the second list of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CİTES). In Azerbaijan, there is a serious decrease in the number of medicinal leech, *Hirudo orientalis* due to intensive use and illegal exports.

Keywords: Leeches, *Hirudo orientalis, Dina stschegolewi, Erpobdella obscura, Haemopis sanguisuga, Placobdella costata,* Azerbaijan

Abstract ID: FIM-038

Mean Trophic Level of Turkey's Inland Fisheries

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According to the "fishing down the marine food web" hypotheses, mean trophic levels (MTL) of fish are declining and the present exploitation patterns are unsustainable. Catch compositions continue to shift from mainly long lived, high trophic level piscivorous pelagic fish to low trophic level planktivorous pelagic fish and invertebrates. To test whether this hypothesis holds true in relation to Turkey's inland fisheries, landings data between 2000 and 2018 from Turkstat and species trophic level (TL) data from FishBase were used to calculate weighted MTLs.

As expected, the estimated MTLs and landings data for Turkey as a whole confirmed the validity of the "fishing down the marine food web" hypothesis. Seven geographic regions of Turkey were studied separately in order to determine each region's contribution to Turkey's overall inland water MTL. All regions except for the Black Sea region showed declining MTL from 2000-2018.

Alburnus tarichi is the most commercially important inland fish species in the Eastern Anatolian region. Although the landings of *A. tarichi* (TL=2.7) declined from 2000 to 2018, their contribution to the overall landings of the region actually increased (in 2000 78% and in 2018 88%) indicating that the decrease in other species landings were higher. Similarly, another commercially important species, *Cyprinus carpio* (TL=3.1), showed a decline trend in landings. The decrease in landings of *A. tarichi* and *C. carpio* explain the MTL drop in this region.

A decline in both landings and MTL was also observed in the Southeastern Anatolia and Aegean regions. In 2000, the contribution of *C. carpio* to the total landings was 71% for the Southeastern Anatolian region and 72% for the Aegean region. However, its contribution decreased to 39% and 21% respectively in 2018. In the Marmara Region, total contribution of *Atherina boyeri (TL=3.2)* and *C. carpio* to the landings was very high in 2000 (80%) and in 2018 its contribution fell to 30%. Therefore, MTL decline in this region can be explained with this two high TL species.

In the Mediterranean region, in 2000-2011, MTL and landings are relatively indicated a plateau. After 2011 until 2018, a sharp decrease in *C. carpio* landings caused a reduction in both total landings and MTL. MTL and landings in the Central Anatolia region also declined, and this decreasing pattern is mostly due to falling production of the two higher TL species *Sander lucioperca* and *C. carpio.* Their total contribution to landings was 73% in 2000, however in 2018, their contribution reduced to 15%. In the case of the Black Sea region, landings also indicated a diminishing pattern but MTL increased. This is because the landings of lower TL species such as *Squalius cephalus and Mugil spp*. fell at a higher level than those of higher TL species.

***Keywords*:** mean trophic level, inland fisheries, fisheries management

Abstract ID: FIM-039

Fisheries and Lake Level Fluctuations in Lake Van

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This study tests the hypothesis that water level fluctuations influence the fish productivity of Lake Van. In addition, the application of a relative fluctuation index (RLLF) and its relationship with lake productivity is reviewed. The water level was measured approximately every 30 days resulting in an annual average (WL_Y). The water level time series data, available at Hydroweb, spans from 2000 to 2015. The fisheries data of Lake Van, concerning fisheries landings, was collected from the Turkish Statistical Institute and stem from the landings of two cities, Bitlis and Van between 2000 and 2015. Lake Van is inhabited by a single fish species, *Alburnus tarichi*.

The mean lake level amplitude can be calculated either as the average amplitude of interannual water levels (RLLF-a) or as the average seasonal pulse amplitude (RLLF-s). Therefore, a relative fluctuation index (RLLF) can be used to indicate long term interannual stability and average seasonal pulse. In order to test whether water level fluctuations demonstrated significant concordance with fish landings, landing data as a dependent variable and inter annual water level amplitude (WL amp) and mean water level (WL mean), as independent variables were used to test for linear regression. The regression of both interannual fluctuations (WL amp) and water levels with landings was insignificant. The yearly amplitude in water level was 0.6675 m (±0.2 m). The negative trend in the interannual fluctuations suggests that yearly amplitude has been decreasing steadily since 2000.

RLLF values lower than 1 are indicative of hydrologically stable but less productive lakes. For Lake Van, the estimated values of Seasonal fluctuations (RLLFs) and inter annual fluctuations (RLLFa) are 0.390351 and 0.097932, respectively. These RLLF values are rather low, which means that the lake is hydrologically stable with limited aquatic/terrestrial transition zone (ATTZ) interactions and a relatively low nutrient load. This may explain why no significant regression can be established between landings and water levels.

***Keywords*:** water level fluctuations, Lake Van, productivity, fisheries

Abstract ID: FIM-055

Determination of the Receiver Ranges for Acoustic Telemetry in Keban Reservoir

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Telemetry is a technology that allows data measurements to be made at a distance including telephone and computer network, radio etc. Fish telemetry involves all methods obtaining information on free-ranging fish by remote means. In recent years, many electronic tags such as radio and acoustic transmitters, passive integrated transponder tags (PIT-tags), data storage tags (DTS) and pop-up satellite tags (PSAT) have been used in fish telemetry studies. Acoustic telemetry is the transmission of ultrasonic energy or sound signals at frequencies generally above our hearing range of 20-500 kHz in water. Acoustic transmitter is attached to the fish and transmit signals to a receiver at a distance of tens of meters to a few kilometers away.

In acoustic telemetry studies, receiver (hydrophone) spacing is generally determined based on range testing and historical acoustic data. Acoustic detection ranges is highly variable according to the habitats due to noise conditions caused by weather, boats, aquatic life, etc. and/or variations in absorption.

In this study, range test was applied in Keban Reservoir in order to determine optimum detection distance of the VEMCO acoustic equipment. A total of 10 hydrophone (VEMCO VR2W-69kHz) were positioned at 100 meters intervals in Keban Reservoir. A stationary transmitter (Syntagh V13-1x-069k-3) was positioned at the first hydrophone and this transmitter sent acoustic signal 7 sec intervals. These signals were received and stored by hydrophones (receivers). At the end of range test study, the data in the receivers transferred to the computer using by Bluetooth and evaluated by VEMCO range test software.

Detection distances were determined as 100% at the distance of 149.49, 243.26 and 347.65 meters while they were 90.86% at the 464.52 m and 45.77% at the 579.46 meter. Detections rates after 773.42 meter were decreased under 3.39%. The detection rate at the 500 m was higher than 75%. In addition signal detection rates during the night were higher than during the day.

Consequently, optimum detection distance (signal detection upper than 75%) was determined as 500 m in Keban Reservoir for acoustic telemetry studies.

***Keywords*:** Acoustic telemetry, Hydrophone, Range test, Keban Reservoir.

Acknowledgement: This study is supported by TUBITAK (Project Number: 118O319)

Abstract ID: FIM-057

The Fisheries Potential of Mozambique Republic

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Mozambique is located on the southwest coast of Africa, in a strategic position where South Africa and Zimbabwe serve as a gateway to six countries that protect their around. To the north are Tanzania, Malawi and Zambia and Zimbabwe in the west, the Republic of South Africa and Swaziland in the south-west. The east is surrounded by the Indian ocean. Rivers are more in the north. The main river basins extend from north to south. Fishing in the country; traditional, semi-industrial and industrial. Perciformes and Characiformes (freshwater fish) species, Penaeidae, Callinectes, Mytilus, Scomberidae, Sparidae, Clupeidae, Scorpenidae, Carangidae family members (marine species) and marine algae are hunted frequently. The sale of seafood in Mozambique is fresh, dried and smoked. In the country, fish are usually sold randomly, without respecting the cold chain rule. There are usually sales as a whole. The country has the National Fisheries Administration, the National Fisheries Institute, the National Fish Inspection Institute, the Fisheries Fund and the Fisheries Museum.

In Mozambique, fishing and aquaculture is carried out and especially the ocean species are extensively hunted. Aquaculture is limited. Some shellfish and some Freshwater species (Tilapia) are being aguacultured. In the northern part of the country, there is the potential to grow seaweed between Mocímboa Beach and North Nampula and Inhambane in the south. Although conditions are insufficient in terms of seafood processing technology, some products are produced as finished or semi-finished products.

Keywords: Mozambique, Fisheries, Aquaculture, Potential, Seafood

Abstract ID: FIM-061

The Effect of Hook Size and Bait Type on Catching Efficiency in Angling for *Cyprinus carpio* in Keban Dam Lake (Elazığ- Turkey)

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In this study, we aimed to determine the effects of hook sizes and bait type on catch efficiency in recreational fisheries for *Cyprinus carpio* in Keban Dam Lake (Elazığ, Turkey). The study was conducted on 26 individual fishing days randomly chosen between 01 June 2015 and 01 April 2018. Carp angling has been made from shore using bottom fishing techniques which are widely used all over the world. One type of commercially available carp hook in four sizes was used. These hook sizes have been selected as the most commonly used models in carp angling. At the end of the study, 127 *Cyprinus carpio* 25.10- 86.40 cm in total length and 184.7-12241.4 g in weight were caught. The mean catch per unit effort (CPUE) values for No. 6, No. 5, No. 4 and No. 7 were 0.00069, 0.00046, 0.00038 and 0.00028, respectively. The mean yield per unit effort (YPUE) for No. 6, No. 7, No. 5 and No. 4 hooks were 2.732, 1.772, 1.285 and 0.972, respectively. The difference between both mean CPUE and mean YPUE values was statistically significant ($p < 0.001$). The highest CPUE and YPUE values were obtained with corn and the lowest CPUE and YPUE values were obtained with dough ($p < 0.001$). As a result No. 6 and corn bait type has the best efficiency for *Cyprinus carpio* angling. In conclusion, we recommend using No. 6 sized hooks and corn bait for maximum fishing efficiency of *Cyprinus carpio* in Keban Dam Lake.

***Keywords*:** Different hook sizes, Bait type, Angling, CPUE, YPUE

Abstract ID: FIM-070

Some Biological Parameters of the Medicinal Leech Populations in Kızılırmak Delta, Turkey

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Medicinal leeches are used in medicine, pharmacy, cosmetics and veterinary sectors. However, the leech populations are dramatically decreased both European and Turkish wetlands. They should be monitored for sustainable management. The aim of this study was to determine some biological parameters of the medicinal leech populations in Kızılırmak Delta, Turkey.

The study was conducted in totally 7 lakes (Lake Balık, Lake Uzun, Lake Çernek, Lake Liman, Lake Gıcı, Lake Tatlı and Lake Karaboğaz) in delta for monthly during 2018. The leeches were attracted by distributing the water and collected when they swim and transferred to the laboratory alive. Mean weight (g), mean length (cm), condition factor, length-weight relationships and age composition were determined. After the laboratory studies the all leeches were released to their habitats.

Mean weight was 1.47 ± 0.03 g, mean length was 6.3 ± 0.1 cm, mean condition factor was 0.487 ± 0.003, the length-weight relation was exponentially, the growth was isometric and totally three distinct age groups were found. It was noted that the habitat structure and effective control mechanisms carried out in the delta provide important advantages to leech populations.

Keywords: Lake, wetlands, weight, length, condition factor, growth, age composition.

Acknowledgement: This study was supported by Republic of Turkey, Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policies Grant TAGEM/HAYSÜD/G/18/A6/P1/156.

Abstract ID: FIM-004 (Full-Text)

Modeling of Non-Cohesive Sediments from Surmene River to the Eastern Black Sea

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In this study, information about the fate of non-cohesivesediments from the Sürmene River in the Eastern Black Sea region of Trabzon province was obtained by using POM sediment transport model. The POMSED model is designed to simulate with as much realism as possible time-dependent distributions of water levels, currents, temperature, salinity, tracers, cohesive and noncohesive sediments and waves in marine and freshwater systems. The model is capable of simulating the transport and fate of suspended sediments, dissolved tracers and neutrally-buoyant particles in estuarine and coastal ocean systems.

In this study, the depositional areas of the non-cohesive sediments in the marine environment were determined from the river entrance. Non- Cohesive sediments depositional areas were determined by changing parameters such as stream flow velocity, wind direction, and magnitude. Using this model, it is possible to obtain information about the fate of non- cohesive sediments in the marine environment in a short time and thus reduce the coastal erosion and sediment accumulation in coastal areas to a minimum. It has been found that the non-cohesive sediments entering the Eastern Black Sea in the Sürmene River lead to coastal agglomeration. It is stated that the necessary measures should be taken to prevent this situation.

***Keywords*:** Non-Cohesive Sediment, Marine Environment, POMSED Model

INTRODUCTION

The sediment movements and depositional areas are of vital importance in various fields, such as wetland protection and restoration, maintenance of navigation channels, dredging and dredged material relocation, effects of construction works on siltation and turbidity levels dispersion of pollution nutrient transport, etc. Along with the development of computation technology, the numerical simulation technology can provide a powerful method to cope with these problems (Chen, 2008).

Sediment transport is vital for coastal and coastal structures. It is very important to have information about the fate of cohesive and non-cohesive sediments entering the sea. Is there enough sediment entering the sea? If there is not enough sediment input, does erosion occur on the coasts? In order to find answers to such questions, it is aimed to obtain information about sediments entering the sea in a short time and thus to propose solutions and suggestions for the coastal problems. The transport and fate of cohesive and non-cohesive sediments can be simulated with POMSED.

Surmene River is selected for the study because of the active hydroelectric power plants on the river. The region is a basin with one of the highest annual rainfall and the flow rate (Eruz et al. 2005).

The Surmene River, which flows into the sea from Surmene District of Trabzon, has a large basin and a high flow stream. The average flow of Surmene River is 5.40 m3 / s according to 1999 data (Boran and Sivri, 2001). Surmene River carries a high amount of terrestrial material to the marine environment depending on river erosion.

According to Boran and Sivri, 2001, in 1999, Surmene River, 16455.159 tons of suspended solids were discharged into the Black Sea.

In the study, the fates of the non-cohesive sediments carried by the Surmene River into the Black-Sea are examined after entering the marine environment. Non-cohesive sediment depositional areas in the marine environment were modeled with direction and magnitude of wind speed components and the drift velocity of the sediment. Using this model, it is possible to obtain information about the fate of non-cohesive sediments in the marine environment in a short time and thus reduce the coastal erosion and sediment accumulation in coastal areas to a minimum.

MATERIALS AND METHODS

Study Area

Surmene River borns in the mountains of the Black-Sea, flows by carrying the natural elements, composites with the household waste and chemical contaminants of Surmene, and finally arrives at Black-Sea. In this study, the motion of non-cohesive sediments and depositional areas from beginning at the intersection of Surmene River and Black-Sea are modelled.

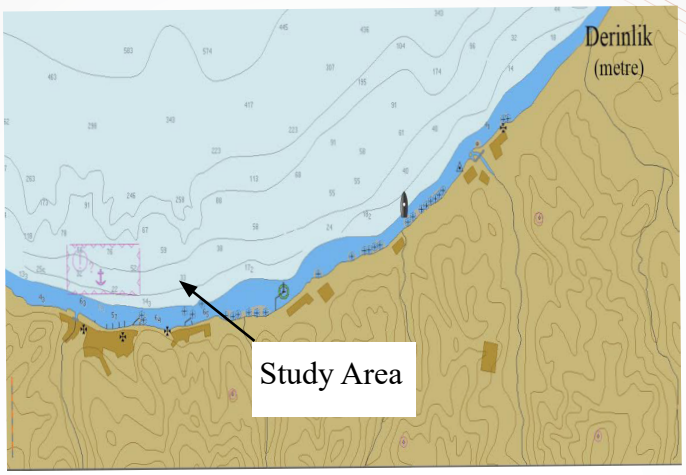


Figure 1. Bathymetric map of Eastern Black- Sea (Eruz et al. 2005).

Vertical Coordinate Representation

It has often been noted that the ordinary (x,y,z) coordinate system has certain disadvantages in the vicinity of large bathymetric irregularities. It is desirable to introduce a new set of independent variables that transforms both the surface and the bottom into coordinate surfaces called σ -coordinate system which is illustrated in Figure 2.

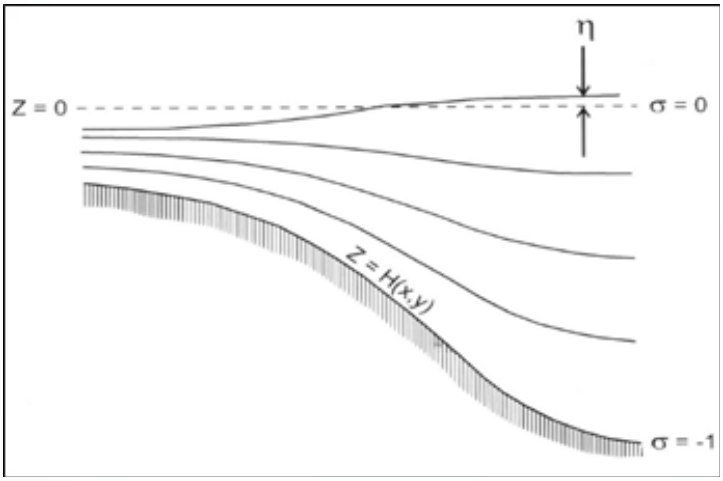


Figure 2. The sigma coordinate system (Krone, 1962).

The governing external and internal mode equations are transformed from coordinates (x,y,z) to (x*,y*,σ,t*), where

$$x^* = x\,,\ y^* = y\,,\sigma = \frac{z-\eta}{H+\eta}\,,t^* = t \qquad (1)$$

$$D \equiv H + \eta \qquad (2)$$

and by applying the chain rule; the following relationships linking derivatives in the old system to those in the new system are obtained:

$$\frac{\partial G}{\partial x} = \frac{\partial G}{\partial x^*} - \frac{\partial G}{\partial \sigma}\left[\frac{\sigma}{D}\frac{\partial D}{\partial x^*} + \frac{1}{D}\frac{\partial \eta}{\partial x^*}\right] \quad (3)$$

$$\frac{\partial G}{\partial y} = \frac{\partial G}{\partial y^*} - \frac{\partial G}{\partial \sigma}\left[\frac{\sigma}{D}\frac{\partial D}{\partial y^*} + \frac{1}{D}\frac{\partial \eta}{\partial y^*}\right] \quad (4)$$

$$\frac{\partial G}{\partial t} = \frac{\partial G}{\partial t^*} - \frac{\partial G}{\partial \sigma}\left[\frac{\sigma}{D}\frac{\partial D}{\partial t^*} + \frac{1}{D}\frac{\partial \eta}{\partial t^*}\right] \quad (5)$$

$$\frac{\partial G}{\partial z} = \frac{\partial G}{\partial \sigma}\frac{\partial \sigma}{\partial t} = \frac{1}{D}\frac{\partial G}{\partial \sigma} \quad (6)$$

Where, G is an arbitrary field available, and σ ranges from σ = 0 at z = η to σ = -1 at z = -H.
A new vertical velocity can now be defined as

$$\omega \equiv w - U\omega\sigma\frac{\partial D}{\partial x^*} + \frac{\partial \eta}{\partial x^*} - V\sigma\frac{\partial D}{\partial y^*} + \frac{\partial \eta}{\partial y^*} - \left(\sigma\frac{\partial D}{\partial t^*} + \frac{\partial \eta}{\partial t^*}\right) \quad (7)$$

which transforms the boundary conditions

$$\omega(x^*, y^*, 0, t^*) = 0\,, \omega(x^*, y^*, -1, t^*) = 0 \quad (8)$$

Also, any vertically integrated quantity, for example G, now appears as
$\bar{G} = \int_{-1}^{0} G d\sigma$ (Krone, 1962; HydroQual 2002; Mellor 1998).

Governing Equation

The three-dimensional advection-dispersion equation for transport of sediment of size class k (k =1,2) is:

$$\frac{\partial C_k}{\partial t} + \frac{\partial U C_k}{\partial x} + \frac{\partial V C_k}{\partial y} + \frac{\partial (W - W_{S,k}) C_k}{\partial z} = \frac{\partial}{\partial x}\left(A_H \frac{\partial C_k}{\partial x}\right) + \frac{\partial}{\partial y}\left(A_H \frac{\partial C_k}{\partial y}\right) + \frac{\partial}{\partial z}\left(K_H \frac{\partial C_k}{\partial z}\right) \quad (9)$$

with the boundary conditions

$$K_H \frac{\partial C_k}{\partial z} = 0\,, z \to \eta \quad (10)$$

$$K_H \frac{\partial C_k}{\partial z} = E_k - D_K\,, \; z \to -H \quad (11)$$

where Ck is the suspended sediment concentration of size class k (represented by 1 and 2, for cohesive and non-cohesive sediments, respectively); u, v, w denote velocity in the x, y and z-direction; A_H is the horizontal diffusivity; K_H is the vertical eddy diffusivity; E_k, D_K are the resuspension and the deposition flux of size class k; η is the water surface elevation above a specified datum; and H is the bathymetric depth below the datum (Cheng, 1997).

Resuspension of Non-Cohesive Sediments

The resuspension of sediment from a non-cohesive sediment bed is calculated using a procedure developed by van Rijn (1984). The van Rijn method has been shown to yield good results for predicting suspended load of fine sands (van Rijn, 1984; van Rijn, 2007; Ziegler and Nisbet, 1994).

MODEL SETTING

The bathymetry map of Eastern Black-Sea in Figure 1. has been meshed 50x20 and depth values corresponding to each of the mesh values are incorporated into the model. POMSED module was used to transfer these data to MATLAB program and thus Figure 3. was obtained.

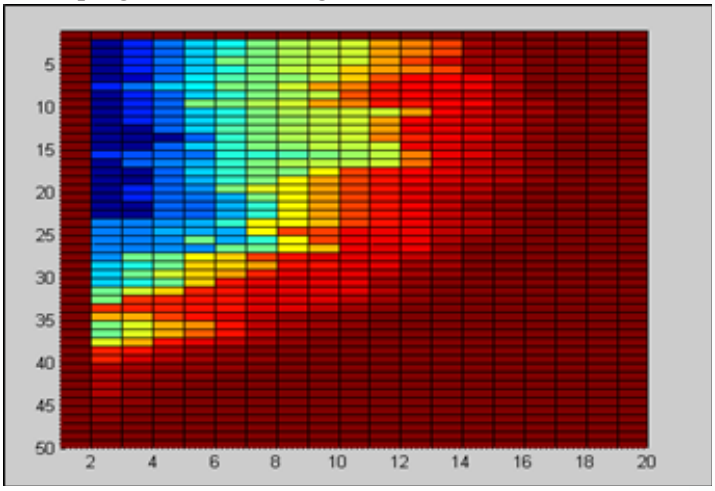


Figure 3. Topography of Eastern Black-Sea.

The modules used in the model can be turned on and off according to the will of the user. All modules except the sediment transport module have been turned off for this study. The depth of the area studied has been divided into 4 levels and the depositional areas for the cohesive sediments have been examined with different parameters for each of these levels.

Variables used in the program:

RB2: Amount of Non-Cohesive-Sediment entering the sea (mg/l)
wusurf, wvsurf: Wind stream components on the surface (m2s-2)
U,V: Sediment horizontal velocity components (ms-1)
Svel1: Sediment drift velocity (ms-1)

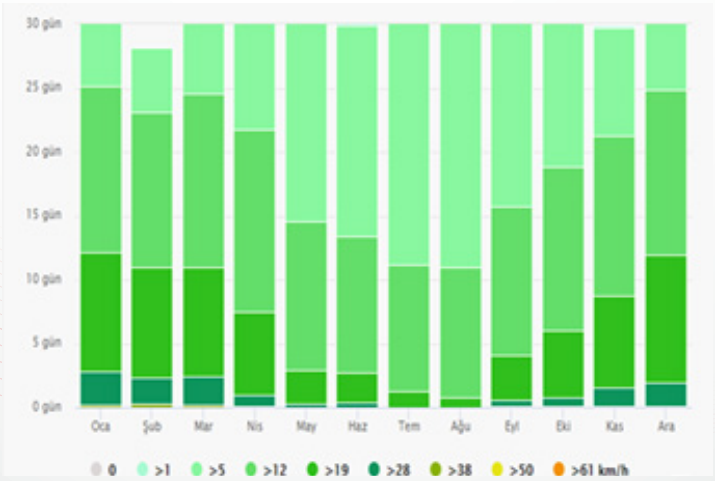


Figure 4. General Directorate of Meteorology
The wind speed of Trabzon Province in 2016 (URL-1).

APPLICATIONS

The Investigation of Non-Cohesive Sediment Depositional Areas

In this section, in the north-east direction (direction of arrival) of the wind, at least 2 km / h (Fig. 4) and the sediment drift rate is at least 0.002 m/s. In other words, if the air is windless, the flow rate is slow. As the amount of non-cohesive sediment that enters into the sea from the Surmene River changes, the fate of the Non-Cohesive sediments in the marine environment are investigated.

Non-cohesive sediment depositional areas for constant wind stream, constant sediment drift velocity and variant non-cohesive sediment amount are investigated. By changing the amount of entering non-cohesive sediments and keeping the other parameters constant, it is seen that the depositional areas of non-cohesive sediments also change. Deposits occur near coastal areas. (Figure 5-6).

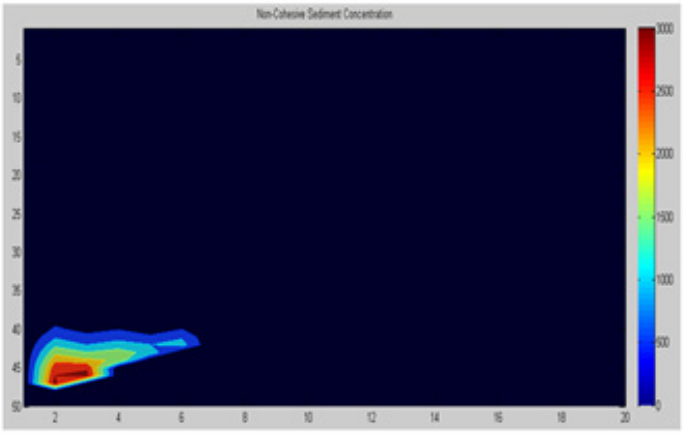


Figure 5. Non-Cohesive sediment depositional areas for RB2=5000 mg/l.

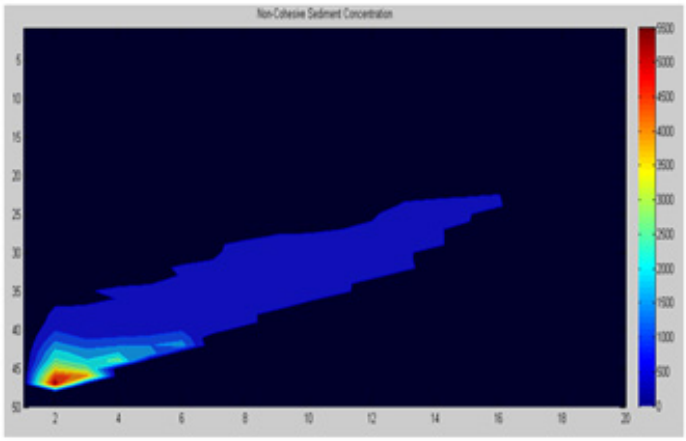


Figure 6. Non-Cohesive sediment depositional areasfor RB2=6000 mg/l.

Investigation of Depositional Areas for Varying Sediment Drift Velocity

In this section, Non-cohesive sediment depositional areas are investigated for constant non-cohesive sediment amount entering the sea, constant wind stream component (north-east wind) and decreased sediment

drift velocity in marine environment. As seen in Figures 7.-8 and 9, decreasing the sediment drift velocity changes the sediment depositional areas in marine environment.

If the sediment drift velocity is reduced, non-cohesive sediments are settling at the river entrance and also non-cohesive sediments are settling into the open sea side of the river entrance (Figure 7-8 and 9).

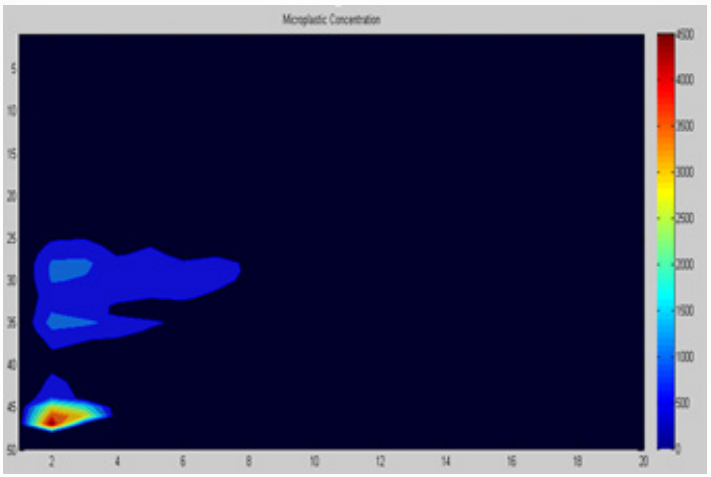


Figure 7. Non-Cohesive sediment depositional areas for Svel1=5e-10 m/s, RB2 =5000 mg/l.

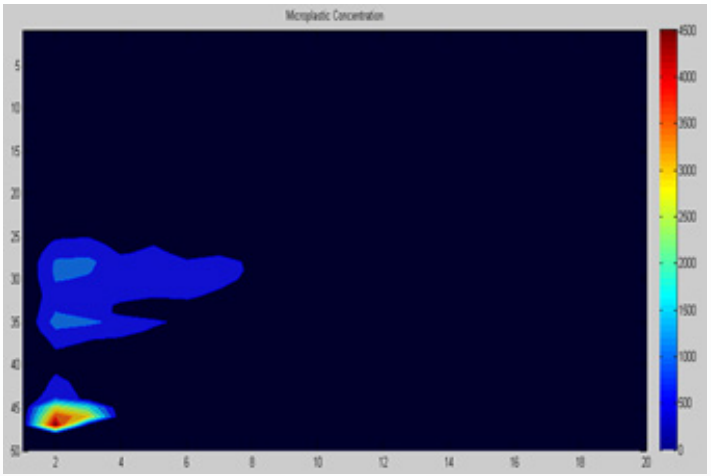


Figure 8. Non-Cohesive sediment depositional areas for Svel1=5e-20 m/s, RB2=5000 mg/l.

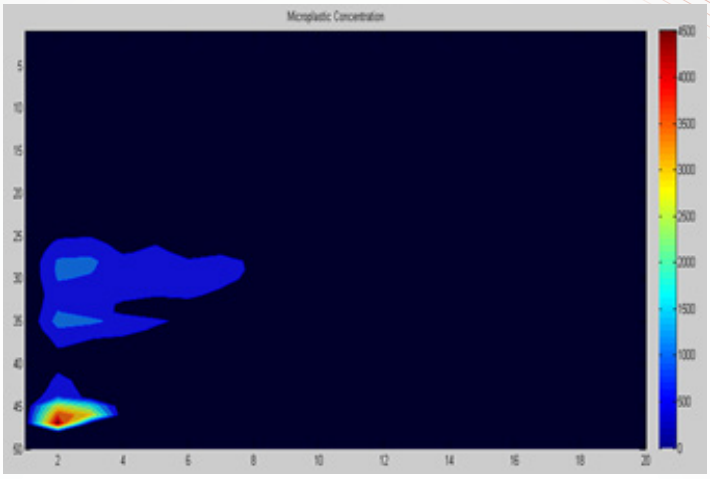


Figure 9. Non-Cohesive sediment depositional areas for Svel1=5e-40 m/s, RB2=5000 mg/l.

RESULTS

When the amount of non-cohesive sediment entering the East Black Sea from the Surmene River increases, it is seen that the non-cohesive sediments are settling intensively to the river entrance in the marine environment. Also, if other parameters are kept constant and the amount of non-cohesive sediments that only enters the sea is increased, settling occurs in the eastern coastal areas since the river entry in the marine environment.

If other parameters are kept constant and sediment drift velocity is changed, non-cohesive sediments are settling both at the river inlet and offshore.

If any other parameters remain constant, the behavior of non-cohesive sediments entering the sea from the river is determined by changing any parameter in the marine environment. Moreover, the determination of the fate of non-cohesive sediments in the marine environment is determined in a very short time.

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Abstract ID: FPT-024

Seasonal changes in fatty acid composition of *Cyprinion macrostomus* Murat River (Bingöl), Turkey

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In this study, the fatty acids of *Cyprinion Macrostomus* (*C. macrostomus)* hunting from Murat River (Bingöl) in two stations (Göynük, Ilıcalar) during a year were determined as monthly sampling. Size and weight measurements of the fish were made and chlorophyll-a was determined depending on seasonal changes. The effects of gender, station and seasonal differences on fatty acid composition were investigated. The relationship between size and weight (R^2 =0.97) was high at both of the stations. Average total lipid was higher in females (Göynük: 4.66 %; 3.55 %, respectively) than males (Ilıcalar: 4.60 %; 3.82 %, respectively). Multivariate statistical analysis were applied including analysis of similarities (ANOSIM), similarity of percentages analysis (SIMPER) and a permutational multivariate analysis of variance (PERMANOVA) to analyze the average similarity between/ within groups. The most important difference between the seasons was found between autumn-winter (R=0.5 p <0.01) and spring-autumn (R=0.5 p <0.01). Although there was a difference between the genders (R= 0.06 p <0.05), there was no difference between the stations (R = 0.1, p <0.05). Chlorophyll-a was the highest in summer in the both stations. However, it was higher Göynük (5.81µg / L) than Ilıcalar (4.18 µg/L). Also, omega-3 (ω3) fatty acids using as phytoplankton biomarkers were also high in summer. The average ∑ω3 / ∑ω6 ratio of *C. macrostomus* at Göynük was higher than Ilıcar (22.32; 20.70, respectively). The high content ω3 indicates good quality nutrient of *C. macrostomus* lipids. One of the most important reasons of the situation may be that the average annual water temperature was lower at Göynük Station (13.39˚C) than Ilıcalar (18.65˚C). Because. it is known that ω3 fatty acids are stored more in cold waters.

***Keywords*:** *C. macrostomus*, Murat River, fatty acids, ω3

Abstract ID: FPT-040

The Effect of Nano-Chitosan Application on Some Lipid Nutritional Quality Indexes Calculated from Fish (*Oncorhynchus mykiss*) Oil

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Nano-scale chitosan samples (NS) fabricated from 0.1% chitosan by using electrospinning technique were treated with fish flesh samples. Average 253 nm diameter nano-scale chitosan samples were successfully obtained. Following the nano-scale treatment, the treated fish flesh samples were stored at 4 ºC for 5 days. Each analysis period, fish oils were obtained from control group fish flesh samples and fish flesh treated with 253 nm diameter nano-scale chitosan, separately. In this study, the effect of nano-scale chitosan treatment on atherogenic (AI), thrombogenicity (TI), hypocholesterolemic/hypercholesterolemic (HH) indexes were calculated. Use of $1.5x10^{-3}$g NS limited the decrease of the HH index in fish oils. NS application limited the reduction in the polyene index (PI) more effectively than Control fish oil samples. The ratio of eicosapentaenoic acid to docosahexaenoic acid decreased (by 46%) for the first two days of storage in C, the ratio in the fish flesh treated with NS was measured to be 16.7% on day 5. Nano-scale applications were found to be highly effective for the preservation of the lipid nutritional quality indexes of fish meat.

Keywords: Nano-scale chitosan, electrospinning, fish lipid index, cold storage, nutritional quality.

Abstract ID: FPT-056

The Investigation of Seasonal Variations in Antioxidant Enzyme Activities of *Cyprinion macrostomus* Caught from Murat River, Turkey

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The aim of this study was to determine the seasonal changes in antioxidant enzyme activities (superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione reductase (GR) and glucose 6-phosphate dehydrogenase (G6PD)) and malondialdehyde (MDA) levels of gills, gonads, kidneys and livers of *Cyprinion macrostomus* caught from Murat River (Bingöl, Turkey). The investigations were performed in summer, autumn, winter and spring at two localities: Ilıcalar and Göynük. The Spectrofotometric method was used to determine the activities of enzymes and MDA levels of fish tissues. In general, in the tissues during the study, GR and G6PD activity was lower than other enzyme activities; CAT and SOD activity is higher than others. Statistically significant differences were found between seasons and stations ($p < 0.05$).

Keywords: *Cyprinion macrostomus*, Murat river, seasonal variations, oxidative stress biomarkers, antioxidant enzymes

Abstract ID: FPT-060

Surimi and Surimi-Based Products

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The Japanese word Surimi means frozen fish protein obtained from minced and washed fish flesh. The word “suru” means process and “mash/mi” means meat in Japanese. Surimi is an easy to use intermediate product that generally produced in 10 kg blocks, conveniently transported, stored between -18 °C and -20 °C. Surimi can be used in the production of surimi-based seafoods such as imitation crab meat, kamaboko, chikuwa, hanpen, fish ball, tempura, satsuma-age. It is colorless and semi-finished raw material that does not contain natural fish smell. Its origins are the Far East countries. In surimi production, fish which are not very popular, which are not preferred for fresh consumption and which have low economic value are used. Surimi is evaluated with gel quality and color. Frozen surimi is produced worldwide, including in the USA, Southeast Asia, Europe, China, Korea, Russia and South America. Total global production of surimi (both tropical and coldwater) is about 800 000 tonnes in 2018.

Keywords: Surimi, surimi based products

Abstract ID: FPT-068 (Full-Text)

General Components and Functions of Smoke Used in Fish Smoked

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Smoking has been used as seafood preservation methods since ancient times. Wood-smoke is active against many spoilage and pathogenic microorganisms and also improves sensory acceptability. The chemical composition of wood-smoke has very complex. It consists of a mixture higher molecular weight of organic compounds and low molecular weight gases. There are identified over 400 volatiles compounds in wood smoke including, such as phenol, acids, carbonyls, alcohols, ester, lactones and furans. The functional components of smoke play an important role in determining their antimicrobial and antioxidant activity and are also give a specific aroma and color to the fish. Usually, compounds with phenols and acidic groups are most antimicrobial effective.

***Keywords*:** Wood, Smoke, Components, Functions

INTRODUCTION

Smoking is one of the oldest food preservation methods and still widely used preservation methods. Smoking refers to the exposure of meat to the smoke of burning wood. It is a combined process; salting, drying, temperature and incense effect respectively. The smoking process adds a brown color, aroma, and flavor to the product and increases the shelf life of the product with its antioxidant, bacterial and bacteriostatic effect (Gökoğlu, 2002; Sikorski and Kalakowski, 2010).

Two smoking methods are commonly utilized: hot and cold smoking. Hot smoking are carried out at temperatures in the range 55 - 80 °C and depending upon the size and type of meat, requires a very short time of exposure to the smoke to obtain generally desired flavor and aroma. The hot smoking also leaves the food product in a state of being cooked state owing to the smoke temperature. Cold smoking are executed at temperatures between 15 and 25 ° C. In order to obtain the desired aroma and flavor in the final product, the smoking time varies according to the size and type of the fish. (Maga, 1988; Milly, 2003).

In general, smoke is generated using deciduous hardwoods such as oak, beech, and walnut (Storey, 1982; Gökoğlu, 2002). Their cell structures are compact, making them ideal for being smoking (Shmulsky and Jones, 2019) However, using conifers such as pine, cedar, spruce, and fir can cause problems. They contain too much sap and because of their high tar content, they can produce a bitter flavor. It also develops a black color the smoke which in turn makes the smoked dirtier (Gökoğlu, 2002).

Wood smoke has a complex mixture of compounds. The chemical composition of wood-smoked primarily depends on the wood type and wood moisture content. It consists of a mix of low molecular weight gases and high molecular weight organic compounds in the particles. The dry wood mass consists of cellulose (~45%, lignin (20-30%) and hemicellulose (Miller and Sikorski, 1990)

Generated wood smoke usually consists of two phases: gas phase and particle phase. The particulate phase includes resine soot, tar and ash. The tars are the fraction of wood smoke which contain the vast majority of polycyclic aromatic hydrocarbons (PAHs) (Rozum, 2007). The gaseous phase is usually highly complex mixture of chemicals including phenols, acids, carbonyls, alcohols, hydrocarbons, ammonia, carbon dioxide, carbon monoxide, esters, particulates, sulfur dioxides, and other various compounds (Erkan, 2004). So far, more than 400 substances have been isolated and identified many of them have also been quantitatively determined (Table 1). Research has shown that ash, tar, and the gases do not contribute very much to the flavor, aroma, or preservative properties of the smoked products, while the phenolic compounds have been identified as the primary source for them (Hasheider, 2017).

Table 1 Compounds identified in wood smoked (Toledo, 2007)

Compounds	Number of types
Acids	48
Alcohols	22
Carbonyls	131
Esters	22
Furans	46
Lactoners	16
Phenols	75
Miscellanseous	50
Total	410

Functional Characteristics of Smoke Composition

Antimicrobial activity

The shelf life of smoked fish products depends on the temperature applied, the level of water activity also the effect on the antioxidant and antibacterial of the smoked components. (Arvanitoyannis and Kotsanopoulos, 2012). The antimicrobial potential of the smoked concentration depends on the concentration of phenols, carbonyls and organic acids inhibit microbial growth (Milly, 2003). Bacteria are more susceptible to the action of smoke compounds than yeasts and molds, the latter being the most resistant. The antimicrobial action is more pronounced in Gram-positive bacteria than in Gram-negative ones, and viable cells are more readily affected than spores (Miller and Sikorski, 1990, Toledo, 2007).

The phenols are well known to possess the strongest antimicrobial activity. Approximately 20 different phenols compounds from wood were isolated and chemically defined. Some of them are important guaiacol, 4-methylguaiacol, 4-ethylguaiacol, catechol, syringol, vanillin, phenol, 4-propilguiacol, eugenol, 3-methoxycatechol, 4-methylsyringol, cresol, 2,6-dimethoxy-4-propylphenol, 2,6-dimethoxy-4-ethylphenol, and 4-ethylguaiacol. Phenolic compounds have bactericidal and antioxidant effects and also carry the smoke aroma to the smoked product (Pearson and Gillett, 1996).

Phenolic compounds are known to the bacterial cytoplasmic membranes rupture and cause the intracellular fluids to leak (Davidson, 1997). The antimicrobial activity of carbonyls can be inferred the ketones and aldehydes present in the smoke. Carbonyl compounds in smoked inhibits microbial growth by penetrates the cells wall and inactive enzymes occupying in cytoplasm and cytoplasmic membrane (Milly, 2003). The carbonyls act in the polypeptide chains, mainly in the side chains of basic amino acids, condensing with free, primary amino groups. These amino groups can be the active part of the an enzyme or they that can be function for binding the substrate by hydrogen-bond. (Painter, 1998). Even if the carbonyls cannot input the interior of a microbial cell, they can still prevent growth by inhibiting nutrient intake. Organic acids appear to have only a minor preservative action, which occurs as the result of greater acidity on the surface of smoked meat (Pearson and

Tauber, 1996).

Antioxidant Activity

Fish that are rich in polyunsaturated fatty acids at high concentrations are unfortunately very sensitive to lipid oxidation. (Fraser ve Sumar, 1998). The smoked fish were resistance to oxidative rancidity and the antioxidant effect of smoking was noticed. Phenolic compounds found in wood smoke have the highest antioxidant effect compared to other components. Positive effects of many phenolic substances on the prevention of lipid oxidation in smoked fish have been demonstrated. Even in very low concentrations, antioxidants are compounds that can delay or inhibit the oxidation by neutralizing the radicals capable of beginning the chain reaction (Miller and Sikorski, 1990; Kjallstrand and Petersson, 2001). Smoke components such as formaldehyde and acetic acid prevent bacterial and mold growth when present on the product surface. It is reported that the method of obtaining smoke effects the antioxidative properties of the smoke (Gökoğlu, 2002).

Flavor and Color

In addition to preserving food quality with its antioxidant and antimicrobial properties of wood smoke components, also smoking imparts a desirable aroma, flavour and color to smoked product. The aromatic character of the smoke is influenced by the type of wood, the production method and the conditions of smoke collection and combustion. The role of smoke components consists primarily of developing the characteristic smoky odor and taste (Miller and Sikorski, 1990; Lingbeck et. al, 2004).

The component of smoke sweeteners is very complex and includes compounds relating to many different chemical classes: ketones, aldehydes, acids, esters, alcohols; acids, phenols, hydrocarbons; and nitrogen compounds. The phenolic compounds are an important fraction from not only qualitative but also quantitative points of view. The phenolic fraction consists primarily 2-methoxyphenol (guaiacol), 2,6-dimethoxyphenol (syringol) and their derivatives and of dihydroxybenzenes arising from the pyrolysis of lignin. (Soldera et al., 2008). The flavor of the product also depends on the concentration of the smoke components. Organic acids have little or no direct influence on the flavor of smoked products (Lingbeck et al., 2014)

The formation of color in smoked products is complex. The carbonyls are the source of color, typically the amber brown, generated from the smoking process. Also, carbonyl-having compounds are involved in contribute the golden-brown coloring of smoked products because of reaction with amino acids, and the actionof formation of Maillard reaction products (Toledo, 2007). The phenols and carbonyls in the smoke contribute to the typical flavor and color of the smoked products. Phenolic substances are responsible for the typical smoke aroma. The carbonyl compounds contribute to the formation of the smoked color on the surface of a smoked product. The mainly reaction in meat color is the browning reaction between the carbonyls and amino groups of the carbonyls of the smoke from the combustion of hemicelluloses and celluloses. (Maga, 1988).

As a result; the composition of smoke wood is well known and the role of these components in imparting sensory, antibacterial and antioxidative properties to the smoked product. Due to the abundance of bioactive components, smoked has a great potential for prolonging the shelf life of smoked fish products.

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Impacts of lactic, fumaric, succinic and ortho-phosphoric acids on ammonia and biogenic amine production by fish-spoilage bacteria

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The effects of four organic acids (lactic, fumaric, succinic and orto-phosphoric) on ammonia and biogenic amines production by five fish spoilage bacteria (*Enterobacter cloacae, Proteus mirabilis, Vibrio vulnificus, Photobacterium damselae* and *Pseudomonas luteola)* which were isolated and identified from fish were investigated using a HPLC method in ornithine decarboxylase broth.

Ammonia production by fish spoilage bacteria was in range from 2.51 mg/L by *V. vulnificus* to 10.60 mg/L by *E. cloacae*. Fumaric and orto-phosphoric acid were significantly inhibited ammonia production by *E. cloacae,* whilst stimulation effects were noticed in ammonia production by other bacteria tested in the presence of organic acids. Among fish spoilage bacteria, putrescine production by *Phot. damselae* and *V. vulnificus* were the highest with corresponding value of 129.13 and 71.49 mg/L. Succinic acid induced higher putrescine accumulation by *Pseu. luteola,* although lower putrescine formation was observed by *Phot. damselae* in the presence of succinic acid in the broth. Histamine production by bacteria was below 2 mg/L in ornithine decarboxylase broth. Histamine production by *Pseu. luteola* was significantly inhibited by organic acids, although orto-phosphoric acid was only organic acid suppressing histamine accumulation by *V. vulnificus* and *Phot. damselae.* The study results revealed that the effect of organic acids on biogenic amine production by bacteria varied depending on bacteria and type of organic acids.

Keywords: Organic acid, biogenic amines, lactic acid, fumaric acid, succinic acid

INTRODUCTION

Biogenic amines in foods are mainly generated by decarboxylation of the corresponding amino acids by microorganisms (Moreno-Arribas et al., 2003). Histamine, tyramine, tryptamine and 2-phenylethilamine are the most toxic amines that are present in food for human health, because of effects on both the nervous and vascular systems, including headaches, smooth muscle contraction, hypo- or hypertension, gastric acid secretion, allergies and enteric histaminosis (Pessione et al., 2005). Putrescine among the biogenic amines can also enhance the toxic effects of histamine and tyramine by inhibiting the detoxifying enzymes diamine oxidase and hydroxymethyl transferase and also react with nitrites to form nitrosamines (Eerola et al., 1997). Another major reason is the negative effect of putrescine on food quality as it is one of the indicators of undesirable changes in proteins (Rokka et al., 2004). Putrescine can give foodstuffs so-called "putrid odor" (Wang et al., 1975). Putrescine is one of the most common biogenic amines in food and its increased occurrence in food is caused by the metabolic production of contaminating microorganisms (ten Brink et al., 1990; Wunderliclova et al., 2014

Accumulation of biogenic maines in foods requires (I) the availability of precursors (*i.e.* amino acids), (II) the presence of microorganisms with amino acid decarboxylases enzyme, which either derived from environmental contamination or from an added starter culture and (III) favourable conditions that allow bacterial growth, decarboxylase synthesis and decarboxylase activity (Stadnik and Dolatowski, 2010). Although amino acid decarboxylases are not widely distributed among bacteria, species of many genera such as *Bacillus, Citrobacter, Clostridium, Klebsiella, Escherichia, Proteus, Pseudomonas, Shigella, Photobacterium* and the lactic acid bacteria (*Lactobacillus, Pediococcus*, and *Streptococcus*) are capable of decarboxylating one or more amino acids (Karovicova and Kohajdova, 2005; Özogul and Özogul, 2005).

Organic acids are usually the fermentative by-product of ubiquitous organisms such as the lactic acid bacteria (LAB), which produce a major antimicrobial and bio-preservative substance, lactic acid (Casey and Condon, S. 2002). Organic acids can, therefore, be either naturally present as constituents of the food or can later be added directly or indirectly to the products. Some of the organic acids, i.e., lactic, acetic, propionic, citric, and benzoic acid have commonly been used as food preservatives and have been reported to exhibit general antimicrobial activities against microflora encountered in meat, for example (Bégin and Van Calsteren, 1999; Nazer et al., 2005). Mechanism of inactivation by these acids is the ability of un-dissociated form to penetrate through the cell membrane, dissociate inside the cell, resulting in decreased intracellular pH value, which is essential for the control of ATP synthesis, RNA and protein synthesis, DNA replication and cell growth (Theron and Lues, 2007).

Some of these organic acids such as acetic, benzoic, citric, formic, lactic, and propionic acid, are already known chemical preservative agents exhibiting a broad spectrum of antimicrobial and enzymatic activities (Brul and Coote, 1999; Theron and Lues, 2007; Anyasi et al., 2015). Acetic and lactic acids, in particular, are commonly used as cheap, environmentally friendly and effective interventions for reducing the levels and prevalence of

bacterial pathogens in food products (Rajkovic et al., 2010). As a result of their bactericidal properties, organic acids have constituted the basic active ingredients of antimicrobial products developed and evaluated for the reduction of foodborne pathogenic bacteria on food surfaces (Lianou et al., 2012;Anyasi et al., 2017). Thus, the aim of the study was to investigate the effects of four organic acids (lactic, fumaric, succinic and ortho-phosphoric) on ammonia and biogenic amines production by five fish spoilage bacteria (*Enterobacter cloacae, Proteus mirabilis, Vibrio vulnificus, Photobacterium damselae* and *Pseudomonas luteola)* in ornithine decarboxylase broth.

MATERIALS and METHODS

The production of putrescine from all fish spoilage bacterial strains was monitored using ornithine decarboxylase broth (ODB) containing 1 g peptone, 0.5 g Lab-Lemco powder (Oxoid CM0017, Hampshire, UK), 2.5 g NaCl (Merck 1.06404.1000, Darmstadt, Germany), 4.01 g l-ornithine monohydrochloride (Sigma O2375, Steinheim, Germany) and 2.5 mg pyridoxal HCl (Sigma P9130) in 500 mL of distilled water. After that, ODB was pipetted in 10-ml bottles and then autoclaved at 121 C in 15 min prior to use.

Nutrient broth (Merck 1.05443.0500) were used for propagation of bacterial cultures. After propagation, 0.5 mL of bacterial cultures (~108 cfu/mL) was removed and put into 9 mL of the ODB. Each organic acid at doses of 1% was added into the ODB. The control was the absence of any of the organic acids. Samples were incubated at 37oC for 72 h. For extraction of the bacterial strains, 5 mL of the ODB containing bacterial strains was removed to separate bottles and then 2 mL of trichloroacetic acid (6%) was added. They were then centrifuged at 3000 g for 10 min and then filtered through a filter paper (589/2, Ø125 mm; Schleicher & Schuell, Dassel, Germany). After that, 4 mL of bacterial supernatantwas taken for derivatisation to be analysed by HPLC. The confirmation of biogenic amine production was carried out using a rapid HPLC method (Özogul, 2004). For ammonia and trimethylamine (TMA) analysis, same analytic method was conducted. The mobile phase consisted of acetonitrile and high-performance liquid chromatography (HPLC) grade water for the amine analyses.

A Shimadzu Prominence HPLC apparatus (Shimadzu, Kyoto, Japan) equipped with a SPD-M20A diode array detector and two binary gradient pumps (Shimadzu LC-10AT), auto sampler (SIL 20AC), column oven (CTO-20AC) and a communication bus module (CBM-20A) with valve unit FCV-11AL was used. For the BA analyses, the column was ODS Hypersil, 5 µ, 250 ×4.6 mm (Phenomenex, Macclesfield, Cheshire, UK).

The mean value and standard deviation were calculated from the data obtained from the three samples for each treatment. One-way ANOVA was used to determine the significance of differences at $P<0.05$. All statistics were performed using SPSS 15.0 for Windows (SPSS Inc., Chicago, IL. USA)

RESULT

Table 1 shows ammonia and biogenic amine production by fish spoilage bacteria in the presence and absence of organic acids. Ammonia production was the highest by Ent. cloacea and Pseu. luteola, with corresponding value of 10.80 and 7.01 mg/L. Ortho-phosphoric acid significantly increased ammonia production by *Pseu. luteola, Phot. damselae* and *V. vulnificus* ($P<0.05$). Presence of organic acids apart from ortho-phosphoric acid in the medium did not affect ammonia production by *Pseu. luteola.* However, ammonia production by P*hot. damselae, Prot. mirabilis* and *V. vulnificus* significantly stimulated by all organic acids. Inhibition effects of organic acids were only observed by fumaric acid and ortho-phosphoric acid on *Ent. cloacea.*

Putrescine, agmatine and TMA were main amines produced by bacteria in ODB, whereas other biogenic amines were produced negligible levels (<2 mg/L). Among fish spoilage bacteria, *Phot. damselae* was main putrescine producer (129.13 mg/L). *Pseu. luteola* produced putrescine as low as 1.66 mg/L. Succinic acid led to about 100 fold higher putrescine production by *Pseu. luteola,* whereas it significantly reduced putrescine production by *Phot. damselae*. Fumaric and ortho-phosphoric acid reduced putrescine production by *Ent. cloacea* and *Prot. mirabilis*, respectively. Presence of organic acids in the medium led to higher putrescine production by *V. vulnificus*.

Cadaverine production by bacteria was below 0.8 mg/L. Cadaverine production by P*hot. damselae* increased in the presence of organic acids, although organic acid induced lower cadaverine accumulation by *Ent. cloacea* and *Prot. mirabilis*. The highest spermidine content was noticed by *Phot. damselae* in the presence of ortho-phosphoric acid in the medium (1.62 mg/L). Succinic acid also induced higher spermidine production by *V. vulnificus* and *Pseu. luteola*. Serotonin production by bacteria was <0.7 mg/L. Ortho-phosphoric acid had significant effect on stimulating serotonin production by *Prot. mirabilis* ($p<0.05$). Although fish spoilage bacteria had an poor ability to produce tyramine in ODB, lactic acid was found to suppress tyramine production by most of the fish spoilage bacteria. Moreover, tyramine formation by *Ent. cloacea* was also reduced in the addition of organic acids. *Pseu. luteola* accumulated TMA as 8.80 mg/L, whereas *Phot. damselae, Prot. mirabilis* and *V. vulnificus* did not produce TMA. TMA production by *Pseu. luteola* significantly inhibited in the presence of organic acids. However, presence of organic acid apart from lactic acid resulted in higher TMA production by *Ent. cloacea* and *Prot. mirabilis.*

Histamine production by bacteria was below 2 mg/L in ornithine decarboxylase broth. Histamine production by *Pseu. luteola* was significantly inhibited by organic acids, although ortho-phosphoric acid was only organic acid suppressing histamine accumulation by *V. vulnificus* and *Phot. damselae.*

Agmatine produced the highest level by *Pseu. luteola* (2.21 mg/L). Agmatine production by *Pseu. luteola* was significantly inhibited by organic acids. Apart from lactic acid, presence organic acid increased agmatine production by *Phot. damselae* and *V. vulnificu*s. Fumaric acid also significantly stimulated agmatine production by *Ent. cloace.*

Table1. Ammonia and biogenic amine production by fish spoilage bacteria in the absence or presence of organic acids

mg/L	AMN	PUT	CAD	SPD	TRP	PHEN	SPN	HIS	SER	TYR	TMA	DOP	AGM	Group
Pseu. luteola	7.01b^{x} 0.68^{y}	1.66^{d} 1.16	0.38^{bc} 0.01	0.06^{c} 0.00	0.04^{a} 0.00	0.05^{a} 0.00	0.05^{a} 0.00	1.60^{a} 0.03	0.31^{c} 0.03	0.12^{b} 0.01	8.80^{a} 0.28	0.59^{a} 0.03	2.21^{a} 0.10	Control
	8.36^{b} 0.10	161.01^{a} 14.79	0.44^{b} 0.14	1.04^{a} 0.08	0.00^{c} 0.00	0.00^{b} 0.00	0.00b 0.00	0.39^{c} 0.36	0.12^{d} 0.01	0.09^{b} 0.02	0.00^{c} 0.00	0.00^{d} 0.00	0.04^{c} 0.00	SUC
	10.13^{b} 0.82	10.47^{b} 0.70	0.01^{d} 0.01	0.11 0.03c	0.00^{c} 0.00	0.03^{ab} 0.04	0.00^{b} 0.00	0.32^{c} 0.02	0.03^{e} 0.01	0.33^{a} 0.01	0.00^{c} 0.00	0.33^{c} 0.03	0.41^{b} 0.02	FUM
	38.39^{a} 2.43	4.21^{c} 0.22	0.25^{c} 0.00	0.25^{b} 0.01	0.02^{b} 0.00	0.00^{b} 0.00	0.00^{b} 0.00	0.60^{bc} 0.00	0.54^{b} 0.01	0.12^{b} 0.01	0.81^{b} 0.00	0.62^{a} 0.03	0.06^{c} 0.00	ORT
	9.31^{b} 0.95	1.27^{d} 0.01	0.69^{a} 0.04	0.03^{c} 0.00	0.00^{c} 0.00	0.00^{b} 0.00	0.00^{b} 0.00	0.93^{b} 0.00	0.66^{a} 0.06	0.05^{c} 0.00	0.00^{c} 0.00	0.51^{b} 0.02	0.04^{c} 0.00	LAC
Phot. damselae	2.53^{d} 0.20	129.13^{c} 10.25	0.00^{c} 0.00	0.52^{b} 0.04	0.00^{b} 0.00	0.00^{b} 0.00	0.00^{b} 0.00	0.20^{c} 0.01	0.06^{d} 0.00	0.26^{b} 0.02	0.00^{b} 0.00	0.40^{d} 0.01	0.10^{c} 0.00	Control
	22.16^{a} 1.77	14.85^{d} 0.48	0.18^{ab} 0.02	0.23^{c} 0.01	0.06^{a} 0.00	0.07^{a} 0.01	0.03^{a} 0.00	1.65^{a} 0.06	0.84^{a} 0.05	1.03^{a} 0.07	0.00^{b} 0.00	2.61^{a} 0.15	0.67^{a} 0.07	SUC
	10.02^{b} 0.11	147.56^{b} 1.92	0.13^{b} 0.05	0.68^{b} 0.07	0.00^{b} 0.00	0.00^{b} 0.00	0.00^{b} 0.00	0.22^{bc} 0.02	0.07^{d} 0.00	0.17^{b} 0.03	0.00^{b} 0.00	1.41^{b} 0.07	0.26^{b} 0.00	FUM
	23.98^{a} 1.00	184.16^{a} 6.10	0.24^{a} 0.01	1.62^{a} 0.11	0.00^{b} 0.00	0.00^{b} 0.00	0.00^{b} 0.00	0.00^{d} 0.00	0.56^{b} 0.05	0.26b 0.00	0.48^{a} 0.03	0.64^{c} 0.01	0.28^{b} 0.02	ORT
	6.52^{c} 0.64	135.87^{bc} 6.20	0.18^{ab} 0.01	0.56^{b} 0.00	0.00 0.00	0.00 0.00	0.00^{b} 0.00	0.29^{b} 0.03	0.23^{c} 0.01	0.17^{b} 0.00	0.00^{b} 0.00	0.49^{cd} 0.03	0.10^{c} 0.01	LAC
Ent. cloacea	10.80^{b} 0.28	5.87^{c} 0.12	0.72^{a} 0.04	0.03^{bc} 0.01	0.00^{c} 0.00	0.05^{b} 0.01	0.03^{b} 0.00	0.55^{c} 0.06	0.36^{a} 0.03	0.53^{a} 0.04	0.15^{c} 0.02	0.55^{b} 0.00	0.05^{b} 0.00	Control
	12.43^{a} 0.03	17.05^{a} 0.59	0.00^{c} 0.00	0.04^{b} 0.00	0.11^{a} 0.01	0.24^{a} 0.05	0.05^{a} 0.01	1.62^{a} 0.11	0.00^{c} 0.00	0.54^{a} 0.03	6.44^{a} 0.38	0.09^{c} 0.00	0.10^{b} 0.01	SUC
	2.96^{d} 0.05	3.44^{d} 0.22	0.00^{c} 0.00	0.00^{c} 0.00	0.00^{c} 0.00	0.02^{bc} 0.00	0.00^{c} 0.00	0.84^{b} 0.05	0.00^{c} 0.00	0.29^{b} 0.03	4.56^{b} 0.14	2.14^{a} 0.19	12.08^{a} 0.30	FUM
	4.85^{c} 0.37	10.28^{b} 0.33	0.15^{b} 0.01	0.04^{b} 0.01	0.05^{b} 0.01	0.06^{b} 0.00	0.00^{c} 0.00	0.50^{c} 0.01	0.39^{a} 0.03	0.09^{c} 0.00	7.22^{a} 0.68	0.65^{b} 0.06	0.12^{b} 0.01	ORT
	11.95^{a} 0.39	6.15^{c} 0.24	0.12^{b} 0.00	0.08^{a} 0.00	0.00^{c} 0.00	0.00^{c} 0.00	0.00^{c} 0.00	0.75^{b} 0.01	0.11^{b} 0.00	0.12^{c} 0.01	0.00^{c} 0.00	0.45^{b} 0.02	0.11^{b} 0.00	LAC

[x]Data are expressed as mean value of three samples, [y] Standard deviation.

[a–d] Indicate significant differences ($P < 0.05$) between control and treated group in a column. AMN, ammonia; PUT, putrescine; CAD, cadaverine; SPD, spermidine; TRP, tryptamine; PHEN, 2-phenylethyl amine; SPN, spermine; SER, serotonin; TMA, trimethylamine; DOP, dopamine, AGM, agmatine. SUC: succinic acid; FUM: fumaric acid, and ORT: orto-phosphoric acid, LAC: lactic acid.

Table 2. Ammonia and biogenic amine production by fish spoilage bacteria in the absence or presence of organic acids

mg/L	AMN	PUT	CAD	SPD	TRP	PHEN	SPN	HIS	SER	TYR	TMA	DOP	AGM	Group
Prot. mirabilis	3.14^{e} 0.29	9.13^{c} 0.40	0.76^{a} 0.15	0.04^{c} 0.00	0.00^{b} 0.00	0.00^{a} 0.00	0.00^{a} 0.00	0.32^{c} 0.03	0.21^{d} 0.01	0.08^{c} 0.01	0.00^{d} 0.00	0.57^{b} 0.06	0.17^{c} 0.00	Control
	14.04^{b} 0.27	21.81^{b} 2.04	0.00^{c} 0.00	0.09^{b} 0.00	0.02^{a} 0.01	0.00^{a} 0.00	0.00^{a} 0.00	0.84^{b} 0.02	0.02^{e} 0.01	0.07^{c} 0.01	1.45^{b} 0.01	0.21^{c} 0.02	0.13^{c} 0.03	SUC
	12.13^{c} 0.06	38.12^{a} 1.04	0.00^{c} 0.00	0.16^{a} 0.01	0.00^{b} 0.00	0.01^{a} 0.00	0.02^{a} 0.00	1.51^{a} 0.09	0.65^{b} 0.06	0.96^{b} 0.00	5.56^{a} 0.14	4.94^{a} 0.17	1.23^{a} 0.01	FUM
	7.18^{d} 0.26	5.10^{d} 0.08	0.44^{b} 0.03	0.04^{c} 0.00	0.02^{a} 0.00	0.00^{a} 0.00	0.00^{a} 0.00	0.37^{c} 0.02	5.11^{a} 0.02	1.50^{a} 0.03	0.74^{c} 0.04	0.64^{b} 0.03	0.21^{b} 0.01	ORT
	14.66^{a} 0.04	7.61^{cd} 0.20	0.12^{c} 0.01	0.04^{c} 0.00	0.00^{b} 0.00	0.00^{a} 0.00	0.00 0.00	1.46^{a} 0.06	0.35^{c} 0.01	0.02^{d} 0.00	0.00^{d} 0.00	0.62^{b} 0.03	0.15^{c} 0.00	LAC
V. vulnificus	2.21^{e} 0.23	71.49^{c} 2.95	0.12^{b} 0.02	0.67^{c} 0.10	0.00^{a} 0.00	0.00^{a} 0.00	0.08^{a} 0.00	0.23^{b} 0.01	0.69^{a} 0.06	0.13^{ab} 0.04	0.00^{b} 0.00	0.55^{b} 0.05	0.04^{d} 0.01	Control
	7.67^{b} 0.02	158.46^{a} 12.60	1.91^{a} 0.12	1.45^{a} 0.09	0.00^{a} 0.00	0.00^{a} 0.00	0.10^{a} 0.03	1.49^{a} 0.00	0.30^{c} 0.02	0.19^{a} 0.00	0.01^{b} 0.01	0.32^{c} 0.03	0.36^{a} 0.04	SUC
	4.03^{d} 0.27	113.65^{b} 9.64	0.00^{b} 0.00	0.28^{d} 0.01	0.00^{a} 0.00	0.00^{a} 0.00	0.00^{c} 0.00	0.08^{b} 0.00	0.00^{d} 0.00	0.19^{a} 0.02	0.39^{a} 0.03	0.00^{d} 0.00	0.28^{b} 0.02	FUM
	11.29^{a} 0.41	159.73^{a} 4.88	0.11^{b} 0.01	0.89^{b} 0.03	0.00^{a} 0.00	0.00^{a} 0.00	0.00^{c} 0.00	0.00^{b} 0.00	0.47^{b} 0.01	0.06^{b} 0.07	0.00^{b} 0.00	0.63^{ab} 0.06	0.28^{b} 0.01	ORT
	6.40^{c} 0.32	166.47^{a} 13.72	0.12^{b} 0.00	0.62^{c} 0.08	0.00^{a} 0.00	0.00^{a} 0.00	0.04^{b} 0.00	0.35^{b} 0.40	0.00^{d} 0.00	0.14^{ab} 0.01	0.00^{b} 0.00	0.67^{a} 0.04	0.21^{c} 0.01	LAC

*Data are expressed as mean value of three samples, ^{y} Standard deviation.
$^{-d}$ Indicate significant differences ($P < 0.05$) between control and treated group in a column. AMN, ammonia; PUT, putrescine; CAD, cadaverine; SPD, spermidine; TRP, tryptamine; PHEN, 2-phenylethyl amine; SPN, spermine; SER, serotonin; TMA, trimethylamine; DOP, dopamine, AGM, agmatine. SUC: succinic acid; FUM: fumaric acid, and ORT: orto-phosphoric acid, LAC: lactic acid.

DISCUSSION

The presence and accumulation of biogenic amines depend on many factors, such as availability of free amino acids and sugars, pH, water activity, temperature, bacterial density, bacterial competition for nutrients and synergistic effect between microorganisms (Aguilar and Klotz, 2010). In the current study, putrescine was one of the main amine produced fish spoilage bacteria in ODB. The highest putrescine production level in Brain Heart Infusion medium supplemented with 1% of amino acids was reported in *Citrobacter freundii* and *Enterobacter* spp. strains, followed by *Serratia grimesii, Proteus alcalifaciens, E. coli, Escherichia fergusonii, Morganella morganii, Pro. mirabilis, Proteus penneri* and *Hafnia alvei*, respectively (Durlu-Ozkaya et al., 2001). In the current study, putrescine production was the highest with *Phot. damselae* and *V. vulnificus*. High levels of putrescine and cadaverine appear to potentiate the toxicity of histamine, as well as tyramine (Taylor, 1985). The most

accumulated amine by bacterial isolates in tyrosine enrichment medium were putrescine followed by tyramine and dopamine. Significant putrescine accumulation (>1000 mg/L) was observed for *Serratia liquefaciens* and *Ent. cloacae,* although *Serratia rulnidace* did not produce putrescine (Houicher et al., 2013). *Prot. mirabilis* and *Ent. cloacae* which were dominantly found in spoiled sardine, were reported as strong amine producers (Houicher et al., 2013). *Morganella morganii, Proteus vulgaris*, *Phot. damselae* and *Raoultella planticola* was reported as histamine forming bacteria from different type of fish (Takahashi et al., 2003). In the current study, histamine production by fish spoilage bacteria in ODB was low (2 mg/L). Özogul and Özogul (2005) reported that production of agmatine by all bacterial strains was higher than 13.07 mg/L in tyrosine-enriched broth and this amount can be converted from arginine (170 mg/L) present in peptone and beef extract. In ODB, agmatine production was below 2 mg/L by all fish spoilage bacteria.

Several types of chemical preservatives like sodium sulphide,sodium nitrite,glycine and salt and natural preservatives like lactic acid bacteria and plant extracts,that have lim-iting or stimulating effects on the BAs decarboxylaseactivity as well as the accumulation of BAs in food(Suzzi &Gardini,2003; Mah &Hwang, 2009; Özoğul et al., 2017;Kuley et al., 2018). In the present study, although the effect of organic acids depended on bacterial strains, specific amine and type of organic acid, organic acids apart from lactic acid generally resulted higher biogenic amine accumulation. Succinic acid led to higher putrescine production by *Pseu. luteola*, whereas it significantly reduced putrescine production by *Phot. damselae*. Fumaric and ortho-phosphoric acid reduced putrescine production by *Ent. cloacea* and *Prot. mirabili*s, respectively. Presence of organic acids in the medium led to higher putrescine production by *V. vulnificus*. Histamine production by *Pseu. luteola* was significantly inhibited by organic acids, although ortho-phosphoric acid was only organic acid suppressing histamine accumulation by *V. vulnificus* and *Phot. damselae.*

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Fatty acid profiles of two different freshwater fish species (*Capoeta umbla* and *Squalius cephalus*) caught from Keban Dam Lake

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The fatty acid profile of the edible meat of two different fish species (*Capoeta umbla* and *Squalius cephalus*) caught from Keban Dam Lake in Elazığ was investigated.

The freshwater fish species were caught with gill net in June 2019. The captured fish were 12 hours post-capture on arrival at the laboratory in ice. A minimum of 3 individuals from each species was gutted, filleted and muscle tissue (edible muscle) was minced and extracted for analyses. The total lipid content of fish and fatty acids methyl esters in extracted lipid of freshwater were done. After that fatty acid profiles were carried out by using gas chromatography (GC) instrument.

The fatty acid compositions of two different freshwater fish species ranged from 25.42% to 29.86% as saturated fatty acids, 18.64% to 28.05% as monounsaturated fatty acids and 28.22% to 31.65% as polyunsaturated fatty acids. Myristic acid (C14:0), palmitic acid (C16:0), stearic acid (C18:0), vaccenic acid (C18:1n-7), oleic acid (C18:1n-9), linoleic acid (C18:2n-6), arachidonic acid (C20:4n-6), eicosapentaenoic acid (C20:5n-3) and docosahexaenoic acid (C22:6n-3) were the most important fatty acids in these species. The fish species investigated had a high nutritional quality in terms of EPA and DHA values. All fish species had high levels of EPA and DHA and much higher total n-3 PUFA than n-6 PUFA content. It has been suggested that the ratio of w6/w3 was useful indicators to compare the relative nutritional values of fish oils. Concequently, when the levels of EPA, DHA and w6/w3 ratio are considered, *Capoeta umbla* and *Squalius cephalus* were rich in PUFA and can be used as good fish oil sources for human consumption.

Keywords: Freshwater fish; fatty acids; PUFA; EPA; DHA.

INTRODUCTION

Fish oils are very rich in unsaturated fatty acids (omega-3 and omega-6) and are very important for human health. However, long chain omega 3 fatty acids cannot be synthesized by the human body and they need to be taken from food (Alasalvar et al., 2002). The fact that fish oils contain essential fatty acids such as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) increases the importance of fish for human health. These essential fatty acids are also known to play a key role in preventing many diseases such as heart attacks, cardiovascular diseases, depression, migraine, joint rheumatism, diabetes, high cholesterol, blood pressure, and allergies (Kinsella, 1987; Leaf et al., 1988; Simopoulos, 1991). The American Heart Association Nutrition Committee recommends the consumption of fish two or three times a week, given the high benefits of consuming seafood in human health (Kris-Etherton et al., 2003; Mnari et al., 2007). It is important to identify fatty acids that have such positive effects on human health.

Lipid levels and fatty acid compositions in fish may vary depending on species, sex, age, season, breeding period, nutrient status, various pollutants, geographic differences, water temperature and natural or culture of fish. These variables may explain the differences in fatty acid composition between species and even fish of the same species. In addition, freshwater fish were found to contain w3 PUFA less than marine fish (Rahman et al., 1995; Luzia et al., 2003; Shirai et al., 2001). There are not enough studies on the fatty acid components of *Capoeta umbla* and *Squalius cephalus* species which are consumed by the people of the region because of their delicious meat in the Keban Dam Lake. Therefore, in this study, it was aimed to determine the total fatty acid composition and w3/w6 fatty acid ratio in the muscle of *Capoeta umbla* and *Squalius cephalus* caught from Keban Dam Lake.

MATERIAL and METHOD

Sample preparation

Capoeta umbla and *Squalius cephalus* were obtained from Keban Dam Lake in Elazığ, Turkey. The captured fish were 12 hours post-capture on arrival at the laboratory in ice. A minimum of 3 individuals from each species was gutted, filleted and muscle tissue (edible muscle) was minced and extracted for analyses. The total lipid content and fatty acids of

freshwater fish were done. After that, fatty acid profiles were carried out by using gas chromatography (GC) instrument.

Fatty acid analyses

Lipid content was determined by the method of Bligh & Dyer (1959). Lipid samples were converted to their constituent fatty acid methyl esters by the method of Ichihara et al. (1996), by using 2 M KOH in methanol and n-heptane with minor modifications. Twenty mg of extracted oil was dissolved in 2 ml n-heptane followed by 4 ml of 2 M methanolic KOH. The tube was then vortexed for 2 min at room temperature. After centrifugation at 4,000 rpm for 10 min, n-heptane layer was taken for gas chromatography analyses.

RESULT

The percentages of saturated fatty acids (SFA), monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) of *Capoeta umbla* were 29.86%, 18.64% and 31.65% while these values of *Squalius cephalus* were determined as 25.42%, 28.05% and 28.22%, respectively. In terms of total SFA, MUFA and PUFA values, statistical differences were observed between these two species ($p < 0.05$). Twenty five different fatty acids were identified in the muscle of these species. The most important fatty acids detected were palmitic acid (C16: 0), stearic acid (C18: 0), palmitoleic acid (C16: 1), oleic acid (C18: 1n9), vaccenic acid (C18: 1n7), linoleic acid (C18: 2n6), eicosapentaenoic acid (EPA, C20: 5n3) and decosahexaenoic acid (DHA, C22: 6n3).

Among the saturated fatty acids, the highest fatty acids were palmitic acid and stearic acid in both species. The highest amount of palmitic acid (17.31%) and stearic acid (9.07%) were found to be in *Capoeta umbla* species. While there was no statistical difference between the species in terms of palmitic acid, statistical difference was determined in terms of stearic acid ($p<0.05$).

The saturated fatty acid values of *Capoeta umbla* and *Squalius cephalus* species are shown in Table 1.

Table 1. SFA (%) content of two different freshwater fish species caught from Keban Dam Lake

Fatty Acids	*Capoeta umbla*	*Squalius cephalus*
C12:0	0.04 ± 0.01^{x}	0.06 ± 0.01^{x}
C14:0	1.88 ± 0.04^{x}	1.75 ± 0.04^{x}
C15:0	0.22 ± 0.01^{x}	0.17 ± 0.00^{y}
C16:0	17.31 ± 0.65^{x}	16.72 ± 0.20^{x}
C17:0	0.34 ± 0.01^{y}	0.63 ± 0.04^{x}
C18:0	9.07 ± 0.41^{x}	5.64 ± 0.26^{y}
C20:0	0.14 ± 0.04^{y}	0.33 ± 0.03^{x}
C22:0	0.84 ± 0.03^{x}	0.04 ± 0.01^{y}
C24:0	0.03 ± 0.01^{y}	0.09 ± 0.01^{x}
∑SFA	29.86 ± 0.91^{x}	25.42 ± 0.11^{y}

Different letters (x, y) in the same row indicate a significant difference between two different freshwater Fish species ($p<0.05$).

Monounsaturated fatty acids values of *Capoeta umbla* and *Squalius cephalus* species are given in Table 2. Among the total monounsaturated fatty acids, the most important fatty acids were palmitoleic acid (C16: 1), oleic acid (C18: 1n9) and vaccenic acid (C18: 1n7). These important

fatty acids were found in the highest amount in *Squalius cephalus* species. There were statistically significant differences in these fatty acids in both fish species ($p < 0.05$). The amounts of palmitoleic acid, oleic acid and vaccenic acid in *Capoeta umbla* species were 3.14% 10.11% and 3.77% while in *Squalius cephalus*, these values were found to be 9.26%, 12.67% and 4.79%, respectively.

Table 2. MUFA (%) Content of Two Different Freshwater Fish Species Caught from Keban Dam Lake

Fatty Acids	*Capoeta umbla*	*Squalius cephalus*
C14:1	0.06 ± 0.01^{y}	0.15 ± 0.01^{x}
C15:1	0.14 ± 0.01^{x}	0.13 ± 0.01^{x}
C16:1	3.14 ± 0.17^{y}	9.26 ± 0.05^{x}
C17:1	0.29 ± 0.01^{x}	0.23 ± 0.01^{y}
C18:1n9	10.11 ± 0.69^{y}	12.67 ± 0.22^{x}
C18:1n7	3.77 ± 0.14^{y}	4.79 ± 0.27^{x}
C20:1n9	0.72 ± 0.05^{x}	0.20 ± 0.01^{y}
C22:1n9	0.36 ± 0.03^{y}	0.58 ± 0.01^{x}
C24:1n9	0.08 ± 0.02^{x}	0.06 ± 0.02^{x}
∑MUFA	18.64 ± 0.71^{y}	28.05 ± 0.13^{x}

Different letters (x, y) in the same row indicate a significant difference between two different freshwater Fish species ($p<0.05$).

Total polyunsaturated fatty acids (PUFA) of *Capoeta umbla* and *Squalius cephalus* species are shown in Table 3. Among the total polyunsaturated fatty acids, the highest fatty acids were linoleic acid (C18: 2n6), eicosapentaenoic acid (C20: 5n3) and decosahexaenoic acid (C20: 6n3). The highest linoleic acid and EPA values were observed in *Squalius cephalus* species as 7.19% and 6.92%, while the highest DHA was found as 22.45% in *Capoeta umbla* species. In terms of linoleic acid, EPA and DHA values, statistical differences were determined between in these two species ($p < 0.05$). DHA, an important fatty acid of polyunsaturated fatty acids, was the most abundant fatty acid in fish muscle.

Table 3. PUFA (%) Content of Two Different Freshwater Fish Species Caught from Keban Dam Lake

Fatty Acids	*Capoeta umbla*	*Squalius cephalus*
C18:2n6	2.43±0.22^{y}	7.19±0.19^{x}
C18:3n6	0.07±0.00^{x}	0.08±0.01^{x}
C18:3n3	0.74±0.07^{y}	2.35±0.08^{x}
C20:2 cis	0.31±0.04^{x}	0.34±0.00^{x}
C20:4 n6	0.70±0.01^{x}	0.12±0.00^{y}
C20:5n3	4.97±0.02^{y}	6.92±0.01^{x}
C22:6 n3	22.45±1.13^{x}	11.23±0.28^{y}
∑PUFA	31.65±0.83^{x}	28.22±0.39^{y}

Different letters (x, y) in the same row indicate a significant difference between two different freshwater Fish species ($p<0.05$).

ΣPUFA/ΣSFA, Σn-6, Σn-3, Σn-6/n-3, DHA/EPA values of *Capoeta umbla* and *Squalius cephalus* species are given in Table 4. The highest ΣPUFA/ΣSFA ratio (1.11) was found in *Squalius cephalus* species while the lowest value (1.06) was determined in *Capoeta umbla*. Although the highest Σn6 values were observed in *Squalius cephalus* species as 7.28%, the lowest Σn-6 was found as 3.19% in *Capoeta umbla*. There were statistically significant differences in these values in both fish species ($p <0.05$). Considering the amount of Σn-3, which is an important part of the lipids in fish muscle, this value was found to be highest in *Capoeta umbla* species. Σn-6/n-3 ratios were found to be low for both species. DHA/EPA values of *Capoeta umbla* and *Squalius cephalus* determined 4.52 and 1.62, respectively.

Table 4. Changes in Fatty Acids Ratios Two Different Freshwater Fish Species Caught from Keban Dam Lake

Fatty Acids	*Capoeta umbla*	*Squalius cephalus*
∑PUFA/SFA	1.06±0.00^{y}	1.11±0.02^{x}
∑n6	3.19±0.21^{y}	7.28±0.18^{x}
∑n3	28.16±1.08^{x}	20.50±0.21^{y}
∑n6/n3	0.11±0.01^{y}	0.36±0.01^{x}
DHA/EPA	4.52±0.21^{x}	1.62±0.04^{y}

Different letters (x, y) in the same row indicate a significant difference between two different freshwater Fish species ($p<0.05$).

DISCUSSION

The flavour of fish meats is closely related to the protein and fat content in their structures, and the scarcity or abundance of these ingredients is an important factor affecting the quality of the product. Especially in terms of human health, fish meat is important because it contains high amounts of protein, fatty acids, minerals and vitamins.

Omega-3 and omega-6 fatty acids are essential fatty acids that must be taken externally because they are not synthesized in the human body. Therefore, these fatty acids should be obtained in sufficient amounts from the diet. Taking these fatty acids from food is very important for metabolic health (Brown, 2000). Omega-3 fatty acids such as eicosapentaenoic acid (EPA) and decosahexaenoic acid (DHA) are first synthesized by algae such as *Chlorella pyrenoidosa, Dunaliella salina, Arthrospira platensis* (Öztürk, 2014). These fatty acids then accumulate in the fish through the food chain. Therefore, EPA and DHA, the ω-3 series fatty acids, are abundant fatty acids in fish (Gordon and Ratliff, 1992). Moreover, fish are an important source of nutrition for EPA and DHA, which are essential for human metabolic activities (Leaf and Weber, 1988).

It has been reported by many researchers that the most important fatty acids of freshwater and marine fish are palmitic acid, stearic acid, palmitoleic acid, oleic acid, vaccenic acid, linoleic acid, EPA and DHA (Jankowska et al., 2003; Guler et al., 2007; Özogul et al., 2007; Donmez, 2009; Durmuş and Özoğul, 2018; Durmuş, 2018). In this study, similar results were obtained with the researchers. Bulut and Mert (2014) determined the fatty acid composition of *Squalius cephalus* (L., 1758) living in Serban Dam Lake (Afyonkarahisar). As a result of the study, the amounts of palmitic acid, stearic acid, oleic acid, palmitoleic acid, DHA, arachidonic acid, EPA, linoleic acid and linolenic acid were found to be 19.37%, 5.76%, 16.82%, 13,60%, 10,44%, 7.33%, 5.95%, 4.55% and 3.06%, respectively. The researchers found that total SFA, MUFA and PUFA content in total lipid were 28.41%; 32.52%; 38.19%. Çakmak et al. (2015) investigated a comparison of males and females in terms of muscle and liver fatty acid composition of total lipid in *Leuciscus lepidus*. The researchers identified twenty different fatty acids. The main fatty acids identified in both sexes are similar with the present study. Total saturated fatty acids (SFA) were measured as 24.83% in males and 21.79% in female muscles. The percentages of total monounsaturated fatty acids (MUFA) were 27.66% and 28.23%, respectively, compared to total lipid extracted from muscle males and females, respectively. PUFA compositions of male and female *Leuciscus lepidus* species were reported as 47.51% and 49.98%. Yılmaz et al. (1996) investigated the total lipid and fatty acid composition of *Capoeta capoeta umbla* and *Capoeta trutta* in Elazığ Keban Dam Lake. The major fatty acids in both fish were palmitic acid, oleic acid, linolenic acid, EPA, DHA and nervonic acid. It was determined that palmitic acid (73.73-89.01%) was the highest among saturated fatty acids and oleic acid was the highest among monoenoic fatty acids. It was observed that w 3 fatty acids of polyunsaturated fatty acids were higher than w 6 fatty acids of both fish. Among w 3 fatty acids, the highest amount of eicosapentaenoic (5.38-14.65%) and docosahexaenoic (2.43-4.47%) were detected. The researchers found similar or different results. These differences were thought to be due to factors such as the region where the fish was caught, nutrition, size, age and seasons.

HMSO (1994) reported that the PUFA/SFA ratio should be at least 0.45. In this study, the highest ratio was 1.11 in *Squalius cephalus* and the lowest value was 1.06 in *Capoeta umbla*. The ratio of w6 / w3 has been reported to be an important indicator used to compare nutritional values of fish oil (Piggot and Tucker, 1990). It has been reported that the w6 / w3 ratio should be kept as low as 1:1 or 2:1 (Candela et al., 2011). The UK Department of Health recommended that a maximum w6 / w3 ratio should be 4 (HMSO, 1994). A low omega-6 / omega-3 ratio has been reported to reduce the risk of breast cancer in women and positively affect patients with asthma (Simopoulos, 2004). Özogul et al. (2009) reported that the w6 / w3 ratio of 34 different fish species caught from the Mediterranean did not exceed the recommended limit values. Similarly, Ayas et al. (2013) reported that the w6 / w3 ratio of shrimp ranged from 0.2 to 0.7. In the present study, w6 / w3 ratio showed similar results with other researchers and it was determined that it did not exceed the recommended limit values.

As a result, omega-3 fatty acid contents of *Capoeta umbla* and *Squalius cephalus* species were found to be high and important for human health. Considering EPA, DHA and w6/w3 levels, *Capoeta umbla* and *Squalius cephalus* species were found to be rich in PUFA (especially EPA and DHA) and these species have desirable fatty acids for human health.

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Abstract ID: FPT-076

Antibacterial Activity of Resin of Pine Tree on Bacteria Isolated from Surfaces of Seafood Plant

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Resin is a kind of liquid that trees secrete to protect themselves. The tree, which wants to repair itself in cases of cracking and splitting, begins to secrete resin at this point. The resin, which then dries in the cracked area, prevents the injury of the tree. Another benefit of the resin for trees is that it acts as an obstacle to harmful insects. For insects wishing to decay the tree from the inside, resin acts as a drug. It is used in medicine for therapeutic purposes, cleaning bacteria in the mouth, cleaning teeth and inflammation of the respiratory tract.

Turkey's Aydin District collected from red pine (*Pinus brutia*) examined the antibacterial activity of the resin. The resin extracts were prepared with acetone and methanol.
The solvents were evaporated off and resin extracts were obtained. Ethanol and acetone extracts were used by dissolving in 80% ethanol. Four different water solutions (0.5.1.2.5%) prepared from this ethanol-soluble extract were tested.

Antibacterial activity of resin extracts on *Staphylococcus hominis*, *Staphylococcus aureus*, *Pseudomonas fluorescens*, *Pseudomonas alcaligenes*, *Pseudomonas mendocina* and *Staphylococcus aureus* ATCC 13552 mec C positive, *Escherichia coli* NCTC 13846 were studied.

As a result, *Staphylococcus hominis* showed inhibitory effect of ethanol extract and 5% water solution. The effect of ethanol-soluble extract was observed on *Pseudomonas fluorescens, Pseudomonas alcaligenes*, *Pseudomonas mendocina*.

Keywords: Resin, Antibacterial activity, *Staphylococcus spp., Pseudomonas* spp.

Abstract ID: GEN-005

Chromosomal Banding Properties of *Sander lucioperca* (Linnaeus, 1758) in Beyşehir Lake, Turkey

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In this study, it is aimed to describe of chromosomal banding properties (with C-banding and Ag-NOR staining) of pikeperch, *Sander lucioperca* (Percidae: Luciopercinae). Pikeperch is a percid fish species that has a high cultivation potential due to its high commercial value. According to the literature, there is no chromosomal study in this species from Turkey.

Live fish specimens were collected from Lake Beyşehir (Kayabaşı Village, Beyşehir, Konya) and transferred to the laboratory and kept in well aerated aquarium until analysis. The head kidney tissue and air drying technique were used for chromosome preparation. The C-banding technique was performed for determining constitutive heterochromatin regions whereas Ag-staining technique was followed for determining nucleolus organizer regions (NORs). The prepared slides were scanned under light microscope and photographs of banded metaphases were taken.

Constitutive heterochromatin regions were observed on the pericentromeres of most of the chromosomes. Otherwise, Ag-NORs were determined on one pair of chromosome. This report is the first that determines chromosomal properties of *S. lucioperca* from Turkey. This study may also contribute the cytogenetic information of this species.

***Keywords*:** Chromosome, constitutive heterochromatin region, nucleolus organizer region

Abstract ID: GEN-063

Differences of immune-related gene expression in rainbow trout exposed to prolonged starvation

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In this study, expression levels of immune system related genes in muscle and liver tissues of rainbow trout of long term fasting and re-feeding period were investigated. 12 rainbow trout were placed in each trial group. Fish weighing an average of 100 g were subjected to fasting for 70, 120 and 160 days and then for 30 days re-feeding. During fasting and re-feeding, 25mg of fish and muscle and liver tissues were taken and dissected with tissuelyser. RNAs were isolated with RNA mini kit (Qiagen). The cDNAs obtained with RT2 First strand kit (Qiagen) were used as templates in the SYBRGreen-based Real-Time process. Differences in expression levels of IL, TNF and Transferrin genes were determined. ACTB gene was used as housekeeping gene.

As a result of the study, it was seen that IL gene expression level in muscle and liver tissues was expressed 5 times in 70 days fasting, 7 times in 120 days fasting and 17 times in 160 days fasting. After 30 days of re-feeding, it was observed that it decreased up to 3 times. TNF gene expression level was found to reach the highest level of fasting for 160 days. It was observed that transferrin gene was expressed at the highest level with 9 and 17 times during the fasting periods of 120 and 160 days. It was observed that the average weight, which was started at 100 g during fasting periods, decreased to 57.6 g and reached to 89 g after 30 days of feeding. In parallel, gene expression levels were close to the control group but IL gene expression level was expressed 3 times compared to the beginning. As a result, it was determined that expression levels of TNF, IL and Transferrin genes, which affect the immune system with fasting in fish, reached peak level on day 160.

Keywords: Rainbow trout, Gene expression, Immune system, Starvation, Fish health

Abstract ID: GEN-084

Investigation of the Effects of Hurnif (*Alhagi pseudalhagi*) on the Oxidative Stress and DNA Damage During the Embryonic Development Period of Rainbow Trout (*Oncorhynchus mykiss*)

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This study was performed to determine the effects of a series of solutions prepared with different dilutions of hurnif (*Alhagi pseudalhagi*) on certain oxidant and antioxidant parameters in the eggs of Rainbow Trout (*Oncorhynchus mykiss*). The study material consisted entirely of rainbow trout eggs. Once fertilized, eggs obtained from the fish were separated into four groups, which consisted of the control group (1st Group), and three additional groups treated with varying degrees of dilutions of hurnif as the following: 1/500 diluted (2nd Group), 1/1000 diluted (3rd Group), and 1/5000 diluted (4th Group). Samples were taken on 1st. hour, 48th. hour, 7th. day, 21st day and 32nd day respectively. Glutathione (GSH) and advanced oxidation protein products (AOPP) levels of the samples were determined using spectrophotometric methods, while the 8-hydroxy-2' -deoxyguanosine (8-ohgd), lipid hydroperoxides (LOOH), total antioxidant status (TAS), and total oxidant status (TOS) levels were determined with the ELISA method using commercially available kits. OSI levels were calculated using the formula TOSx100/TAS. The Minitab v14.0 package software was used to analyze the obtained data. ANOVA test was used for repeated measurements, and Tukey HSD test was used when determining the differences between the groups. Evaluation of 8-ohdg, AOPP ($p<0.01$), LOOH, TAS, and TOS ($p<0.001$) revealed a statistically significant difference between the groups, while the differences for GSH and OSI levels were found to be statistically insignificant between the groups ($p>0.05$). As a result, it was revealed that treatment of rainbow trout eggs with varying degrees of dilutions of hurnif affected certain oxidant/antioxidant parameters, and this result was surmised to have born out of the antioxidant properties associated with hurnif.

Keywords: Hurnif (*Alhagi pseudalhagi*), rainbow trout, oxidant/antioxidant parameters

Abstract ID: GEN-087

Morpho-genetic Analysis of Keban Dam Lake Populations of *Capoeta umbla* (Heckel,1943)

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Genetic characterization is the first step to be considered in suitable conservation and management of aquaculture especially for breeding purposes. Meristic, morphometrics and genetic characterization of *Capoeta umbla* of Keban Dam Lake was carried out. Advanced techniques for morphometric analysis offers more efficient and powerful tools in identify differences between fish populations and to differentiate between species of similar shape.

Morphological and genetical analysis of *Capoeta umbla* populations was investigated from Keban Dam population of Elazığ-Turkey to identify its diversified populations. Therefore, about 60 similar size of fish samples were collected from Keban Dam Lake population and analysed morphometric and meristic characters by sequence analysis of three gene regions (16S,COI, and Cytb).

Capoeta umbla, 18 haplotypes of 16S rRNA gene, 19 haplotypes of COI and 14 haplotypes of CYTB were identifiedand.The most common haplotypes are Hap1 and Hap6 for 16S, Hap2, Hap1 and Hap6 for COI, while Hap3, Hap5 and Hap12 for Cytb.Haplotip diversities of 16S rRNA, COI and Cytb gene sites were found to be Hd=0,94, Hd=0,946 and Hd=0,798, respectively.On the resulting base compositions for the 16S rRNA gene region T:%18.7, C:%24.5, A:%35.5 ve G:%21.3 and for the COI gene region: T: %27.1, C: %17.8, A: %26.6 ve G: %28.5 and for the Cytb gene region: T: %31.4, C: %27.3, A: %25.6 ve G: %15.7 has been determined. Nucleotide diversities of 16S rRNA, COI and C Cytb gene sites were found to be π=0,00221, π=0,0518 and π=0,0115, respectively.

The relationship between classical morphometric measurements (6) and meristic traits (13) was examined in 60 specimens (30 males, 30 females) caught in the Keban Dam Lake. Standart length of all specimens ranged from 16,4 to 33,9 cm. Morphological differences between males and females was not marked. Biometric analysis of the morphometric and meristic traits indicated a homogenous morphology stock of *Capoeta umbla*.

Keywords: Keban Dam Lake , *Capoeta umbla*, Population, 16S, COI,Cytb, Sequence analyses

POSTER PRESENTATIONS

Abstract ID: AQD-003

The Spermatozoa Velocities of Guppy, *Poecilia reticulata*

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We investigated to spermatozoa velocities of Guppy, *Poecilita reticulata* by computer assisted sperm analysis system (CASA) in this study. The semen samples from 6 fish individuals were collected by abdominal massage under stereo-microscope. The collecting sperm bundles were put into immotile solution (IMS) in which spermatozoa release and to remain quiescent. The spermatozoa of guppy were activated under phase contrast binocular microscope with activation solution (AS).

According to our results, the spermatozoa velocities of Guppy were determined to the straight line velocity (VSL); 53.18±5.52 µm/s, the curvilinear velocity (VCL); 138.35±8.02 µm/s and the angular path velocity (VAP); 102.91±19.06 µm/s.

Keywords: Guppy, *Poecilia reticulata,* spermatozoa velocity.

Abstract ID: AQD-025

Evaluation of Tatar Dam Lake Water Quality in terms of Trout Culture

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Tatar Dam Lake is located in Tunceli, Elazığ and partly Bingöl provinces in Eastern Anatolia Region. It was built on Peri river. The dam consists of a type of rock body fill. The lake volume is 299,6 hm^3 and the lake covers 10,84 km^2. A detailed study on the limnological characteristics of the dam lake has not been done so far. In this study, the water quality of Tatar Dam Lake was evaluated in terms of trout aquaculture.

At Tatar Dam Lake, samples were taken from 5 different locations and at different depths (0, 5, 10, 20, 30, 40, 50 meter) monthly in 2015. At the sampling locations, water were sampled with on-site measurements (temperature, dissolved oxygen, oxygen saturation, pH and electrical conductivity) and taken to the laboratory in a ice box. In the laboratory, the analysis of major parameters, namely (Hardness mg/l (calcium), ammonium nitrogen NH_3^+ mg/L, nitrite nitrogen NO_2^-N mg/l, nitrate nitrogen NO_3^-N mg/l were performed. In Tatar Dam Lake, the temperature, pH, dissolved oxygen, ammonium nitrogen, nitrite nitrogen, nitrate nitrogen and total hardness throughout the year showed changes in the range as 4.9-26.8 (mean;15.6) °C, 8.0-8.9 (mean;8.5), 8.4-12.9 (mean;10.3) mg/L, 0.001-0.075 (mean;0.013) mg NH_3^+/L, 0.001-0.011 (mean;0.002) mg NO_2^-/L, 0.181-0.612 (mean;0.333) mg NO_3^- /L and 134-163 (mean;150), respectively.

As a result, the water quality of Tatar Dam Lake was found suitable for trout farming when compared with the classification values proposed by Sedgwick (1985), Stevenson (1987), Barton (1996), Wedemeyer (1996), Brannon (1991), Smith and Piper (1975), Soderberg (1983), Westin (1974), Birkbeck (1973) and Brown and Mcleay (1975).

Keywords: Tatar Dam Lake, water quality, trout culture

Abstract ID: AQD-028

Fish Health in Aquaponic Systems: Recommendations for Beginners from our Experiences

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Water quality parameters are considered as key factors that strongly affect the fish health and plant needs in aquaponic systems. The aim of this study is to review the potential factors that impacts fish health under different aquaponic culture conditions according to our previous experiments.

We conducted three experiment: lettuce in raft system, broccoli in ebbflow system in laboratory conditions and basil in ebbflow system in room conditions.

Amount and type of fish feed, timing and number of feeding and fish waste/faeces are important for sustainable management of the aquaponic system. Feeding one time in a day increased the waste of feeds and caused the higher turbidity. Feeding two times with less amount of feeds increased the water clarity. Using small and different feeds also decreased the waste of feeds. However lighting conditions are also important for both plant and fish. In a Raft system aquaponic, the shading effect cause the discoloration problem in fish. However, direct sunshine and enhanced light caused excessive algal growth in a ebb flow aquaponic system with basil. The combination of fish and plants should be compatible with the characteristics of each production type to balance nutrient production from fish culture and nutrient uptake by plants. We used goldfish in our experiments, and they were well compatible with all plants. Stocking density, diet, feding technique, and management procedures, possibly affecting stress levels, also impact the health, of the fish. Increasing stock density from 10 to 20 fishes in each tank, decreased the water quality and caused stress in fishes. Quality of external filter (filtering capacity) also impacted the water quality. Algal biomass was increased with low quality filter. Labour and maintenance cost were also decreased with high quality external filters in laboratory conditions. Further studies are needed to enhance the knowledge of aquaponic in Turkey.

***Keywords*:** Aquaponic, Fish welfare, Turkey, Water quality, Fish Feeds

This study was supported by Çankırı Karatekin University Scientific Research Projects Support Program (BAP Project no: OF061218L01).

Abstract ID: AQD-036

Adaptation of Captured Siraz (*Capoeta umbla* Heckel, 1843) Broodstocks to Fish Tanks for Domestication

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In the last decades, fisheries production declining as aquaculture production increasing worldwide. Nowadays, almost fifty percent of seafood consumption covered by aquaculture industry. On the other hand, aquaculture industries relied on a few aquatic species. There is a need to bring new fish species into the aquaculture sector, which is based on the captured and domestication of new species from nature. Adaptation of a wild fish species to aquaculture conditions has many bottlenecks in terms of providing optimal fish welfare, survival, feeding and breeding. To overcome these problems, environmental enrichments which have positive effects on fish welfare should be done. Some substrates in culture conditions can reduce stress on captured fish and enables them to adapt quickly to the aquacultural environment. Tank floor substrates such as earth, gravel, sand, etc. have positive effects on fish welfare in terms of reduced damage on body parts, prevented aggressions, lower mortalities or adaptation of captured fish for feeding.

In this research, adaptation of captured Siraz (*Capoeta umbla* Heckel, 1843) broodstocks to fish tanks for domestication was studied and different substrates were tested. A total of 320 siraz fish were caught with gillnets on 15-23 October 2018 in Tatar region. Mean weights of captured fish was 340 ± 73 g. Fish were stocked to 3 m^3 circular fiberglas tanks with 2 m diameter. 80 fish died after 2 days because of fungal disease. On 26 October 2018, a total of 12 circular fiberglass tanks floor covered with substrates; earth, sand and artificial grass were prepared for adaptation testing. Stocking density was kept around 2.3 kg m^{-3} for each tank. This trial was conducted with 240 fish and 4 replicated. Fish were disinfected with potassium permanganant before stocking into tanks. Upper of fish tanks were covered to prevent fish from splashing out of the tank. After stocking, 3 mm trout feed was given to the fish daily. Disinfection bath was carried out every 15 days for fish with potassium permanganant. At the end of study (26 November 2018), the mortality rates were 18.75%, 87.5% and 95% for earthen, sandy and artificial grass tanks, respectively. It was obviously seen that earth had a significant effect on adaptation of captured siraz broodstocks to the tank environment. In the adaptation of wild fish to the aquaculture conditions, earthen ponds appear to be a serious factor for welfare of captured fish broodstocks.

***Keywords*:** Siraz, *Capoeta umbla*, captured broodstock, tank adaptation.

Abstract ID: AQD-037

Hepatitis E and A Infections in Aquatic Foods

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Hepatitis E virus (HEV), the causative agent of hepatitis E, was detected first in 1983 by electron microscope. Virus classified in the family Hepeviridae, that icosahedral capsid symmetry with a diameter of around 27–30 nm. The HEV genome is, single-stranded, non-segmented, a positive-sense, 7.2 kb long and contains RNA molecules (Meng, 2010; Pavio N ve ark.2015; Vasickova P, 2007; Chaussade H ve ark. 2013). Hepatitis E virus (HEV) is transmitted fecal-oral route and causes large waterborne outbreaks worldwide (Yugo ve ark.,2013; Meng,2013).

Hepatitis A virus (HAV) is a member of the Picornaviridae family consisting of a 7.5-kb, non-enveloped, positive-sense, single-stranded RNA genome. These viruses gastroenteritis, hepatitis, myocarditis, and aseptic meningitis viruses are transmitted by the fecal–oral route and are widely prevalent in locations with poor cleaning (White and Fenner, 1995; Koopmans ve ark., 2002; Pınto ve ark., 2003; Sinceroa ve ark., 2006).

Hepatitis A virus (HAV) and hepatitis E virus (HEV) cause foodborne diseases and zoonotic infections (Shieh et al. 2007; Colson et al. 2010), especially in underdeveloped areas of industrialization. Some recent studies have shown that viruses are found in the stomach and digestive tissues of shellfish, bivalve mollusks (Namsai ve ark.,2011; Gao ve ark.,2015; Cui ve ark.,2016; Rosa ve ark., 2017).

In this review, investigate the distribution of Hepatitis A virus (HAV) and hepatitis E virus (HEV) in aquatic foods in research in recent years.

Keywords; Hepatitis A virüs, Hepatitis E virüs, Shellfish

Abstract ID: AQD-050

Identification of Vibrio anguillarum Infection Agent by a Microbial Identification System in a Rainbow Trout (*Oncorhynchus mykiss*) Farm

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Fish farming is developing faster than many sectors in our country. In parallel with this development, the risk of disease and with new pathogens increase resistance of pathogens. In addition to conventional methods, molecular techniques can be used to diagnose bacterial fish diseases. The identification of bacteria, one of the molecular techniques according to the fatty acid profile, is one of the most reliable and rapid methods.

In this study, *Vibrio anguillarum* cultures isolated from a trout farm in Isparta Region were identified by conventional methods and fatty acid profile. For bacterial production and isolation; Tryptone lineage agar (TSA), Thiosulfate Citrate, Sucrose (TCBS) and Muller Hinton agar (Merck) were used in the antibiogram test studies. For cultural identification; Conventional biochemical tests and fatty acid profile (MIS - Microbial Identification System) were performed; Hewlett Packard ™ gas chromatography and MIDI Sherlock® Microbial Identification system was used.

There were no significant clinical findings on the farm except for intense juvenile deaths and regional coloration. Phenotypic and biological test results also show a general agreement with the literature. The fatty acid profile of the isolate showed compatibility with *Vibrio anguillarum* species with 89.24% accuracy. Thus, in addition to biochemical tests, molecular identification results were obtained to identify bacteria. It was determined that the agent is; sensitive to norfloxacin and gentamicin; resistant to amoxicillin, oxolinic acid, nitrofurantoin, ampicillin, trimethoprim+sulfamethoxazole, kanamycin, chloramphenicol, bacitracin, streptomycin, oxytetracycline, gentamicin, penicillin, erythromycin and enrofloxacin.

Keywords: *Oncorhynchus mykiss*, *Vibrio anguillarum*, Microbial Identification System

Abstract ID: AQD-053

The Effect of Soya Meal on Reproductive and Growth Performance in *Pseudotropheus socolofi* Fish

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Soybean meal is a feed raw material containing high levels of phytoestrogens. These plant oestrogens may effect growth and reproductive performance and gender ratio of the organisms due to their estrogenic or anti-estrogenic properties. This study was carried out to determine the effects of dietary soybean inclusions on reproductive and growth performance of *Pseudotropheus socolofi*. One male and 5 female fish with initial weight of5-9 g were randomly placed in each replicate. 5 experimental diet supplemented with soybean 3 %, 16 %, 27 %, 35 % and 44 % were fed to triplicated groups of fish for 90 days.

At the end of the experiment, there were the statistical differences in terms of mean weight and feed conversion rate ($P < 0.05$) between 3 % and 44 % the treatments. However, no significant differences between the groups were determined in specific growth rate, weight gain and survival rate ($P > 0.05$). When the reproduction data were evaluated, the statistical differences were not found between groups with regard to fertilization rate, egg efficiency, egg hatching rate, egg diameter, gonadosomatic index and percentage of spawning brood stock ($P > 0.05$).

In conclusion, feeding with soybean meal up to 35% rate did not negatively affect the growth of *Pseudotropheus socolofi* and up to 44% inclusion of soybean meal had no effect on reproductive variables.

Keywords**:** *Pseudotropheus socolofi*, growth, reproduction, soybean meal.

Abstract ID: AQD-093

A Preliminary Study on Some Blood Parameters of Giant Spring Minnow (*Pseudophoxinus anatolicus*, Hanko 1925)

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In interpopular diagnosis and determination of the polluters in the water, regular values of the hematologic parameters of the fish which lives in a natural habitat helps as well. Depending on the environmental factors, there happens to be some alterations in the fish blood composition, especially on hormones, erythrocytes, leukocytes, hematocrit and hemoglobin concentration. Hence, hematologic analyzes can be used to follow the health conditions of the fish which live in natural habitats. Factors such as sexual maturity, gender, age, length, weight, diet, method of capturing, season, warmth of the water, pH etc. affect the blood structure of the fish.

In this study; determination of some blood parameters of the Giant Spring Minnow (*Pseudophoxinus anatolicus*),which is put in the red list by IUCN and also is an endemic species that got exepmlified in Konya province Seydişehir district Kuğulupark area, was intended.

The 10 Giant Spring Minnow that have been used as study material, were hunted by multifilament extension nets in a water source in Konya province Seydişehir district Kuğulupark area. Average features of the fish were measured as 128.24±11.94 gr, 21.10±0.74 cm TL, 19.83±0.70 cm FL, 18.23±0.63 cm SL.

In the analysis; Lökosit (*WBC*) 24.86±6.19 ($x10^3/mm^3$), Trombosit (*PLT*) 180.75±34.50 ($x10^6/mm^3$), Hemoglobin (*HGB*) 10.31±0.96 (g/100 ml), Red Blood Cell (*RBC*) 2.46±0.53 ($x10^6/mm^3$), Hematokrit (*HCT*) 24.96±5.70 (%), Mean Cell Volume (*MCV*) 100.14±3.11(fL), Mean Corpuscular Hemoglobin (*MCH*) 39.97±3.29 (μμg), Mean Corpuscular Hemoglobin Concentration (*MCHC*) 40.63±4.25 (%)

These data which were determined in the natural habitat of the Giant Spring Minnow, which has a potential for production, can be used as reference values for animal welfare in the cultivation studies.

***Keywords*:** *Pseudophoxinus anatolicus,* Blood parameters, Seydişehir, Alternative species, Production

Abstract ID: BIO-009

First record for the *Lepomis gibbosus* in the Gediz River basin (Turkey)

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The study is the first reference of pumpkinseed, *Lepomis gibbosus* (L., 1758), a non-native species in the Gediz River basin located in the Aegean Region. One specimen was caught on 23 May 2016 by fyke net from Demirköprü Dam Lake on the Gediz River during the fieldwork of the 2015-ÖDL-SUÜF-0003 numbered project. The specimen was photographed and fixed in a 4% formalin solution immediately after capture and was brought to the laboratory for further systematical examinations. Total length and weight were measured as 12.2 cm and 36.0 g.

According to the literature, this non-native species has not been recorded from the Gediz River before, and, moreover, the fishermen of Demirköprü Dam Lake stated that they had never encountered this fish. With this study, the *L. gibbosus* showing high environmental tolerances and potential invasive character was registered for the first time from Gediz River. This species has a predatory effect on Cyprinid larvae and is a potential competitor for food of native fish species. The ecological and economic effects of *L. gibbosus* in the Gediz River should be monitored by the cooperation of stakeholders such as fishermen, scientists and competent authorities.

***Keywords*:** Pumpkinseed, *Lepomis gibbosus*, Non-native species, Gediz River

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Abstract ID: BIO-014

Fish Fauna of Birecik Dam Lake (Şanlıurfa)

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This study; it is located on the borders of Şanlıurfa and Gaziantep Province, the administrative structure was carried out between 2014-2016 in order to determine the fish fauna in Birecik Dam Lake which is connected to Şanlıurfa province. Taking into consideration the physical structure and weather conditions of the Birecik Dam Lake, the region was visited on a monthly basis and 18 fishing operations were performed provided that the nets were kept in water for one night. In this study, gill nets (mesh size 20, 36, 44, 48, 60 and 72 with 50 meters each; mesh size 80, 100, 120, 140 and 200 mm with 100 meters each) and fyke-nets were used. In addition, in the shallow areas where the stream's mouth, small fishes that were too small to be caught with nets were caught by using a electroshock device, hand net, seine and fishing line. In the results of working; A total of 25 taxa belonging to 5 families were identified in Birecik Dam Lake.

***Keywords*:** Birecik Dam Lake, Fishing, Fish Fauna, Gill Net, Seine

Abstract ID: BIO-086

Reproductive biology of Invasive Sand Smelt (*Atherina boyeri* Risso, 1810) population in İznik Lake (Bursa, Turkey

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The aim of this study was to determine, the reproductive biology of Sand Smelt (*Atherina boyeri* Risso, 1810) population in İznik Lake, which is one of the exotic and invasive fish species in Turkish inland waters.

Samples were monthly collected by using beach seine net with 6, 9, 12 and 14 mm mesh size from January-2014 to December-2014 in 4 different station. Caught fish measured total length with 0.1 cm precision and gaged total weight with 0.0.1 g precision. Gonadosomatic Index (GSI) values were calculated by monthly for the detection of reproductive period. *SizeMatR* (v0.1.0) package used for estimating of the size et sexual maturity.

The total length and weight of 2938 fish individuals were ranged from 26 to 112 mm and from 0.11 to 11.02 g, respectively. Additionally, female:male ratio was 1:0.70. Accordingly, breeding activities of the species was intensively found to take place between April-Jun in İzmir Lake. According to investigated 227 female gonads, the mean total number of eggs were estimated as 978 egg/fish. The size at first sexual maturity (L_{50}) for *A. boyeri* in İznik Lake was 49.8 mm for female and 45.6 mm *TL* for the male respectively.

Keywords: Exotic species, invasive species, gonadosomatic index, length at first maturity

Abstract ID: ECO-002

Evaluation of Water Quality of Özlüce Dam Lake in Terms of Trout Breeding and Carrying Capacity Estimation

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This study was carried out to reveal the physicochemical properties of Özlüce Dam Lake located within the city borders of Elazığ and Bingöl. The study on the dam lake was planned between January and December 2015 however, it could be done between January and June 2015. Between these dates, surface water samples were taken monthly and instant measurements were made at a total of 5 stations determined in Özlüce Dam Lake. In one of these stations (Station 4), different depths of measurement and sampling were performed. According to the results, evaluations were made on trout production and carrying capacity in the lake.

It was determined that the temperature values of water quality parameters ranged from 5.6 to 19.4 °C in surface water, and between 3.3 to 18.9 °C in water column at fourth station, the dissolved oxygen concentration of 9.2 to 12.1 mg/l in surface water, 4 mg/l to 11.4 mg/l in water column at fourth station, the pH values of 7.6 to 8.7 in surface water, 7.4 to 8.6 in water column at fourth station, nitrite concentration of 0.0002 mg/l to 0.0736 mg/l in surface water, 0 mg/l to 0.2389 mg/l in water column at the fourth station, nitrate concentration of 0.04 mg/l to 2.33 mg/l in surface water, 0 mg/l to 2.29 mg/l in water column at fourth station and the secchi disc depth 1m to 5m.

When the specified rules are followed, Özlüce Dam Lake was found suitable for periodical trout farming and according to the phosphorus based transport capacity, it is estimated that the trout can be grown in the lake around 21,500 tons/year.

Keywords: Özlüce Dam Lake, Secchi disc, Water quality, Carrying capacity

Abstract ID: ECO-013

The Evaluation of Water Quality and The Estimation of Carrying Capacity for Rainbow Trout Cage Aquaculture of Uzunçayır Dam Lake

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This study was carried out to reveal the physicochemical water quality of Uzunçayır Dam Lake located in Tunceli province. The study was conducted monthly sampling between April 2017 and March 2018. For this purpose, water samples were collected from different depths of a total of 7 stations in Uzunçayır Dam Lake. Considering the results obtained, rainbow trout breeding and carrying capacity of the reservoir have been evaluated.

During a period of one year, the dam lake was found that the water temperature was 3.5-27.1 °C, the pH was 7.9-8.9, the concentration of dissolved oxygen was 7.9-12.8 mg/L, electrical conductivity was 185-437 µS/cm, ammonium nitrogen was 0.001-0.126 mg NH_4^-N/L, nitrate nitrogen was 0.086-0.955 mg NO_3^-N/L, nitrite nitrogen was 0.001-0.028 mg NO_2^-N/L, total nitrogen was 0.402-1.940 mgN/L, total phosphorus was 0.001-0028 mg P/L, chlorophyll-a was 0.1-3.1 mg/L, suspended solids was 0.3-8 mg/L, total hardness was 109-224 mg/L and the depth of Secchi disc was between 0.4-5.5 m. It was determined that Uzunçayır Dam Lake was classified as high quality water (Class 1) according to the criteria of Surface Water Quality Regulation.

As a result, it was estimated that Uzunçayır Dam Lake is suitable for trout farming and it was estimated that around 39,400 tons/year trout can be cultivated in the lake based on an estimation by phosphorus loading model.

***Keywords*:** Uzunçayır Dam Lake, Water quality, Secchi disc, Carrying capacity

Abstract ID: ECO-020

Water Quality Characteristics of Some Streams (Uluköy, Bayırbağı-Pagnik, Üzümlü, Işıkpınarı) in Erzincan Basin

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The streams Uluköy, Bayırbağı (Pağnik), Üzümlü and Işıkpınarı in Erzincan basin are important tributaries feeding Karasu River. This study has been prepared by using a part of the project titled "Investigation of Surface Waters of Yukarı Fırat Basin in terms of Quality and Aquaculture". The water quality of these water resources was evaluated for the first time with this study. Surface water samples were taken seasonally between 2012 and 2014. The physical and chemical properties (temperature, pH, dissolved oxygen, dissolved oxygen saturation, electrical conductivity, BOD, COD, NH_4-N, NO_2-N, NO_3-N, suspended solids, Ca hardness, total hardness, alkalinity, SO_4, Cl, Mg, P, chlorophyll-a, Ca, Na, K) of water samples were analyzed.. The monitored water resources were evaluated according to the Water Pollution Control Regulation Inland Water Resources Criteria and Drinking Water Quality Criteria (TSE 266, EC, WHO, EPA). According to the results obtained, % dissolved oxygen concentration in all sampling points according to WPCR criteria were in the Class II water quality. Electrical conductivity concentration in Uluköy and Işıkpınarı sampling points were in the Class II water quality. Average NO_2 in Uluköy, Üzümlü and Işıkpınarı sampling points have found in the Class II water quality also Bayırbağı-Pagnik point was in the Class III. The sampling points were in the Class I water quality according to WPCR in terms of all other parameters. With the evaluations made in terms of Drinking Water Quality Criteria, it was determined that the sampling points were in accordance with TSE 266 in terms of temperature, pH, anion and cation and in terms of some parameters it was found to be in accordance with EC, WHO and EPA criteria.

***Keywords*:** Uluköy, Bayırbağı-Pagnik, Üzümlü, Işıkpınarı, water quality

Abstract ID: ECO-026

Hidden Threat in Waters, Microplastics

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Plastics are polymeric materials that are used in every field of our daily life because of their advantages such as ease of use, good electrical and thermal insulation, flexibility, lightness easy processability, corrosion resistance and economy. Also microplastics, which are defined as plastic particles less than five millimeters, are one of the important micro pollutants and very harmful to the environment and health, caused by synthetic textile fibers, cosmetics, detergents and toothpastes, waste from plastic factories, automobile tires.

It is estimated that plastics may pose serious ecological problems in the future the reasons as production of more durable types in line with the needs and developing technology, containing them with harmful additives, being too small, not decomposing, adsorbing toxic chemicals and be ingested by livings as food, not being completely removed in wastewater treatment plants and easily transported in the atmosphere and water resources and difficult extinction in nature.

Plastics which are divided into micro pieces, can be found especially on the surface of water resources the reason of their density is less than water, along the water column and even so very serious studies should be done in the sediment in order to use and sustainability of the water resources. Scientists have pointed out if the amount of free microplastic in nature, continues to increase in this way, there will be a risk of exceeding the fish amount in the oceans at 2050. In recent years, the awareness for microplastics and their environmental damage has been increasing worldwide and the use of microplastics in cosmetics has been banned in Europe and America from 2018. In order to prevent excessive use of plastics, it is thought to solve this problem significantly as giving fine for business owners who give free plastic bags, reduction of microplastics coming from the sewage at source, equipping the washing machines with a unit to hold synthetic textile fibers and the addition of an ultrafiltration unit to some conventional wastewater treatment plants. Although the use of plastic is not completely abandoned, at least using free or less plastic alternatives would be an environmentalist and rational approach.

***Keywords*:** Microplastic, plastic, water, sustainability

Abstract ID: ECO-033

Determination of Water Quality of Hazar Lake

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In this study conducted in Hazar Lake between January and December 2014, the sampling points were determined with dividing lake into equal parts. The coordinates of the determined stations were determined by the GPS device.

Water samples monthly were taken homogeneously from 28 points as 21 littoral and 7 open water zones.Water temperature, dissolved oxygen, pH, electrical conductivity and secchi disk depth were measured at the sampling points. Chlorophyll a, total hardness were determined according to standard methods. Dissolved main cations (ammonium, sodium, potassium, calcium, magnesium) using cation column and main anions (chloride, nitrite, nitrate, phosphate, sulfate) using an anion column were analyzed by Ion Chromatography (APHA, 1995). Total phosphorus and total nitrogen were determined by Hach-Lange DR6000 instrument (ISO, 1986).

In this study, although the temperature varied greatly according to the months, the difference between the stations was not much. The average annual temperature was 14.5 ° C. The mean pH value was measured as 9.4 ± 0.07. Monthly average pH values were similar in all stations.The average electrical conductivity was determined as 2094 ± 47.2 µS / cm. It started to decrease in autumn months and was recorded at the lowest average values in winter months. The average dissolved oxygen, nitrite, nitrate total nitrogen, total phosphorus, sulfate, chlorophyll a, secchi disc depth, sodium, potassium, calcium, magnesium, ammonium, chloride were 9.2 ± 0.3 mg O_2/L, 0.029 ± 0.022 mg NO_2^--N/L, 0.052 ± 0.049 mg NO_3^--N/L, 0,71 ± 0,18mg N/L, 0.027 ± 0.004mg P/L, 19±1 mg SO_4^{-2} / L, 1,52 ± 0,5 µg / L, 2,9 m, 120±3.52, 5,7±0,4, 4,7 ± 0,3 Ca^{+2} mg / L, 110 ± 2,9 Mg^{+2} mg/L, 0.081 ± 0.011mg NH_3-N/L, 409 ± 22 mg/L, respectively.

When Hazar Lake was evaluated according to the Quality Criteria of Inland Surface Water Resources, in terms of temperature, dissolved oxygen, total phosphorus and nitrate nitrogen it was found in first class but in terms of oxygen saturation and nitrate nitrogen it was in second class and in terms of pH it was in third class quality. According to chlorophyll, secchi disc depth and total phosphorus values, Hazar Lake was found to be an oligotrophic lake.

Keywords: Hazar Lake, water quality, oligotrophic lake

Abstract ID: ECO-041

Determination of Polyaromatic Hydrocarbon Levels in Water and Sediment Samples of Atatürk Dam Lake, Turkey

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Polycyclic aromatic hydrocarbons (or polyaromatic hydrocarbons) (PAHs) are dangerous organic pollutants found in petroleum and petroleum derivatives, resulting from unburned fossil fuels, and enter into natural waters by oil spills, vehicle emissions, industrial wastewater and atmospheric precipitation.

It is very important to know the risk levels of these pollutants, which are known to have high toxic, mutagenic and carcinogenic effects that may threaten human health.

In this study, the levels of 17 PAH compounds were determined for the first time in the water and sediment samples, which were seasonally collected in the sampling stations in the Atatürk Dam Lake during one year.

Keywords: Atatürk Dam Lake, Polycyclic Aromatic Hydrocarbons, Water, Sediment

Abstract ID: ECO-042

Determination of Polyaromatic Hydrocarbon Levels in Economic Important Fish Species of Atatürk Dam Lake, Turkey

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Polycyclic aromatic hydrocarbons (or polyaromatic hydrocarbons) (PAHs) are dangerous organic pollutants found in petroleum and petroleum derivatives, resulting from unburned fossil fuels, and enter into natural waters by oil spills, vehicle emissions, industrial wastewater and atmospheric precipitation.

It is very important to know the risk levels of these pollutants, which are known to have high toxic, mutagenic and carcinogenic effects that may threaten human health.

In this study, the levels of 17 PAH compounds were determined for the first time in the samples belonging to 3 fish species consumed by the local population, which were seasonally collected in the sampling stations in the Atatürk Dam Lake during one year.

***Keywords*:** Atatürk Dam Lake, Polycyclic Aromatic Hydrocarbons, Fish, Human Heat

Abstract ID: ECO-062

A Preliminary Study on Zooplankton Fauna of Beytepe Pond (Ankara/Turkey)

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In this research, zooplankton and some water quality parameters were investigated in Beytepe Pond (Ankara / Turkey). The material of the study consists of zoplankton samples taken from 3 stations (3 zones on the pond) and water quality parameters taken from 5 stations (3 zones on the pond and pond inlet and outlet zones) in the field study on 24.09.2018. The zooplankton samples were taken using a plankton net (55 µm mesh size) and preserved in 4% formaldehyde. Also, some water quality parameters such as temperature of surface water (°C), dissolved oxygen (mg/L), saturation of dissolved oxygen (%) depth (m), secchi disk (m), pH, salinity and conductivity (µS/cm) (using, a WTW multi 340i and WTW oxi 3210) were measured in the stations. Chemical analyzes (total alkalinity, calcium, magnesium, total hardness, sulfate, organic matter, ammonium, ammonia, nitrite, nitrate, total nitrogen, orthophosphate, total phosphorus, turbidity, silicate, chlorine) were performed for each station.

Orthophosphate and total phosphorus values were higher in the inlet and outlet stations of the pond. Among nitrogen fractions, ammonium nitrogen was determined at the highest same station. Nitrite nitrogen, nitrate nitrogen and total nitrogen parameters were found to be highest at the inlet station of the pond. When evaluated according to the general chemical and physicochemical parameters of the inland water resources; Nitrate nitrogen and orthophosphate values are of 2nd class quality. At the same time, according to the same criteria, total nitrogen and total phosphorus are of 3rd quality.

A total of 13 zooplankton species were identified. Rotifera groups (85%) and Cladocera (15%) were detected in the pond. The maximum number of species was found at the 1st station (11 species), and the minimum number of species was determined at the 2nd and 3rd (5 species) stations. The dominant species were determined as *Polyarthra dolichoptera, Keratella cochlearis* and *Trichocerca pusilla*.

Keywords: Rotifera, Cladocera, Beytepe Pond, physicochemical parameters

Abstract ID: ECO-081

Estimation of Nitrogen-Phosphorus Load from the of Farms Rainbow Trout (*Oncorhynchus mykiss* Walbaum, 1792) Installed on Çandır Göksu Stream (Isparta)

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The rainbow trout (*Oncorhynchus mykiss*), which was first introduced in the 1970s in our country, is a leader in aquaculture with an annual production exceeding 100.000 tons. With this increasing number of plants and production amounts, it has been started to discuss the negative potential effects of aquaculture. Various amounts of wastes are released into the aquatic environment through aquaculture in land-based facilities. It is important to examine the environmental impact of aquaculture. In this study, it was aimed to investigate the estimated nitrogen and phosphorus loads of the rainbow trout facilities on the Çandır Göksu Stream located in the Isparta borders.

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 Çandır Göksu Stream as of 2019. 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 were taken as basis.

The phosphorus input with feed is estimated to be 2.25 tons per year and the amount of phosphorus removed by fish is estimated to be 1.00 tons per year in the Çandır Stream. However, the phosphorus load entering estimated at 1.25 tons per year in the Çandır Stream. The nitrogen input through feed was estimated to be 1.20 tons per year and the amount of phosphorus removed by fish was estimated to be 0.88 tons per year in the Çandır Stream. However, the phosphorus load entering is estimated at 0.32 tons per year in the Çandır Stream. 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 Çandır Stream was estimated as 9.66 to 11.21 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: Çandır Göksu Stream, tainbow trout, *Oncorhynchus mykiss*, estimated nitrogen load, estimated phosphorus load

Abstract ID: ECO-082

Estimation of Nitrogen-Phosphorus Load from the of Farms Rainbow Trout (*Oncorhynchus mykiss* Walbaum, 1792) Installed on Aksu (Köprüçay) Stream (Isparta)

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The rainbow trout (*Oncorhynchus mykiss)* production, which was first started in the 1970s in our country, has become a leader in aquaculture production with an annual production of more than 100.000 tons. Trout is in the first place in terms of the number of farms and production amount due to the fact that the aquaculture is easier to produce than the other fish and suitable water resources.

In this study, it was aimed to investigate the estimated nitrogen and phosphorus loads of the rainbow trout facilities on the Aksu Stream located in the Isparta borders.

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 Aksu Stream as of 2019. 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 were taken as basis.

The phosphorus input with feed is estimated to be 0.73 tons per year and the amount of phosphorus removed by fish is estimated to be 0.28 tons per year in the Aksu Stream. However, the phosphorus load entering estimated at 0.45 tons per year in the Aksu Stream. The nitrogen input through feed was estimated to be 0.39 tons per year and the amount of phosphorus removed by fish was estimated to be 0.22 tons per year in the Aksu Stream. However, the phosphorus load entering is estimated at 0.17 tons per year in the Aksu Stream. 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 Aksu 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: Aksu Stream, tainbow trout, *Oncorhynchus mykiss*, estimated nitrogen load, estimated phosphorus load

Abstract ID: ECO-090

Assessment of Cytotoxicity Activity of *Cyclamen graecum* and *Prospero autumnale* Using Brine Shrimp (*Artemia salina* L., 1758) Lethality Bioassay

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Various extracts of different plant species are known to have cytotoxic, antifungal, antimicrobiological, anticancer, antioxsidant effects, but, it is very important to know the toxic effects of these products used as additives for the safe use.

Cytotoxic activities of two geophyte species, *Cyclamen graecum* and *Prospero autumnale* were detected by brine shrimp (*Artemia salina* L., 1758) lethality bioassay in this study.

The extracts were obtained from below-ground-above-ground of *Cyclamen graecum* and *Prospero autumnale*. Brine shrimp eggs were hatched in 500 ml artificial sea water prepared from sea salt under artificial light at 28 °C. After 48 h, nauplii specimens.were collected with a pasteur pipette and were added to each set of tubes containing 0.5 ml plant extracts and filled to 5 mL total volume with artificial salt water.

The test extracts prepared including control and with three different concentrations (10 ppm, 100 ppm, and 1000 ppm) . After 24 h, the number of survivors was counted and the percentage of death calculated. LC_{50} values were calcuted by Probit Analysis Program.

We found that above-ground of *P. autumnale* with 131.27 ppm exhibited higher cytotoxic activity than *C. graceum* with 321.42 ppm.

***Keywords*:** Cytotoxicity, Brine shrimp, lethality bioassay, *Cyclamen graecum*, *Prospero autumnale*

Abstract ID: FIM-008

Length-weight relationships of *Carassius gibelio* (Bloch, 1782) in the Demirköprü Dam Lake (Manisa/Turkey)

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The present study was conducted to determine the length-weight relationships of Prussian carp *Carassius gibelio* (Bloch, 1782) in the Demirköprü Dam Lake. A total of 733 specimens were caught by gillnet and trammel net and fyke net and beach seine fishing and a combination there of on a monthly sampling basis from July 2015 to November 2016. Specimens were measured to the nearest 0.1 cm total length (L) and weighed to the nearest 1 g total weight (W). The gonads of the specimens were macroscopically observed to sex determination.

It was determined that 65% of the samples were females (n=475), 29% males (n=214) and 6% uncertain sex (n=44). Total length and weight of sampled fish ranged from 10.7 cm (in April) to 39.6 cm (in June) and from 36 to 928 g, with a mean of 25.35 cm and 315.26 g, respectively. Length-weight relationships were determined for males, females and combined sexes as $W=0.0097L^{3.181}$, $W=0.0132L^{3.097}$ and $W=0.0123L^{3.116}$ respectively.

The results indicated further that the length-weight relationships were highly correlated ($r^2=0.938$, $P<0.001$) and the species showed positive allometric growth.

***Keywords*:** Prussian carp, *Carassius gibelio*, Length-weight relationship, Demirköprü Dam Lake

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Abstract ID: FIM-010

Applications for Supporting Aquaculture in Turkey

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The commitment to support aquaculture in Turkey was put into force in 2003 in order to make contributions both on sectoral and environmental basis and still continues since then. This framework can be basically outlined as follows: Contribution to food safety by meeting the animal protein requirement necessary for the healthy and balanced nutrition intake for the consumers, ensuring the registration of the farms in the sector, promoting the use of technology, encouraging environmentally friendly farming, promoting the cultivation of new species, contributing to the development of rural areas and employment, promoting agricultural production, funding research and development projects, contributing to solutions to major problems faced by the sector, ensuring the policies implemented in action. The current aquaculture support program has made a significant contribution to the quality and healthy production, an increase in productivity, rapidly development, improvement and sustainability in the sector. In this context, it would be beneficial to know areas to be supported and conditions play a role in future investment and planning for the development of the seafood sector. The subjective of this study is to assess the applications implemented to the aquaculture in Turkey. The study is also believed to shed light on the fisheries incentive practices.

Keywords: Fisheries, Support management, Sustainability in production

Abstract ID: FIM-043

Illegal Fishing in The Lake of Eğirdir

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In this study, it is aimed to determine the amount of illegal fishing in Eğirdir Lake and the fishing tools used during a prohibited fishing period.

The study was carried out between 15 March - 15 June 2019 in order to reveal the current situation of illegal fishing in the Egirdir Lake. In that period, the type and amount of illegal fishing vehicles obtained as a result of the control activities carried out by the teams of the Ministry of Agriculture and Forestry Eğirdir District Directorate of Agriculture were determined and recorded.

Looking at the data obtained as a result of the study; During the 15 March - 15 June period, which is the prohibition period of 2019, as a result of 45 operations, 1410 meters of gillnets, 5500 meters of trammel nets, which are in illegal use in the lake environment, total 6910 meters of nets, 28 fish baskets, 364 crayfish baskets and 36 fishing gear which named by 'tırıvırı' were found and removed from the environment and prevented ghost fishing activities have been terminated.

Since there is no competition between fishermen in this period, the amount of fish to be taken from the environment will be many times higher than the period in which fishing is allowed times, although the number of fishermen is low. However, it is not possible to know clearly the amount of fish and crayfish withdrawn from the stock through illegal fishing. In addition, the negative impact of fishing during the forbidden period is not only limited to the amount of fish caught, but also the damage caused by the killing of millions of fry.

As a result; illegal fishing is a serious problem in Eğirdir Lake as it is in all of our lakes. It is not possible to produce a solution to this problem only through inspections. It should be placed in the awareness that the duty of protection does not belong only to the supervisors and that this is a duty of all fishermen and local people. For this purpose, regular training activities and awareness studies should be carried out. In addition to the existing inspections in the lake, the establishment of photo traps for detection of illegal fishing and monitoring with drones should be implemented. In the Fisheries Law, deterrence should be provided in penalties and criminal sanctions should be provided for the crimes, but the necessary legal and social conditions should be provided in order not to commit the crime.

***Keywords*:** Eğirdir Lake, illegal fishing, forbidden period

Abstract ID: FIM-044

Evaluations on Fisheries Management on the Yenicaga Lake, Bolu, Turkey

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Yenicaga Lake formed as a result of filling of a depression, which developed with the effect of the North Anatolian fault line, with alluvium afterwards. The wetland area of the lake is 2636500 m^2. Its average depth is 5 m. Yenicaga Lake includes the largest peatland in Turkey that reaches up to 2 meters of depth. This area is characterized by rich plant diversity. Yenicaga Lake also has the potential for commercial fishery. Six different species of fish have been located in the lake. These are *Capoeta baliki*, *Cyprinus carpio*, *Carassius gibelio*, *Squalius cephalus* and *Tinca tinca* from the family Cyprinidae and *Gambusia holbrooki* from the family Poecilidae in coastal regions. *Carassius gibelio, T. tinca and G. Holbrooki* is exotic and invasive species. *C. carpio* is the leading species that has economic importance in the lake. According to IUCN, the population of *C. carpio* in Danube River was described as critical. Furthermore, *Astacus leptodactylus,* which has economic importance, lives in the lake. Since 2014, culture-based aquaculture of mirror carp has been released for fish stocking so as to developing commercial and recreational fishing in the lake.

As a result of the failure of implementing an effective management strategy in Yenicaga Lake, which has been exposed to anthropogenic factors that have been increasing gradually since the 2000s, there was a serious decrease in the commercial species in the lake. During the same period, it has been changed in the ecosystem then some exotic species entered into the lake. With this study, changes of the last 15-20 years in the lake were determined. And suggestions related to primarily commercial fishing and long-term and rational lake management were made. Field research was carried out in three different periods. These were respectively in October-2017, June-2018 and November-2018. As a part of the research, in addition to the sampling related to the macro fauna in the lake, the situation of the present actual fishing in the lake, the distribution of the landings, a number of field and observation studies focusing on the effects of fisheries cooperatives and other relevant stakeholders on lake management were carried out.

According to findings, three species of fish (carp, gray mullet, and tench) are fished and marketed by cooperative member in Yenicaga Lake. Although there was not too much fluctuation in the landings over the years, but there has been a radical decline in the amount of fish landings since 2015. In terms of the sustainability of fish populations in the lake, applying over fishing on *S. cephalus and T. tinca*, which are dominant in the lake, and decreasing the pressure of fishing on *C. carpio* is very important. Applying a controlled and balanced fishing on all species of fish in the lake

will be effective in protecting the diversity of species. On the other hand, peat material in Yenicaga Lake, which is one of the most important peatlands in our country, is operated commercially. This activity results in damaging the natural area of the lake and also, habitat changes and decrease in the diversity of species. Peat production is allowed in the wetlands around the lake during July and August. This period also includes the period when the fish in the lake spawning season and the delicate larval period that follows afterwards. As a result, applying the '*Wetland Management Plan*', which was prepared for the lake in 2014, effectively will play a role in solution the present and potential problems gradually. In this regard, implementation of management plans that were prepared in Yenicaga Lake is important for exploitation fish populations effectively and ensuring sustainability.

***Keywords*:** Yenicaga Lake, aquatic life, commercial and exotic fish species, fisheries management

Abstract ID: FIM-049

Length Based Stock Assessment of Pikeperch (*Sander lucioperca Linnaeus, 1758)* with TropfishR in Karataş Lake (Burdur-Turkey)

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The goal of this study were to estimate the growth parameters and stock assessment of pikeperch *(Sander lucioperca* Linnaeus, 1758*)* in Karataş Lake.

In the sampling, gillnets with 3.2, 4, 5, 6, 7, 8 and 9 cm stretched mesh sizes were used. Fish sampling was carried out on monthly basis, at two different stations with a total of 26 trials, during May-2016 and June 2017. All nets were set in the afternoon and retrieved the following morning. The total length (*TL*) of the fish was measured to the nearest 0.1 cm with a measuring board and total weight (*TW*) recorded with 1g precision digital scale. *TropFishR* package [v1.6] (Taylor and Mildenberger, 2017) was used with *R* (v3.5.0) based *RStudio* (v1.1.456) software for calculating of the parameters.

A total of 289 *S. lucioperca* were caught between 11.1-61.2 cm length range. The length–weight relationship of *S. lucioperca* were described by the parameters: a=0.005 and b=3.168. The value b was founded different from 3. It is said that, fish shows hyperallometric growth properties. The von Bertalanffy growth parameters of *S. lucioperca* estimated as L_{∞}=61.52, k=0.290, t_{anc}=0.132, C=0.762 and t_s=0.034 based on data from length frequency (*LFQ*). M (naturel mortality) was estimated as 0.429 by empirical formula of Then et all. (2015). Z (total mortality) was founded as 2.202 by length-converted catch curve. Also we calculated current F value as 1.773. Biological reference levels were estimates as 3.15, 1.3, 0.80, 0.88, 0.75 for F_{msy}, F_{05}, $E_{current}$, E_{msy} and E_{05} respectively. Annual survival rates were described by the parameters: S=11.06%, C=71.61% and D=17.33%.

These parameters show that stock of *S. lucioperca* in Karacaören Dam-I Dam lake is being overexploited. Because current E value (0.80) is higher than optimum E (0.5). Also most of the annual death stem from fisheries. Applied fishing effort on *S. lucioperca* should be decrease for sustainability of this species in the lake.

***Keywords*:** LFQ, TropFishR, stock assessment, Karataş Lake

Abstract ID: FIM-051

Gillnet Selectivity for *Capoeta umbla* (Heckel, 1843) in Uzunçayır Dam Lake

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This study was conducted to determine the selectivity of multifilament gillnets with 28, 30, 34, 36 and 38 mm nominal mesh size (bar length) for *Capoeta umbla* (Heckel, 1843), in Uzunçayır Dam Lake (Tunceli), between January 2013 and December 2013. In the 24 fishing operations performed by holding method, a total of 896 target species were caught. The SELECT method was used in determining selectivity parameters. Five different functional models (normal location, normal scale, gamma, log-normal and bi-modal) were used to fit the selectivity curve to the catch data. The bi-modal selectivity curve gave the best to fit the data. The optimum lengths obtained from bimodal function for gillnets with 28, 30, 34, 36 and 38 mm mesh sizes were estimated as 26.01 cm, 27.87 cm, 31.59 cm, 33.44 cm and 35.30 cm, respectively.

One of the basic principles of sustainable fisheries is to ensure that the fish has reproduced at least once, before capture. Minimum catch size of this species is not reported in the notification regulated commercial fisheries. According to reproductive biology studies conducted in various environments related to this species, gillnets with 24 mm and above mesh size do not cause an over fishing on *C. umbla* stocks in Uzunçayır Dame Lake.

Keywords: Uzunçayır Dam Lake, *Capoeta umbla*, gillnets, selectivity

Abstract ID: FIM-058

Cath Composition of Anglers in Uluabat Lake (Bursa, Turkey)

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The aim of this study is determining of catch composition of anglers who fishing in Uluabat lake with line.

Uluabat Lake is located in the west-north part of Turkey (border of Bursa province) at an altitude of 9 m above sea level. It is a eutrophic lake and with a mean depth of 2 m, maximum depth 6 m and a surface area of 156 km^2. Specifying of the number questionnaire, official licenced anglier number of Bursa Directorate of Provincial Agriculture and Forestry was used as the main mass (16207). Total questionnaire number was calculated as 375 with 95% confidence interval, 5% tolerance and 50% incident frequency. Field work was carried out of monthly period between January 2015 – December 2015. Caught fish by anglers were classified by species and total length measured with 1 mm and total weight gained with 1 g precision. Identified fish species and ratio in total catch were *Rutilus rutilus* (45.6%), *Carassius gibelio* (11.4%), *Esox lucius* (16.5%), *Scardinius erythrophthalmus (12.73%), Alburnus chalcoides* (8.9%), *Blicca bjoerkna (3.8%) and Cyprinus carpio* (0.8%). 74.6% of caught were not include in commercial catch composition.

In this context, it is said that there are not curiously fishing effect of sportive fisheries on the commercial fishing in the Uluabat Lake.

***Keywords*:** Uluabat lake, Angling, Amateur fisherman, Cath composition

Abstract ID: FIM-074

A Preliminary Study on The Determination of The Tarek Biomass of Van Lake by Hydro Acoustic Method

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The Van Lake is the largest lake in the Turkey. Its alkaline waters host only one teleostean species, (*Alburnus tarichi* Güldenstädt, 1814), the tarek which, constitutes about 25% of yield harvested from inland waters of Turkey. This preliminary study presented the results of a test made to evaluate whether hydro acoustic method can be used to monitor the stock of the species in the Lake Van.

The entire lake was surveyed over more than 300 nm transects between 23 and 27 October 2018. A SIMRAD EY60 portable scientific echosounder with 120 kHz split beam transducer mounted on 15 m long vessel. To ground truth the acoustical recordings, fish sampling was carried out at 3 points with a set of gill-net composed of 11 panels ranging between 9 and 50 mm mesh size. Also, temperature profiles were measured at 10 points representing three limnologically different basins in the lake, namely, Erciş bay, Van-Gevaş bay and Tatvan-Ahlat-Adilcevaz. Each zone was further stratified into two zones on the horizontal, as shallow and deeper (> 60 m) based on vertical temperature profiles and the vertical fish distribution pattern displayed on the echograms. The collected acoustic data were analysed with EchoView 5.3 over a total of 6 strata.

The highest acoustic biomass was observed at the deeper part of Tatvan-Ahlat-Adilcevaz region (54.26 NASC), which was followed by the deep (49.41 NASC) and shallow waters (40.51 NASC) of Van-Gevaş. The acoustic biomass observed in deep (20.40) and shallow (9.78) waters of Erciş was significantly lower than those in the south of the lake. The lowest biomass was observed at the shallow part of Tatvan-Ahlat-Adilcevaz region (6.84 NASC). These results indicated that the overwintering migration of the tarek in the lake was started and a significant part of the stock in the north (Erciş) headed south for warmer waters. The results also suggests that the fishes might follow the lower boundary of the epilimnion during the overwintering migrating.

It was observed that the mesh size series of the gillnet used for sampling was selective over the small size groups and therefore a significant part of the stock (recruits) could not be sampled. Consequently, Target Strength of the tarek in the lake, which is a critical function used to convert the acoustical biomass (NASC) into absolute biomass could not be derived. However, this preliminary study indicated that the schooling behaviour displayed by tarek and the aggregations formed in autumn can clearly be detected using acoustic method.

***Keywords*:** Van Lake, tarek, hydro acoustic, echo sounder, biomass.

Abstract ID: FIM-075

The Relationship Between Water Temperature and Fish Distribution for Autumn Season in Van Lake, Turkey

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In this study, it is aimed to determination of the relationship between water temperature and fish distribution in Van Lake.

The study was conducted on 23-27 October 2018 in Van Lake. During the hydro acoustic survey which conducted these dates limnologically measurements were made at 10 stations. Limnologically measurements were performed with YSI 6600 v2 model measurement device. Measurements were made at 1 m intervals up to a depth of 80 m from the surface. Sampling points were selected to cover the entire Van Lake, representing shores and offshore.

It was observed that the coldest part of the lake is northeast. The temperature was measured to increase towards the south and west. Determined 1.57 °C water temperature difference between northest part of the lake (13.85°C) and southest part of the lake (15.42 °C). However the mixed layer is more important. The mixed layer is less than 10 meters shallow in the middle of the lake and deeper to more than 30 meters on the shores and south. This is considered to be a direct effect on the fish distribution. However, this situation could not be proved statistically because of bad weather conditions have not enough sampling. The tareks which are use 3 large rivers in the northeastern part of the lake for breeding in late spring and early summer, pass to the warmer and deeper parts of the lake in middle of autumn.

This informations show that, the temperature directly affects the distribution of tarek in Van Lake.

***Keywords*:** Van Lake, tarek, fish distribution, limnology.

Abstract ID: FPT-054

Trimethylamin (*TMA*) Production from Trimethylamin Oxide (*TMAO*) By Bacteria and Environmental Effects on Its Production in Some Aquaculture Products

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The aim of this study was to review the importance of *TMAO* in fish and shellfish, Bacteria producing *TMA* from *TMAO* and environmental effects on bacteria and its production.

For this purpose; *TMAO* can convert into *TMA* by bacterial activity. The bacteria species, which can the ability of reducing *TMA* from *TMAO* are *Escherichia, Pseudomonas*, *Achromobacter, Flavobacterium, Alcaligenes, Bacillus, Clostridium, Micrococcus, Serratia, Salmonella, Vibrio* etc. (Regenstein *et al.,* 1982). The methods about detection of *TMA* production by bacterial activity in fish were examined (Egashira et al., 1994; Rodriguez-Jerez et al., 2000; Ye and Day, 2003; Diaz et al., 2004; Helena, 2015).

In this review; bacterial *TMA* production from *TMAO* by mostly from the species of *Enterobactericeae* were explained. There have been many factors that affect TMA production such as bacteria species, the number of bacteria species, fish and shellfish species, storage temperature, storage day, bacterial enzyme, processing etc. were discussed (Regenstein *et al.,* 1982). *TMA* level in marine food products can be determined by using different methods. These methods were discussed by giving literatures (Treacy et al., 1995; Riquixo and Einarsson,1998; Jay *et al.,* 2005). *TMA* is used as an indicator of spoilage. Off-odors are produced by bacteria that increase *TMA* level in marine fish products (Chang *et al.,*1976). The consumption limit of *TMA* value was explained by (Gajewska and Ganowiak, 1992) in fresh fish products as 15 mg/100g. Most of the fish and shellfish contain large amounts of *TMAO*, but freshwater fish contain TMAO in small amount (Regenstein *et al.,* 1982). For this reason, not only bacteria species, but also fish species are very important for producing TMA from *TMAO.* Etienne, (2005) reported that in a very fresh fish the amount of TMA is low, <2 mg/100g., it arises from the bacterial reduction of *TMAO*. The level of TM*AO* and the production of *TMA* in marine fish products depend on many factors such as age, size, season, environmental factors etc. These factors were explained in details by giving literatures (Regenstein *et al.,* 1982; Huss, 1988; Serdaroğlu and Deniz, 2001; Simat *et al.,* 2009; Getu *et al,* 2015).

In conclusion; The control of the growth of *TMA* producing bacteria is very important for the control of *TMA* value. These bacteria or the activity of bacterial enzymes which breakdown *TMAO* to *TMA* can be eliminated from marine food products by advanced and preservative processing technologies For the control of *TMA* production; suitable chilling, processing, packaging, temperature control, effective cold storage, the inhibition of bacteria and enzymes, killing technologies of *TMA* producing bacteria can be applied in marine fish products which contain *TMAO*.

***Keywords*:** *TMA*, *TMAO*, trimethylamine producing bacteria, marine food products

Abstract ID: FPT-085

Determination of Shelf Life During Cold Storage (4±1° C) of Pike Barbell (*Luciobarbus esocinus* Heckel, 1843) Fish Fingers Coated Addition of Goji Berry

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In this study, the shelf life of Pike Barbell (*Luciobarbus esocinus* Heckel, 1843) fish fingers, that ordinarily packed and stored at 4±1ºC. For this purpose, the moisture, ash, fat, protein, pH, TVB-N and TBARs value, total aerobe microorganisms (at 5 ºC and 30 ºC incubation temperature) and yeast-mold counts of both the material and the experimental groups were investigated. The sensorial, chemical and microbiological changes of the products obtained in the research under cold storage conditions were also examined, analyses were performed every 3 days, and the study was conducted in two parallel analyses with two repetitions.

The material of the research consisted of Pike Barbell (*Luciobarbus esocinus* Heckel, 1843) obtained from the Keban Dam Lake. Together with the control group, three experimental groups fish finger were obtained with the addition of the goji berry extract into this content by 1% and 2%. The samples were then stored in styrofoam packs at 4±1°C.

When the data obtained according to the results of nutrional composition analysis were analyzed statistically; the difference between fish finger groups was not significant ($p>0.05$) while the difference between the samples in TVB-N, TBARs values was significant in all groups during storage ($p<0.05$).When the data obtained from microbiological analyzes were evaluated, it was found that the difference between the groups in terms of total aerobe mesophile and yeast-mold counts was significant in the control group and the samples with the addition of goji berry extract ($p<0.05$).

According to the results obtained from the sensory analysis, the difference between the groups in terms of general appreciation level was found to be significant ($p<0.05$). The shelf life of fish fingers was determined as 9 days in group A (control group) and 12 days in group B and C with the addition of goji berry extract when the analyses of the study were assessed. Finally, it was concluded when the data obtained from the analyses of the study were assessed that goji berry extracts added to fish fingers had a positive effect on the shelf life.

Keywords: *Luciobarbus esocinus*, Goji berry, Cold storage, Shelf life

Abstract ID: FPT-089

Additives Used in Surimi Production

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Surimi means “minced fish fillet”. Surimi is myofibrillary protein concentrate obtained by washing the minced fish meat in diluted brine. Surimi gel is a three-dimensional protein network consisting mostly of actomyosin. Desired properties of fish used in surimi are strong gel formation ability, good sensory quality, white lean meat and abundance throughout the year. Surimi is produced in 10 kg blocks. Surimi is easy to pack, store (18 months), transport and use for products. Total global surimi production (both tropical and cold water) was around 800,000 tons in 2018. Surimi industry is based on Alaska pollock and walleye pollock fish that developed by the Japan in 1960s. Surimi is an intermediate products that is used in the production of a wide range of surimi based products. The United States of America, Japan, Thailand and China are major producers of surimi and surimi-based products. Gel forming properties, color and impurities determine the quality of surimi. Various fish species can be used in surimi production using additives such as cryoprotectants, starch, protein and hydrocolloids.

Keywords: Surimi, additives, quality of surimi.

Abstract ID: FPT-091

Electroforethical methods and usage in fisheries

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Electrophoresis; is a term used to describe the movements of ions in solution by the action of electric current. Ionization of ionic compounds forms the basis of electorforesis. The ions of different charges moving at different speeds towards the electrodes at opposite charges are separated from each other in the electrical field.

With increasing interest in the importance of appropriate techniques and genetic information in fisheries research, applications of molecular genetic techniques have been increasing since the 1950s. Nowadays, electrophoresis is often used to aid in the classification of fish species. Sarcoplasmic proteins, serum proteins, liver proteins and many enzymes have been used for this purpose.

Electrophoretic methods that are used frequently in food origin determination in seafood; electrophoresis, SDS-PAGE electrophoresis and isoelectric focusing. With these methods, fresh, frozen and even protein denatured canned, salting, smoked samples that have been subjected to processing processes can be easily determined from which origin.

Routine detection and control of fish pathogens in the continuously developing aquaculture, investigation of epidemiology of bacterial and viral agents, its spread, its mechanism and the use of electrophoretic methods have become widespread.

In this review, applications of electrophoresis methods in fisheries on species detection, food safety and disease diagnosis are tried to be revealed.

Keywords: Electrophoresis, Fisheries, Food safety, Species detection

Abstract ID: SCE-022

Good Agricultural Practices in Aquaculture

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Aquaculture as a sub-sectors of agriculture is important in terms of creating employment, contributing to human nutrition and national revenue, supplying raw materials to other sectors, reducing fishing pressure on the natural stocks and drawing unused water resources into the economy. It also creates significant opportunities for more efficient use of natural resources and preservation of biodiversity.

Aquaculture has been identified by FAO as the fastest growing food sector in the world. It is estimated that the amount of production obtained from aquaculture will be equal to the amount of capture fisheries in 2030 even in the long term it will get ahead of fisheries sector. Turkey is the third fastest growing country in the world in terms of aquaculture. Aquaculture production decreased by 0.3% compared to the previous year and realized as 628 thousand 631 tons in 2018. 35.3% of total production came from marine capture, 9.9% from other seafood, 4.8% from inland fisheries and 50% from aquaculture. The rapid growth of aquaculture in the world and Turkey has some negative social and environmental impacts such as water and environmental pollutions, spread of diseases, reduced fish welfare and unfair working conditions. The development of good agricultural practices (GAP) in Turkish aquaculture is a eco- human and animal friendly method with an aims to protect natural resources and increases traceability, sustainability and food safety. There are regulations about GAP including Law 27778 (07.12.2010) and Circular 14137 on Good Practices Criteria for Aquaculture (2011/006; 01.07.2011) and Communique 30292 on Support for GAP in Aquaculture (2017 / 50; 10.01.2018).

With the use of GAP in aquaculture, protection of the environment and resources, applications of new technologies in aquaculture and traceability, improvement of the product quality with bringing a reliable product from the plant to the food, creating a reason for preference with easy and effective participation for the market, occupational health and safety and fish welfare are supported.

Keywords: Aquaculture, good agricultural practices, traceability, health.

Abstract ID: SCE-011

Evaluation of Aquaculture Potential in Turkey Fisheries

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Aquaculture is making a great effort to make some contributions both on sectoral and national basis. In general, the aquaculture potential should be well evaluated. Especially the continuity of aquaculture in our country depends on the adequate, clean and planned use of water resources of our country. In our country, which currently has this advantage, serious plans for the future should be made and environmental measures should be taken to protect and conserve our water resources. In this study, the waters of the preliminary target for Turkey to progress through many aspects of aquaculture facilities and capacities have tried to present the current situation on 02/09/2018 been made in data and assessments. According to the regions, the highest aquaculture production share is 61% and the Aegean Region is the leading region, followed by the Eastern Anatolia Region with a rate of 11%. Distribution of aquaculture facilities regarding their capacities, the total number of facilities in the seas is 426 with total project capacity of 254.430 tons / year, while the total number of facilities in inland waters is 1860 with total project capacity of 232.356 tons / year. Marine and inland aquaculture productions are 172.492 tons in total and these numbers account for 62.4% of entire production. Inland aquaculture production is 104.010 tons and it shares 37.6% of total production. Considering the amount of production of the most commonly performed type of farming in Turkey, the highest rainbow trout with production 103.705 tons in inland waters and the highest in sea bream with a production output of 6.090 tons are outstanding.

***Keywords*:** Aquaculture, Aquaculture potential, Production capacity

Abstract ID: SCE-016

The Contribution of Trout Production to The Economy of Tunceli (TURKEY)

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Aquaculture is of a great importance in Turkey, which is surrounded by sea on three sides with 8,300 km of coastline. There are 200 natural lakes, over 700 dam lakes and 1000 irrigation pounds with a total surface area of more than 1,4 million hectares. In addition, it has a total of 26 million hectares of aquaculture production area with 33 rivers with an average length of 178 thousand km (Doğan, 2003).

Aquaculture has recently increased remarkably in Turkey as in the world. Freshwater aquaculture production has grown by 56% in the last 10 years (BSGM, 2019).

Located in the Eastern Anatolia region of Turkey, Tunceli Province has a great potential for aquaculture with its rivers and dams. In terms of aquaculture, a total of 9 (nine) water sources have been identified for energy, drinking and irrigation water use with flow rates ranging from 34 m^3 / sec to 1332 m^3 / sec (DSİ, 2017). Total surface area of the dams where trout farming is carried out in the province is 22027 hectares. This amount accounts for almost 2 % of entire freshwater production in Turkey. 24 trout farms engage in aquaculture in concrete ponds and net cages in Tunceli province with a total capacity of 7033 tons / year and 46 020 000 fry / year. Rainbow trout production was 1907 tons in the province in 2017 (TUİK, 2019). The production had an economic contribution of approximately 16.1 million TL to the province. *Cyprinus carpio*, *Leiciscus caephalus*, *Acanthobrama marmid*, *Alburnus mossulensis*, *Capoeta trutta*, *Capalieta umbla*, *Esox lucius* fishing makes also a significant economic contribution to local residents. The subjective of this study is to determine the economic contribution of water sources and aquaculture activities to Tunceli province.

Keywords: Aquaculture, trout, economy, Tunceli

Abstract ID: SCE-032

The Structural and Economical Analyses of Aquaculture Farms in Keban Dam Lake In 2015 Year

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This study was conducted to determine the structural and economic features of cage aquaculture farms (rainbow trout, *Oncorhynchus mykiss*) in Keban Dam Lake (Elazığ) in 2015. The study includes the farms registered to three (Elazığ, Tunceli and Erzincan) Provincial Directorates of Food, Agriculture and Livestock.

There were totally 120 aquaculture farms. They were consisted of small scale farms (44) with 25 tons/year capacity and medium scale farms (37) with (≥50 tons/year) which are officially obliged to employ a fisheries engineer and large scale farms (39) with over 250 tons/year capacity in the lake.

The data used in the study were collected from these farms by using exact count method and face to face survey.

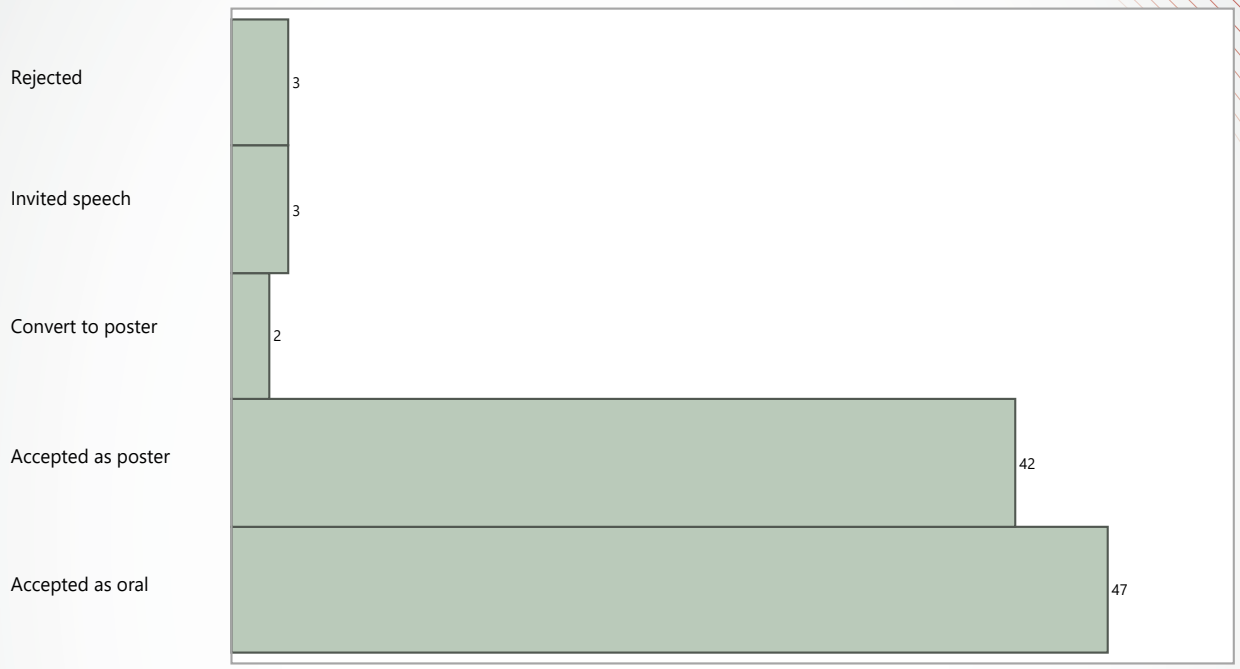
Pellet (granule) feeds were used for trout production in all farms. Average harvest size and price per kg of rainbow trout were 230-260 g and 6-8 TL respectively. The total active capital per farm was calculated as 1.134.519 TL.

The most important share of active capital was fish capital with a ratio of 86.66%. The sum of operating expenses was calculated as 734.200 TL/farm. The highest proportion of these costs was calculated as feed (64.72%) and fry (10%).

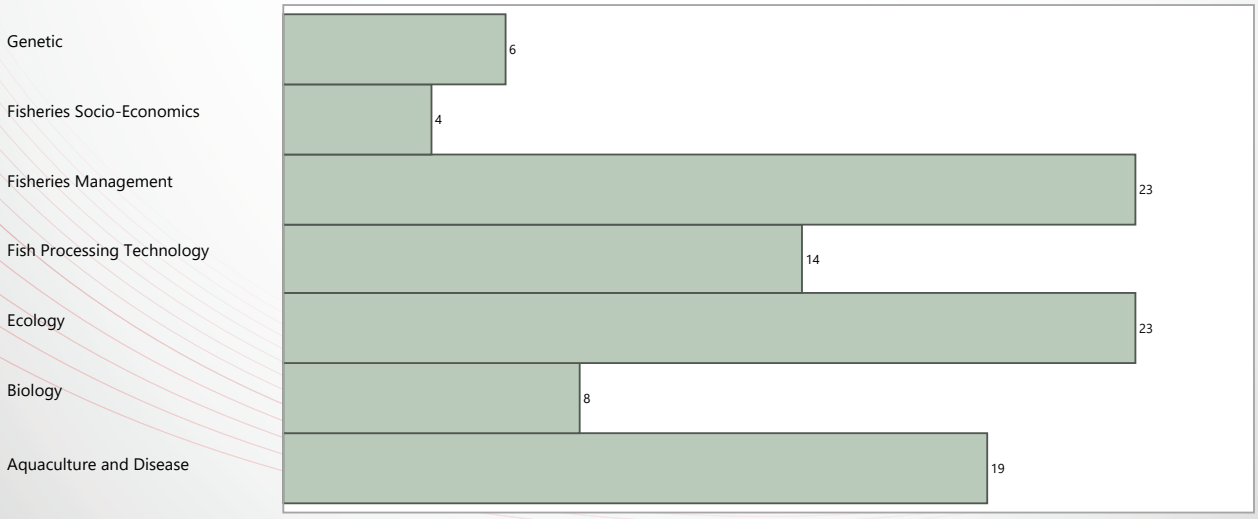
Keywords: Keban Dam Lake, Aquaculture, Structural and Economical Analysis

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