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Sub-Lethal Effects of Heavy Metals Toxicity on Pathological Lesions of Sea Bream

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Abstract

Histopathological indices have been largely used as biomarkers in the monitoring of fish health status during exposure to heavy metals, both in the experimental and environmental studies. The aims of the present study was to provide baseline data on the prevalence of histopathological liver lesions in marine fishes (case study of liver histopathology at mercury exposure) under experimental mercury exposure and to compare the sampling areas in terms of the types and prevalence of lesions present, for monitoring purposes. Experimental study was at seawater re-circulatory tanks. Mercury concentrations were determined using a standard cold vapor atomic absorption. Histopathological analyses were done in tissue processor and the slides were stained with haematoxylin and counter stained with eosin. There were many liver lesions in both area include enlarged and lateral nuclei, nuclear degeneration and vacuolation; oncotic, apoptic, focal, massive, centrilobular and periportal necrosis; atrophy, lipidosis, hydropic and cloudy swelling, oval cell proliferation; bile stagnation, dilation of sinusoid, intracellular edema and dark granules. In conclusion the present investigation indicated that mercury is a toxic substance in seabream and the sub-lethal mercury concentrations tested may cause several changes in the histological indices of the studied fish and we can use these changes as biomarkers of mercury detection.

Keywords: Cell, Fish; Histopathology; Mercury; Toxicology

INTRODUCTION

Histopathology is a useful tools for assessment the effects of toxicants, in cells, tissues and organs (Adams, 2002). Today histopathological biomarkers have been widely used in fish for detection and assessment on chemical effects of exposure to pollutants (Oliveira Ribeiro et al., 2006). Also histopathological indices have been largely used as biomarkers in the monitoring of fish health status during exposure to heavy metals, both in the experimental (Thophon et al., 2003) and environmental studies (Teh et al., 1997).

Quantitative histological studies are important to evaluate sub-acute and chronic effects of pollutants and to facilitate comparison of responses at the different condition. Histological changes are medium term responses to xenobiotics, and histology represents a rapid method for evaluation effects of chemicals in different organs (Jagoe et al., 1996).

Histopathological biomarkers allows examining specific target organs, including gills, gonad and liver, that are responsible for vital functions, and this fact is very important advantage of these category of biomarkers in monitoring programs of marine environments (Gernhofer et al., 2001). Moreover, the changes detect in these organs are normally easier to identify than functional ones, and serve as warning signs of damage to fish health (Fanta et al., 2003).

In recent years, due to the growing awareness of a cause effect relationship between marine pollutants and the occurrence of toxic liver lesions in fish, studies on fish liver histopathology have recently been incorporated (Oliveira Ribeiro et al., 2002a).

Fish tissues are sensitive indicators of marine pollutant and have a high mercury bioaccumulation capacity for both organic and inorganic forms solution in marine environment (Gochefeld, 2003). It is well confirmed links between exposure to pollutants and the development of hepatic lesions. For example toxicopathic liver lesions in fish species are suitable and sensitive signs of hepatit injury and have been used as biomarkers of chemicals in environmental risk assessments (Stehr et al., 2004).

However most studies on mercury are distribution and speciation and accumulation, open literature on mercury in tropical fish and its toxic effects on fish tissues and organs are rare (Oliveira Ribeiro et al., 2002b). The marine pollutant exposure can induce a number of lesions and injuries to different fish organs (Oliveira Ribeiro et al., 2006) but liver is a very important target organ suitable for histopathological monitoring program for detection of damages to tissues and cells (Oliveira Ribeiro et al., 2006).

In many studies the significance role of mercury for histopathological changes to various fish were confirmed (Oliveira Ribeiro et al., 2002a) and yet the damage of this heavy metal on the liver of yellowfin seabream is largely unknown, so the aims of the present study was to provide baseline data on the prevalence of histopathological liver lesions in A. Latus under environmental and experimental mercury exposure and to compare the sampling areas in terms of the types and prevalence of lesions present, for monitoring purposes.

MATERIALS AND METHODS

1. Experimental test

Yellow fine sea bream all immature male in same size (150 g final body weight average) were maintained in seawater re-circulatory system (300-L tanks) equipped with physical/chemical filters and with aeration to the Mariculture Research Station of the South Iranian Aquaculture Research Center, Mahshahr, Iran.

Seventy five fish were randomly divided into five equal groups (15 per group) and each tank was randomly assigned to one of five experimental treatments and allocated to

a 15 static cylindrical polyethylene tank filled with the appropriate concentration of an aqueous solution of Hg (standard solution for atomic absorbance spectrophotometer) in dechlorinated tap water (Safahieh et al., 2010).

Fish were exposed to mercury concentrations of 0 µg l, 10 µg l, 20 µg l, 40 µg 1, 80 µg l respectively, and maintained for three weeks with aeration. These sub-lethal doses were chosen on the basis of preliminary toxicity tests and determinations of LC50 96h for this species, suggestive of inducing toxic effects but not lethally so (Hedayati et al., 2010).

Conditions within each experimental tank were monitored daily with the temperature 25C ± 1, pH 7.8 ± 0.1 and salinity 46 ± 1 ppt under a natural photoperiod (12hL:12hD) in controlled room. Water was oxygen saturated through constant aeration in a static system. Voluntary feed intake was near to maintenance ration at the time of the maintenance, Fish were fed two times a day (08:30 and 17:30 h) but were starved for 48 h prior to the start of the experiment and throughout its duration. Fecal remains and food residues were removed by suction every other day. The food supply was provided to each predator fish with fresh prawn, collected from creeks without pollutants sources.

2. Mercury analysis

In laboratory water samples were filtered with Millipore strainer mesh size 0.45 µm, the filtrate was then acidified with 2mg/l of 20% K2Cr2O7 (w/v) prepared at nitric acid (Gochefeld, 2003) and soluble store at -4 ºC until mercury analyses.

For stabilize of weight, the sediments were freeze-dried (Shi et al., 2005), then were sieved through 63 µ mesh and were allowed to settle, the supernatant water decanted and homogenized, finely powdered sediment sub samples were dissolved in 60 ml container 4 ml of concentrated nitric acid and 2 ml of concentrated sulfuric acid. The mixture was digested at 90°C for l-2 h in hot plate. Upon cooling, 1 ml K2Cr2O7 or 0.5 ml BrCl was added. The solution was filtered using Whatman No.1 filter paper and diluted to 50 ml with deionized water (Gochefeld, 2003) and preserved prior to Hg analysis.

Mercury concentrations were determined by the Department of Marine Chemistry Laboratory, Khorramshahr University of Marine Science & Technology using a standard cold vapor atomic absorption (CV-AAS) method (Unicam 919) equipped with Hg cold vapor generator (VGA 77) (EPA, 1992).

3. Histopathological analysis

A small part of the right liver was removed and examined macroscopically. Liver samples were preserved by immersion in Bouin's fixative solution for 24 h. Dissected tissues were washed in ice cold 0.9% sodium chloride solution, and subsequently fixed in 10% formalin solution for 48 h. After 48 h, the tissues were transferred into 70% ethanol (Haschek, et al., 2010). After incubate, dehydration, xylene and lastly xylene: paraffin mixture in Tissue processor, (Triangle biomedical sciences USA), liver were embedded in paraffin and sectioned using an ultra microtome (Olympus CUT 4055E, USA) to obtain sections of 5µm in size. The sectioned tissues were fixed on the microscope slides and air-dried for 24 h. The slides were later stained with haematoxylin and counter stained with eosin (Haschek, et al., 2010).

In this study the understanding of morphological abnormalities was with data derived from fixed images of cells and tissues as seen through the light microscope using digital optical imaging techniques. The incidence of alterations was reported in a qualitative evaluation, plus a semi-quantitative scale scored in four categories according to the intensity of alterations: None (1), mild (2), moderate (3) and severe (4) (Di Giulio and Hinton, 2008).

RESULT AND DISCUSSION

1. Mercury analysis

Since the catch site was Zangi creek, the ranges of mercury in the Mahshahr creeks were determined. Water mercury concentrations ranged between 3 and 10 µg/l, with the highest concentrations found in Ghazaleh, the Petroshimi and Majidieh creeks had nearly same values while Zangi was the lowest one. Sediment mercury concentrations ranged between 0.3 and 1 µg/g, with the highest concentrations found in Petroshimi and Majidieh creeks, the other creeks had nearly same values while Jafari and Zangi was the lowest one.

Results concerning mercury accumulation in the liver of studied fish showed that there was bioaccumulation in the liver. Mercury concentrations in the liver ranged 2.4 to 140 µg/g in test treatments. The analytical data on mercury concentrations in the laboratory samples from the liver of Yellowfin seabream are summarized in Fig 5. Concentrations of liver mercury increased with increase of water mercury concentration. Results of Bioaccumulation Factor (BAF) strongly suggest that increase of mercury in the surrounded water will be accumulating much more in liver tissue, mercury bioaccumulation had same process with mercury concentration with the highest accumulation between 40 and 80 µg l treatments (table 5).

2. Histopathological analysis

The hepatic tissue of the control fish follows the standard that was described for teleost fish. It was constituted by hepatocytes, which was large in size, polygonal in shape with centrally located nuclei polyhedral form with a spherical nucleus with one or more nucleolus. There were also the portal vein and the central vein, which branches itself into sinusoids. A large number of blood sinusoids were observed and separates the hepatic cords one from another (Fig 3).

The bile ducts lined by cubic epithelial cells were distributed through the hepatic parenchyma and were usually associated with the port vein. There were bile canaliculi, surrounded by the plasmatic membrane of the hepatocytes. A very homogeneous hepatic parenchyma was found in the liver of fish from control group. Hepatocytes were arranged in cords, generally two cells thick between two contiguous sinusoids.

Changes to the histopathological abnormality of the hepatocytes elevated in severity with the increasing dose of mercury in test area. No mortality occurred during the experimental test but the morphological lesions observed in liver revealed important alterations throughout the course of the experiment. The tissues damages and injuries after mercury exposure are summarized in tables 1-5 and figures 4-8. No neoplastic features were observed.

Table 1. Summarized nuclear lesions in the liver of yellowfin seabream during experimental exposure to mercury.

Lesion	*Experimental* exposure (ppb)				
	0	10	20	40	80
Enlarged nuclei	-	-	+	++	++
Lateral nuclei	-	+	-	-	+
Nuclear degeneration	-	++	+	+++	+++
Nuclear vacuolation	-	+	++	++	++

None (−), mild (+), moderate (++) and severe (+++).

Table 2. Summarized necrosis lesions in the liver of yellowfin seabream during experimental exposure to mercury.

Lesion	*Experimental* exposure (ppb)				
	0	10	20	40	80
Oncotic necrosis	-	+	++	++	++
Apoptic necrosis	-	+	+	+	++
Focal necrosis	-	++	+++	+++	++
Massive necrosis	-	-	-	++	++
Centrilobular necrosis	-	++	+	++	+++
Periportal necrosis	-	-	-	++	++

None (−), mild (+), moderate (++) and severe (+++).

Table 3. Summarized other hepatocyte lesions in the liver of yellowfin seabream during experimental exposure to mercury.

Lesion	*Experimental* exposure (ppb)				
	0	10	20	40	80
Atrophy	-	+	-	+	++
Lipidosis	-	+++	+++	++	++
Megalocytosis	-	-	-	+	+
Hydropic swelling	-	+	++	++	++
Cloudy swelling	-	++	++	+++	+++
Oval cell proliferation	-	++	+	+	++

None (−), mild (+), moderate (++) and severe (+++).

Table 4. Summarized intracellular lesions in the liver of yellowfin seabream during experimental and environmental exposure to mercury.

Lesion	*Experimental* exposure (ppb)				
	0	10	20	40	80
Bile stagnation	-	+	++	+++	+++
Dilation of sinusoid	-	++	+++	+++	+++
Intracellular edema	-	++	+	+	++
Dark granules	-	-	+	-	+

None (−), mild (+), moderate (++) and severe (+++).

Table 5. Sub-lethal bioaccumulation factor (BAF) of mercury (µg/g) in the liver tissue of Yellowfin Seabream.

	Control	10 µg l	20 µg l	40 µg l	80 µg l
BAF	0.65± 0.03	1.23±0.11	1.14±0.09	0.96± 0.13	1.75±0.10

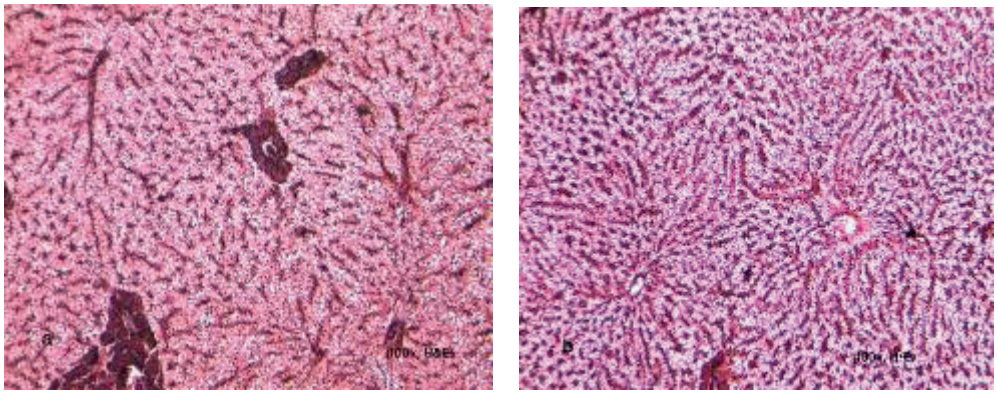


Fig 1. Light microscope features of hepatic parenchyma of yellowfin seabream during control treatment (a) hepatopancreas, (b) portal vein.

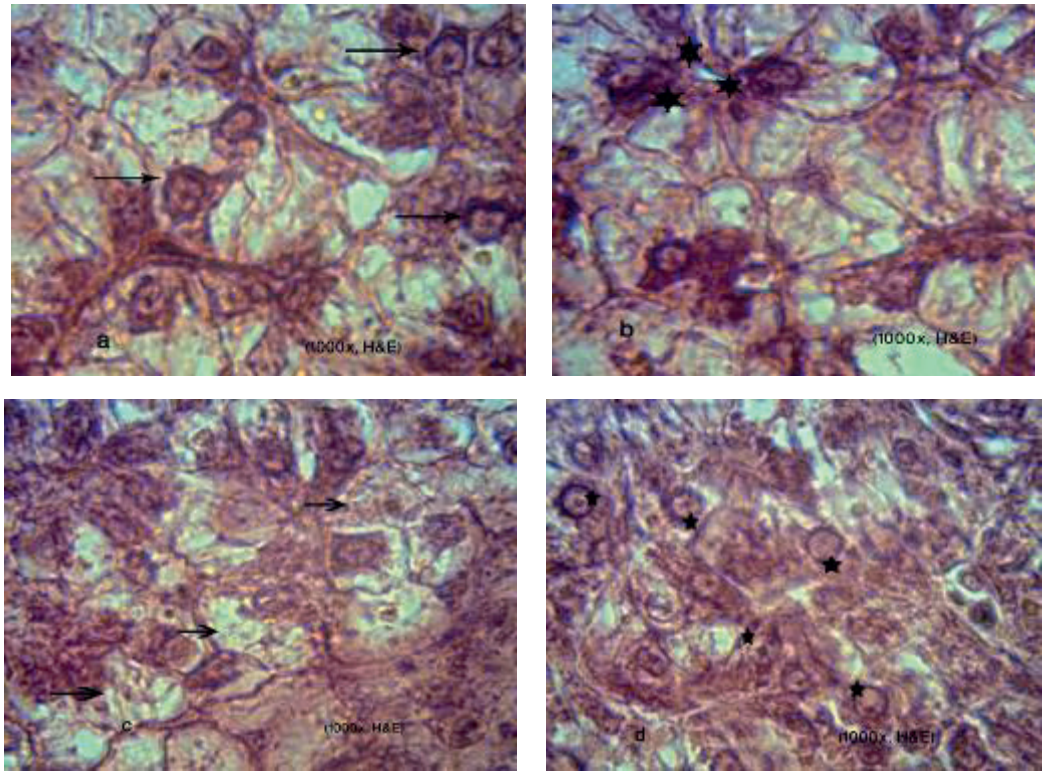
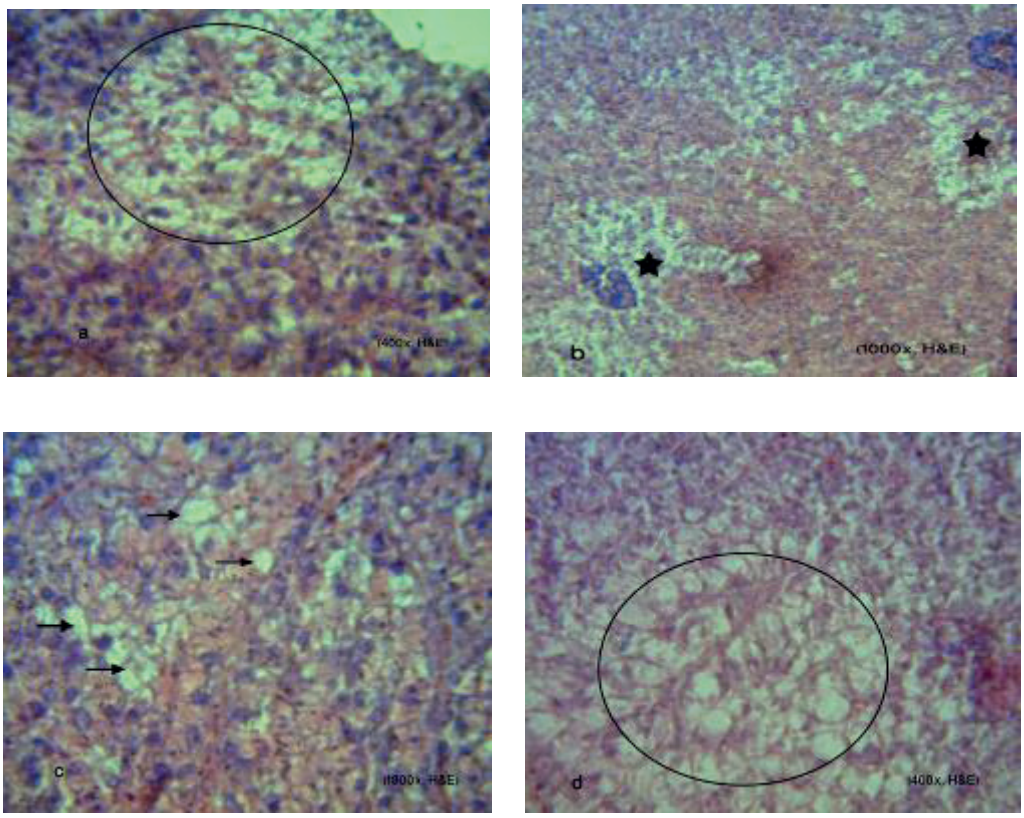


Fig 2. Light microscope features of nuclear lesions in the liver of yellowfin seabream during experimental exposure to mercury (a) Enlarged nuclei, (b) Lateral nuclei, (c) Nuclear degeneration, (d) Nuclear vacuolation.



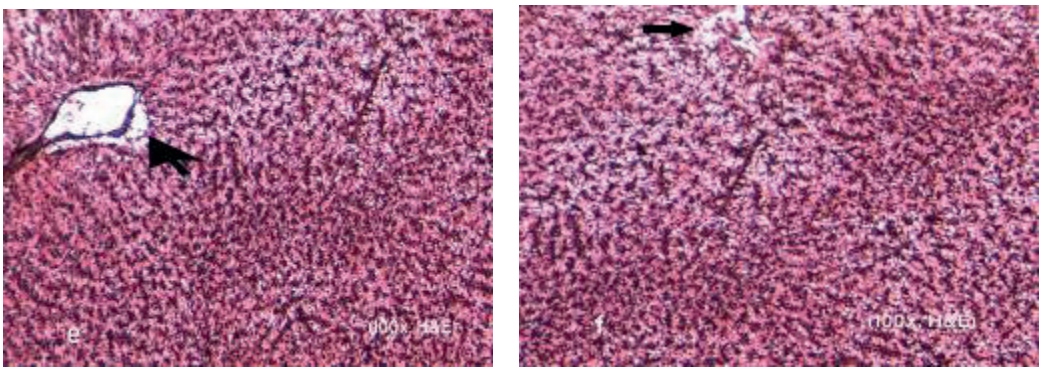


Fig 3. Light microscope features of necrosis lesions in the liver of yellowfin seabream during experimental and to mercury (a) oncotic necrosis, (b) apoptic necrosis, (c) focal necrosis, (d) massive necrosis,(e) centrilobular necrosis, (f) periportal necrosis.

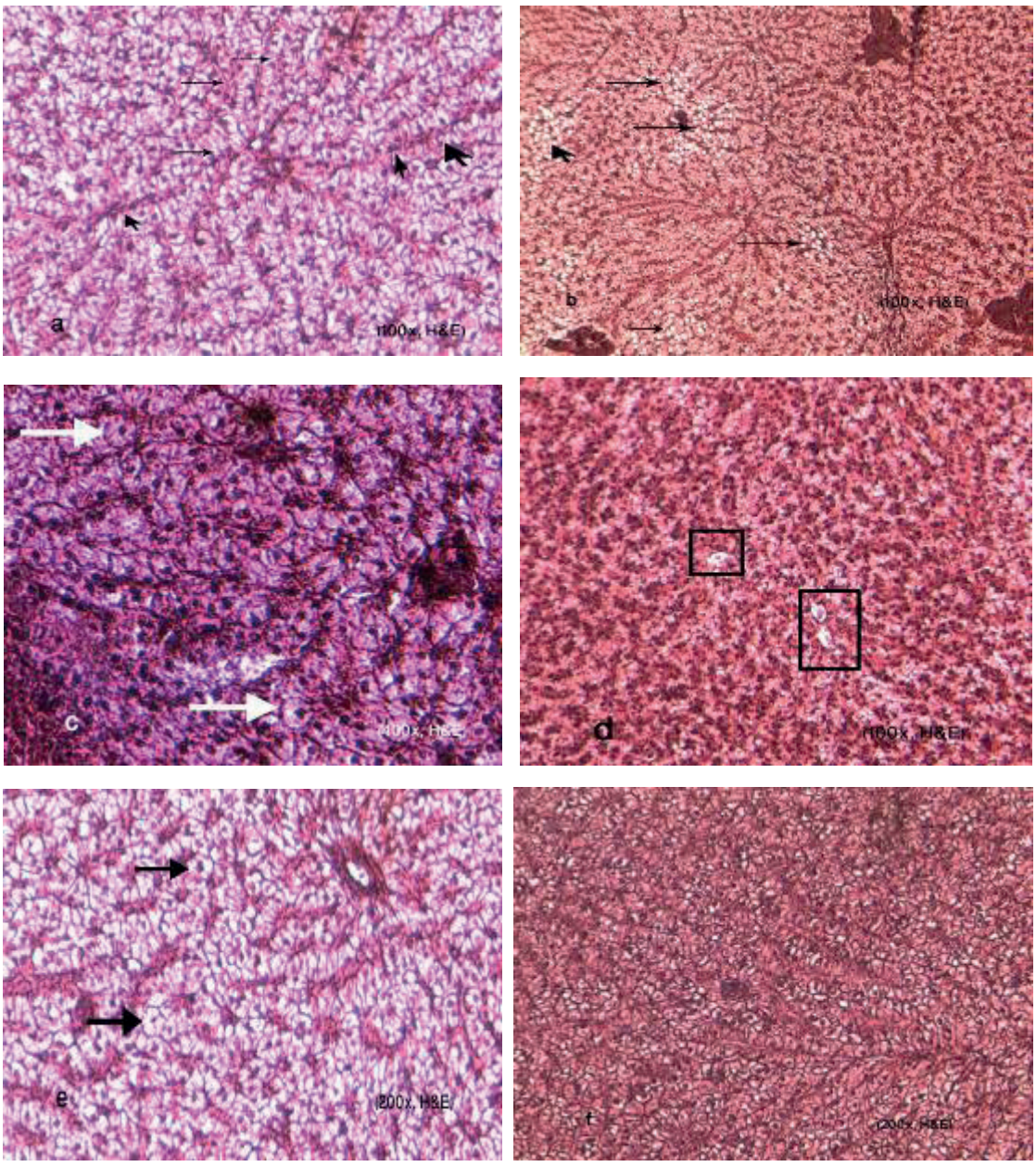


Fig 4. Light microscope features of other hepatocyte lesions in the liver of yellowfin seabream during experimental exposure to mercury (a) atrophy, (b) lipidosis, (c) megalocytosis, (d) hydropic swelling, (e) cloudy swelling, (f) oval cell proliferation.

The most frequent pathological modifications were the increase in the lipid droplets (lipidosis), nuclei change, necrosis, swelling, degeneration, cytoplasmic vacuolization of the hepatic cells, bile stagnation, and dilation of sinusoid, atrophy and pre-necrotic lesions within many hepatocytes with reference to the control treatment. Lipid bodies were also sporadically visible in the cytoplasm of hepatocytes. Also the presence of megalocytosis was significantly higher in the experimental group than in the control group. The Kupffer cells were absent in current fish. Cellular swelling was observed in a few livers of fish exposure. A sever increase of degenerated cells was observed in the exposed specimens compared to the control specimens. These degenerated nucleuses were characteristic of many exposed livers. In general, the degree of the histopathological findings was seemed to be related to the increasing concentrations.

The large vacuole in the cell forces the nuclei to the periphery of the hepatocyte and this condition may associated by nuclear atrophy. Vacuolation of hepatocytes are accompanied with the inhibition of protein synthesis, energy decrease, disaggregation of microtubules, or shifts in substrate utilization (Oliveira Ribeiro et al., 2002a).

Necrosis is irreversible injury that leads to death of the cell, but of course it should mentioned that the term necrosis encompasses not only the actual occurrence of cell death in the living organism, but also the degenerative alternation that follow the death process (Haschek, et al., 2010).

Oncotic necrosis may lead to the reduction in cell number, there will be some degree of inflammation, often with resultant scarring, however the reduction in tissue or organ size may be irregular and distorted (Di Giulio and Hinton, 2008).

Apoptosis is a controlled form of cell death that serves as a regulation point for biologic processes and may consider as the counterpoint of cell division by mitosis (Timbrell, 2009).

The swollen and necrotic hepatocytes appear to compress the vascular spaces, so it can conduct the reason of observed little blood in the sinusoids in the necrotic central lobular areas (Di Giulio and Hinton, 2008).

Periportal necrosis has also been used as peripheral lobular necrosis. Numerous oval cells may be found in the periportal area. Oval cells appear to be most numerous when hepatocyte regeneration is completely, or at least partially, blocked (Haschek, et al., 2010).

Massive necrosis is clearly evident on gross observation. In the sub-acute phase, the affected liver areas are abnormal in color (usually pale) and appear slightly swollen. In chronic exposure, the affected area is depressed below the surface of the adjacent tissue (Stehr et al., 2004). Focal necrosis may be observed grossly as small pale foci. The lesions are particularly evident when they include inflammatory cells (Haschek, et al., 2010).

The swelling hepatocytes in an affected liver were typically swollen, with compression or displacement of adjacent structures. Staining affinity was diminished, generally giving the cells a pale or cloudy appearance. Hydropic change was characterized in almost all treated by enlarged pale-staining cytoplasm.

A cell dealing with disrupted homeostasis can respond in a different ways to maintain itself short of death. This is called adaptation (Haschek, et al., 2010). Atrophy is simple adaptation. At the cellular level, atrophy is often a response to decreased demand for the specialized functions of a particular cell. Atrophy can lead to cell death, either accompanied by apoptotic necrosis or oncotic necrosis (Hinton et al., 2001). But in contrast, hypertrophy is a response to increased metabolic demand for a specialized function provided by the particular cell (Di Giulio and Hinton, 2008).

Lipidosis is often observed in cells that metabolize large quantities of lipids for energy (Haschek, et al., 2010).

Cell swelling is an early change that occurs in most types of liver injury, and which may be a prelude to more effective changes (Hinton et al., 2001). Hydropic swelling is a reversible injury with accumulation of water within the cytosolic matrix or rough endoplasmic reticulum of hepatocytes. This form of swelling can be attributed to a failure to maintain intracellular sodium ion balance (Mommsen and Moon, 2005). The swollen cells have the cytoplasm appeared cloudy and granular. Hinton et al. (2001) state that, although swelling is an integral part of adaptation to cell injury, the finding of hepatocyte swelling as the major indication of toxic injury is rare.

Liver toxicants are typically characterized as being cytotoxic or cholestatic. Cytotoxic mechanisms affect hepatocytes and are responsible for different types of liver injury. Cholestatic mechanisms affect the flow of bile. Intrahepatic cholestasis occurs when the flow of bile is blocked within the liver as it flows through canaliculi, as well as bile ductules (Mommsen and Moon, 2005).

The cholestatic mechanisms that lead to the blockage of bile are not understood very well. “Blockage” may result from blocked transport mechanisms in the cell membrane of hepatocytes (Hodgson, 2004).

Microscopic analysis of yellowfin seabream liver sections reveals a pattern of arrangement of hepatocytes different from that of mammals. A double row of hepatocytes was obvious. The bile preductular epithelial cells found between rows of hepatocytes in liver tubule, however nuclei of hepatocytes contrast with flattened and elongated nuclei of a different cell type. In 1000 timer feature, transects of hepatocyte arrays resemble tubules. Basal aspects of hepatocytes project toward sinusoids or adjacent hepatocytes of neighboring tubules, while cellular apices were directed toward the center of the tubule. It was noticeable that the high nuclear to cytoplasmic ratios were commonly encountered in the centers of tubules. Also larger elements of the bile passageways were present in the parenchyma of current fish liver.

The two-dimensional features of hepatic tubules suggest that individual tubules curve, anastomose and/or branch, thereby forming a complex continuum of parenchyma tunneled by an extensive microcirculation. This large blood supply no doubt leads to intensive mercury exposure and accumulation while hepatocytes and biliary epithelial cells.

The types of lesions to the liver depend on the type of toxicant, the severity of intoxication, and the type of exposure, whether acute or chronic (Hodgson, 2004). There have been numerous reports on histopathological changes in livers of fish exposed to a wide range of heavy metals in marine ecosystems (Rice, 2001).

Some of the indices observed in the hepatic cells in the present study, such as vacuolar degeneration and lipid droplet accumulation are consistent with those documented in specimens of D. labrax, Lates calcarifer and Carassius carassius acutely treated with other heavy metals (Giari et al., 2007).

The presence of necrosis is in fact one of the most visible damages in many tissues affected by heavy metals (Rabitto et al., 2005). In fish liver, the presence of necrosis area is also related with pollutant concentration during the detoxifying process.

Liver lesions such as irregular shaped hepatocytes, vacuolation and nucleus in a lateral position, were also described in the siluriform Corydoras paleatus affected by organophosphate pesticides (Fanta et al., 2003).

Pacheco and Santos (2002) described increased vacuolisation of the hepatocytes as a signal of degenerative process that suggests metabolic damage, due to exposure to marine pollutants. The liver parenchyma of fish exposed to

the environmental metals, such as mercury showed signs of degeneration (cytoplasmic and nuclear degeneration, and nuclear vacuolation) besides the focal necrosis (Oliveira Ribeiro et al., 2006). The changes induced by mercury in the liver hepatocytes such as vacuolization, necrosis and nuclear condensation were also reported for other heavy metals (Figueiredo-Fernandes et al., 2007).

Hypertrophy, vacuolization, nuclear and fatty degeneration of hepatocytes have also been seen by Gill and Epple (1993), who investigated the effects of different organic pollutant on liver of fish. In contrast, study to heavy metals by Cengiz et al. (2001) show that there were hepatic lesions including degeneration, hypertrophy, sinusoids enlargement, change position of nuclei, vacuolization, and infiltration of mononuclear lymphocyte.

The stagnant of bile indicates possible damage to the hepatic metabolism (Fanta et al., 2003). Our histological finds were considered not mercury specific but changes generally associated with the response of hepatocytes to many pollutants.

Degeneration of liver tissue and necrosis of central vein could be due to the accumulation of neutrophils and lymphocytes. Similar results have been found from studies of African catfish exposed to fuel oil for 14 days (Gabriel et al., 2007).

The histological changes observed in the present study indicate that the fish were responding to the sub-lethal effects of the mercury as much as to the secondary effects caused by stress. In conclusion the present investigation indicated that mercury is a toxic substance in yellowfin seabream and the sub-lethal mercury concentrations tested may cause several changes in the histological indices of the studied fish and we can use these changes as biomarkers of mercury detection.

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Çıldır Gölü'ndeki Kerevit (*Astacus leptodactylus* Eschscholtz, 1823) Avcılığının Sosyal, Yapısal Ve Ekonomik Yönden Değerlendirilmesi**

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**Bu çalışma yüksek lisans öğrencisi Ahmet KOÇYİĞİT'in Munzur Üniversitesi BAP birimi tarafından YLTUB 016-15 numaralı projesi ile desteklenen yüksek lisans tezinden özetlenmiştir.

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Özet

Bu çalışma Çıldır Gölü (Ardahan/Kars) kooperatif üyesi balıkçıların sosyo-ekonomik analizinin incelenmesi amacıyla yürütülmüştür. Balıkçıların tamamının bu kooperatiflere üye oldukları ve bunların dışında başka bir sivil toplum kuruluşuna üye olmadıkları belirlenmiştir. Balıkçıların yaşlarının 34 ile 74 arasında değiştiği, %100'ünün evli ve eşlerinin yaşlarının ise 20 ile 70 arasında olduğu tespit edilmiştir. Genellikle %74 oranı ile ilköğretim mezunu oldukları saptanmıştır. Balıkçıların %65.21'i meslekleriyle ilgili özel bir eğitim almıştır. Balıkçıların %17.4'ünün balıkçılık dışında herhangi bir geçim kaynaklarının olmadığı, geriye kalan %82.6'sının ise tarım, hayvancılık veya farklı alanlarda da faaliyet gösterdiği tespit edilmiştir. Genellikle 1 adet tekneye sahip oldukları, teknelerin çoğunluğunun 6 m boyunda ve demirden yapılmış oldukları belirlenmiştir. Aile bireylerinin % 43.47'sinin avcılık faaliyetlerine katıldığı görülmüştür. Teknelerin hepsinin mülkiyeti balıkçıların kendisine ait olup, %30.4'ü tekneyi ailelerin yardımı ile aldıklarını bildirmişlerdir. Balıkçıların kerevit avcılığında pinter ve balık avcılığında fanyalı ağları kullandıkları tespit edilmiştir. Balıkçılar AB ve kalkınma ajansı destekleri ile mazot ÖTV indirimlerinden faydalanmadıklarını beyan etmişlerdir. Balıkçıların %56.53'ü balıkçılıktan elde edilen gelirin yeterli olmadığını ve ek iş olarak restaurant işletmeciliğinden %59.3 ile en fazla kazanç elde ettiklerini söylemişlerdir. Çıldır Gölü balıkçıları mesleklerinin ekonomik olarak yetersiz bulsalar dahi, %60.87 orana sahip 14 balıkçının, ek gelir kaynağı, alışkanlık, tutku/ hobi, babadan kalma meslek ve suya yakın olmaları nedenlerinden bir veya bir kaçının içinde barınması nedeni ile bu işi yapmaktan mutlu oldukları saptanmıştır.

Anahtar Kelimeler: Anket, balıkçılık, Çıldır Gölü, kerevit, sosyo-ekonomik analiz

Social, Structural and Economic Assessment of Crayfish (*Astacus leptodactylus* Eschscholtz, 1823) Hunting in the Çıldır Lake

Abstract

This study was carried out to investigate the socio-economic analysis of fishermen of Çıldır Lake (Ardahan/Kars) cooperative. It has been determined that all fishermen are members of these cooperatives and that they are not members of any other nongovernmental organization. It has been determined that the ages of fishermen vary between 34 and 74, 100% are married and their spouses are between 20 and 70 years old. They were found to be primary school graduates with a rate of 74%. 65.21% of fishermen received a special training on their professions. It was found that 17.4% of fishermen had no sources of income other than fishing, and the remaining 82.6% were active in agriculture, animal husbandry or other fields. It is generally determined that they have 1 boat, the majority of the boats are 6 m in length and made of iron. It was seen that 43.47% of family members participated in hunting activities. Ownership of all of the boats belonged to the fishermen themselves and 30.4% of them were informed that they were receiving them with the help of their boat families. It was found that fishermen used pinters in crayfish hunting and fennel nets in fish hunting. Although Çıldır Lake fishermen 's professions are found to be economically inadequate, it has been determined that 14 fishermen with 60.87% of their income are happy to do this job due to their presence in one or more of the reasons for additional income, habit, passion / hobby.

Keywords: Crayfish, Çıldır Lake, fishery, socio-economic analysis, survey).

GİRİŞ

BM tarafından yayınlanan BM DESA raporu "Dünya Nüfus Beklentileri: 2015" Revizyonu'na göre, günümüzdeki 7.3 milyar mevcut dünya nüfusunun, 2030 yılında 8.5 milyar, 2050 yılında 9.7 milyar seviyesine ulaşması beklenmektedir. Yoksul ülkelerdeki aşırı nüfus artışı, yoksulluğun ve eşitsizliğin ortadan kaldırılmasına, açlık ve kötü beslenmeye karşı mücadelenin daha zorlaşmasına neden olmaktadır [1].

Dünya'da açlık ile mücadelede ilerleme devam etmesine rağmen, hala çok sayıda insan yiyecek bulmakta sıkıntı yaşamakta ve açlık çekmektedir veya aktif ve sağlıklı bir yaşam ihtiyacı için gıda eksikliği sorunlarıyla karşı karşıyadır. Mevcut tahminlere göre, Dünya'da 2014-2016 yılları arasında yaklaşık 795 milyon insan yetersiz beslenmektedir [2]. Su ürünlerinin insan beslenmesindeki yeri tarih öncesi dönemlere kadar uzanmaktadır. İnsanlar son yıllara kadar balığın besleme değerini bilmeyen tüketiciler durumundaydılar. Besin bileşenlerinin incelenmesi ve besin maddelerinin sağlığımız üzerindeki etkisinin bilinmesi ile bugün balık, önemli bir protein kaynağı olarak değerlendirilmektedir [3].

Üç tarafı denizlerle çevrili bir yarımada konumunda bulunan Türkiye'nin 8.333 km'lik kıyı şeridi ve 177.714 km uzunluğunda akarsuları bulunmaktadır. Deniz ve iç su kaynaklarımızın toplam yüzey alanı 25 milyon hektar olup, bu rakam ülkemizin toplam tarım alanlarına yakın durumdadır. Ülkemizin bu potansiyeli dikkate alındığında balıkçılık alanlarının etkin kullanılması büyük önem taşımaktadır [4].

Balıkçılık mesleği ile geçimini sağlayan insanların çoğunun sosyal güvencesinin olmadığı yapılan araştırmalarda değinilmektedir [5].

Bu çalışmada Çıldır Gölü'nde geçimini balıkçılıktan sağlayan kişilerin sosyoekonomik yapısının incelenmesi amaç edinilmiştir. Araştırma Çıldır Gölü'nde su ürünleri avcılığı yapan ruhsatlı ve kooperatife üye balıkçıları kapsamaktadır. Balıkçılar tekne ve av araçları, balıkçının ve ailesinin sosyoekonomik özellikleri ile balıkçılık faaliyetleri açısından incelenmiştir. Av filosunun fiziki özellikleri ve av sermayesi verilmekte, avcılık faaliyetlerinin ekonomik analizi yapılmaktadır. Ayrıca balıkçılık ile ilgili düşünceleri, balıkçıların karşılaştıkları balıkçılıkla ilgili sorunları ve bu sorunların çözümü için önerileri saptanacaktır. Ayrıca mazotta ÖTV uygulaması ile ilgili bilgiler de araştırmada yer almaktadır. Araştırmada elde edilecek sonuçların sosyo-ekonomik araştırmaların sayısına bir yenisini ekleyerek kurumsal hafızaya katkı sağlaması aynı zamanda balıkçılık politikalarının oluşturulmasına ve uygulanmasına ışık tutmaktır.

MATERYAL VE YÖNTEM

Araştırma bölgesi, Ardahan ve Kars il sınırları içerisinde, 123 km2 Doğu Anadolu Bölgesi alanı ile 'nin en büyük ikinci tatlı su gölü olan Çıldır Gölü'dür. Deniz seviyesinden 1960 m. yükseklikte bulunan gölün en derin noktası 42 m. göl havzası 640 km2 dir [6].

Su Ürünleri Kooperatiflerinin, balıkçıların avladığı su ürünleri miktarının detaylı olarak kayıtlarının tutulmaması, tutulan kayıtların ise yanlış olabileceği değerlendirilerek, ekonomik analiz için gerekli olan üretim, masraf, sermaye yapısı, işgücü gibi verilerin başka yöntemlerle topluca elde edilememesinden dolayı, veriler anket yoluyla toplanmıştır. Bunun için, Doğruyol Su Ürünleri Kooperatifi ile, Akçakale Su Ürünleri Kooperatifine üye ve aktif balıkçılık yapan kişiler tespit edilerek, balıkçılar ile yüz yüze görüşme yapılmıştır. Anket soruları, ön anket uygulamasında elde edilen veriler ışığında araştırmanın kapsamına uyacak şekilde hazırlanmıştır.

Anket çalışması 06 Nisan 2017 tarihinde bölgede bulunan su ürünleri kooperatifine kayıtlı 45 balıkçıdan 23 faal balıkçı ile gerçekleştirilmiştir. Çıldır Gölü çevresinde ikamet eden, balıkçıların yoğunlukta olduğu Akçakale Köyü'nde 10 balıkçı, Doğruyol Köyü'nde 3 balıkçı, Taşköprü Köyü'nde 3 balıkçı, Çanaksu Köyü'nde 2 balıkçı, Gülyüzü Köyü'nde 2 balıkçı, Eşmepınar Köyü'nde 2 balıkçı ve Gölebakan Köyü'nde 1 balıkçı olmak üzere Su Ürünleri Kooperatifine üye 23 balıkçı anket çalışmasına katılmıştır.

Balıkçılarla ilgili tüm bilgiler anket yoluyla toplanmıştır. Bu amaçla Dartay ve ark. [7]'ın, çalışma alanlarında kullandıkları anket formları dikkate alınarak, Çıldır Gölü bölgesinin iklim şartları, bölgesel yapısı ve tahmin edilen sosyo-ekonomik sorunları da değerlendirilerek anket uygulaması yapılmıştır. Hazırlanan ankette sorulan sorular; Çıldır Gölü Bölgesinde balıkçılık faaliyetinde bulunan kişilerin; medeni halleri, balıkçıların yaşı, balıkçılık dışındaki meslekleri, mesleki tecrübeleri, meslekle ilgili memnuniyetleri, balıkçıkla uğraşan aile fertleri analizi, balıkçılıkla ilgili kişisel gelişimleri, balıkçılığa başlangıçtaki sermaye miktarı, tekne sayıları, tekne uzunlukları, tekne tipleri, tekne yapı malzemeleri, avcılıkta kullandıkları av malzemeleri ve sayıları, yıllık ortalama avladıkları su ürünleri miktarı, banka kredisi veya destek primlerinden faydalanma durumları, su ürünlerinin pazar analizi ve fiyatları, yıllara göre avlanan kerevit ve balık miktarlarının miktarı, balıkçıların sosyal güvenceleri, aylık kazançlarının ne kadar olduğu ile ilgili ayrıntılı 50 soruluk bir dizi anket yapılmıştır.

BULGULAR VE TARTIŞMA

Balıkçılarının Aile Yapısı, Balıkçıların ve Ailelerinin Eğitim Durumu

Çıldır Gölü'ndeki balıkçıların yaşlarının 34 ile 74 arasında değiştiği ve % 100'ünün evli olduğu tespit eşlerinin yaşlarının 20 ile 70 arasında değiştiği edilmiştir.

Çıldır Gölü balıkçıların eğitim düzeyleri incelendiğinde ilkokul mezunu ile üniversite mezunu arasında değiştiği tespit edilmiştir. En yüksek oranda %74 ile ilköğretim mezunu oldukları saptanmıştır. Balıkçıların eşlerinin eğitim düzeyleri incelendiğinde okur-yazar ile ilköğretim mezunu arasında değiştiği tespit edilmiştir. En yüksek oranda % 83 ile ilköğretim mezunu oldukları belirlenmiştir. Çocukların eğitim düzeyleri incelendiğinde ilköğretim mezunu ile üniversite mezunu arasında değiştiği tespit edilmiştir. En yüksek oranda %50,58 ile ilköğretim mezunu oldukları saptanmıştır

Balıkçıların, balıkçılıkla ilgili aldıkları eğitim durumları incelenmiş ve eğitimi olmayan balıkçı oranı % 65,21'lik oran ile 15 kişi olduğu tespit edilmiştir. Yetiştiricilik ve avlanma alanlarında seminer olarak düzenlenen eğitimlerde toplam 9 kişi kurs görmüştür.

Balıkçıların Balıkçılık Dışındaki Meslekleri

Çıldır Gölü balıkçılarının ekilebilecek arazilerinin azlığı, göl kenarına yakın ikamet etmeleri, balıkçılık mesleğini de ek gelir kaynağı olarak görmüş ve balıkçılığa başlamışladır. Balıkçıların %17,40'ının balıkçılık dışında herhangi bir geçim kaynaklarının olmadığı saptanmıştır, geriye kalan 19 balıkçının tarım, hayvancılık veya farklı alanlarda da faaliyet gösterdiği tespit edilmiştir. Çıldır Gölü balıkçıları, balıkçılıktaki gelirin yetersiz olması nedeni ile farklı meslek gruplarına yöneltmiştir. Balıkçıların % 82,60'ı balıkçılık dışı meslek grupları ile de eş zamanlı olarak uğraşmaktadır.

Avlama Filosunun Teknik Fiziksel Özellikleri

Balıkçıların kullandıkları av araçlarının teknik ve fiziksel özellikleri balıkçıların verdiği bilgiler ve gözlemler sonucu incelenmiştir. Avcılıkta kullanılan teknelerin boyları 4,0-8,0 m. arasında değişiklik göstermekte ve %36,36'lik oran ile de 6,0 m. boy uzunluğundaki tekneler çoğunluğu oluşturmaktadır.

Çoğunlukta kullanılan tekneler; fırtınalı havalarda oluşan iki dalga arasındaki mesafenin, teknenin boyunu kapsayacak şekilde uzunluğunun belirlenmesinde etkili olmuştur. En düşük orandaki tekneler ise %3,03 oranı ile 4 m, 4,5 m, 5,75 m, 6,75 m, ve 8,0 m. boydaki tekneler yer almaktadır.

Balıkçıların sahip olduğu tekne sayısı balıkçıların verdiği bilgiler sonucu incelenmiştir. Sahip oldukları tekne sayıları 1 ile 4 arası değişiklik göstermekte ve %78,26'lik oran ile de büyük çoğunluğunun 1 adet teknesinin olduğu tespit edilmiştir. 2 ve 4 tekne sahibi olanların oranı %8,69 iken, 3 tekne sahibinin oranı %4,34 olarak tespit edilmiştir.

Kars bölgesinin kış ayları soğuk ve kar yağışlıdır. Çıldır Gölü kış aylarında yüzey alanının yaklaşık 30 cm ile 1 m arasında buz tutması balıkçıların sahip olduğu teknelerin yapı malzemesini şekillendirmektedir. Teknelerin yapı malzemesinin genel olarak sert malzemeden olmasında iklim şartlarının etkisi büyüktür.

Balıkçıların %57,5'lik oran ile 19 adet teknenin demir malzemeden, %27,2'lik oran ile 9 adet fiberglas teknenin olduğu, %15,1 oran ile de 5 adet ahşap teknenin olduğu tespit edilmiştir.

Karasu Bölgesi deniz balıkçı tekneleri boylarının 6.50 m ile 22.00 m arasında değiştiği görülmektedir. 6.50 ile 8.00 m arasındaki tekneler %60,72 oranı ile çoğunluğu oluşturmaktadır [8]. İznik Gölü'nde gümüş balığı avcılığı faaliyetinde bulunan balıkçıların kullandıkları teknelerin boyları 6.00-9.00 m arasında değişiklik göstermekte ve %43,33 oranı ile 7.00 m boydaki tekneler çoğunluğu oluşturmaktadır [9]. Gökçeada balıkçılarının avcılıkta kullanılan tekneleri-

nin boyları 5,0-12,0 metre arasında değişiklik göstermekte ve %50,0'lik oran ile de 6,0-7,9 metre boy uzunluğundaki tekneler çoğunluğu oluşturmaktadır [10]. Bu çalışmada ve diğer yapılan çalışmalarda teknelerin ortalama 6 m civarında olduğu görülmektedir. İç su ve kıyı balıkçılığı yüksek miktarda av yapılan avcılık türü olmadığı için, bu tekne boyu yeterli gelmektedir.

Pinter Ağlarının Sayısı ve Özelliği

Balıkçıların kullandıkları kerevit pinterleri, genel olarak tek venterli olarak tespit edilmiştir. Yıpranan, hasara uğrayan pinter ağlarını maddi yetersizliklerinden dolayı yenileyemedikleri tespit edilmiştir. Az miktarda (10-249 adet) pinter ağına sahip balıkçıların ise pinter ağlarının hasarlı, yırtık olduğu tespit edilmiştir.

Balıkçıların Tayfa Olarak Çalışan Aile Fertleri

Balıkçıların ikinci ve üçüncü iş olarak tarım ve hayvancılıkla uğraşması, aile fertlerinin bu işlerle meşgul olması, tayfa olarak çalışan balıkçı sayısında azalma meydana gelmiştir.

Balıkçıların, çocuk veya eşlerin tayfa olarak çalıştığı oran %43,47 iken, tek başına balıkçılık yapanların oranı %56,52 olarak tespit edilmiştir.

Doğu Karadeniz Bölgesi'nde Ailede balıkçılık yapan kişi sayısına baktığımızda %77'sinde aynı ailede 1 veya 2 kişinin balıkçılık yaptığının belirlenmiş olması yeni neslin balıkçılığa fazla ilgi duymadığını göstermektedir [11]. Bu çalışmada ise aile içi bireylerin balıkçılık faaliyetlerine katılma oranı daha yüksek bulunmuştur. Bunun nedeni kırsal bir bölgede yaşadıklarından dolayı başka iş imkanlarının olmamasından kaynaklanabilir

Balıkçıların Finansal Durumu

Çıldır Gölü balıkçılarının kullandıkları kredilerin ihtiyaç kredisi kapsamında kullanıldığı tespit edilmiştir, 8 balıkçının kredi kullanmadığı, 7 balıkçının 1 kez ihtiyaç kredisi kullandığı görülmüştür.

Balıkçıların hibe veya destek kredilerinden haberlerinin olmadığı tespit ediliştir. Balıkçıların destek veya benzeri krediler ile ilgili bilgileri bulunmamaktadır.

Yapılan kapsamlı araştırmada, her iki kooperatif üyesi balıkçıların, devlet desteği olarak mazottaki Özel Tüketim Vergisinden haberlerinin olmadığını, bununla ilgili

Kooperatif Başkanları başta olmak üzere, ilgili kurum veya kuruluşlara müracaatta bulunmadıkları tespit edilmiştir. Bu konu hakkında bilgi beceri ve yeteneklerinin olmadığı gözlemlenmiştir.

Balıkçılığın Ekonomik Olarak Yeterlilik Durumu

Çıldır Gölü balıkçıları, bölgenin iklim ve arazi şartları da göz önünde bulundurulduğunda, balıkçıların göl etrafındaki belde ve köylerde ikamet etmeleri, balıkçılık mesleğine yönelme eğilimi olduğu saptanmıştır. Bu eğilim balıkçılıktan kazanılan ücretin yetersiz olduğunu gösterse de, ek gelir kaynağı olarak balıkçılığa devam ettikleri saptanmıştır. Balıkçılığın ekonomik olarak yeterlilik durumu, %56,53 orana sahip 13 balıkçı tarafından yeterli, 10 balıkçının ise avladıkları balıklardan elde ettikleri gelirin ekonomik olarak yeterli olduğunu ifade etmişlerdir.

Çıldır Gölü balıkçılarının avladıkları su ürünlerinden elde ettikleri aylık kazanç 250–2.500 TL. arası değişiklik göstermektedir, bu faklılık balıkçıların kullandıkları av araçlarının sayısının (kerevit pinteri, fanyalı ip ağ) az yada çok olması nedeni ile faklılık göstermektedir. Balıkçıların balıkçılık dışında, büyük baş hayvancılık ile uğraşıyor olmaları, ek iş olarak gördükleri balıkçılık mesleği üzerine çok fazla eğilmedikleri aylık kazanç ortalamasında fark edilmektedir.

Çıldır Gölü balıkçıları, tarım veya tarım çalışanı, hayvancılık, kamu çalışanı veya emeklisi, şoför, restaurant işletmecisi gibi balıkçılık dışı mesleklerde de çalışıp ek gelirelde etmektedirler. Balıkçılıktan elde edilen gelirin toplam gelir içindeki oranı %8,9 civarında kalırken, en fazla gelir %59,3 ile restaurant işletmeciliğinden elde edilmektedir.

Doğruyol ve Akçakale Su Ürünleri Kooperatif bünyesinde balıklarını stoklamak üzere buzhanelerinin olmamasının ve stoklanmayan balıkların uygun nakliye araçları ile farklı pazar alanlarına nakil edilememesinin satış fiyatı üzerinde büyük etken olduğu gözlenmiştir. Balıkçıların %60,86'sı balıkların satış fiyatlarından memnun olmadıkları, balıklarının daha iyi fiyatlara satılmasını istediklerini ifade etmişlerdir.

Balıkçıların Örgütlenme Durumu

Çıldır İlçesinde, İlçe Tarım Müdürlüğüne kayıtlı iki adet su ürünleri kooperatifi bulunmaktadır. Çıldır Gölü balıkçıları Akçakale ve Doğruyol Su Ürünleri Kooperatifine üyedir. Akçakale Su Ürünleri Kooperatifine kayıtlı 31 üyesinden, sadece 13 üyesi faal olarak balıkçılıkla uğraşmakta, 18 üyesi fahri üye olarak görevini yürütmektedir. Doğruyol Su Ürünleri Kooperatifi'nin kayıtlı 14 üyesi bulunmaktadır ve üyelerin 9'u faal olarak balıkçılıkla uğraşmaktadır ve 4 üyesi fahri üyeliğini sürdürmektedir. Kooperatife kayıtlı balıkçıların, tamamı bağlı olduğu kooperatiften memnun oldukları, ancak kooperatifin denetlenmesinin daha faydalı olacağını kanaati vardır.

Kerevit Avcılığındaki Değişim Durumu

Balıkçıların ifadelerine göre göl faunasına kısa sürede adapte olarak kerevit popülasyonu hızla çoğalmıştır. Balıkçılar yıllara göre kerevit miktarında artma gözlemlemiş, bu artışın başlıca sebebi; gölde kerevit avlayan balıkçıların sabit olması veya zaman zaman azalması, kerevit pinterlerinin pahalı olması nedeni ile balıkçıların pinterleri satın alamamaları, kerevit avcılığının avlanma süresinin 4 ay gibi kısa bir süre ile sınırlandırıp av yasağının gelmesi kerevit popülasyonunu artırmıştır. Kerevit popülasyonunda azalma var diyen % 26,08 orana sahip balıkçıların ise, av yasağı zamanı geldiğinde kullanılmayacak kadar kötü olan kerevit pinterlerinin gölde bırakılması sonucu gölün kirlenmesi ve kerevitlerin hastalığa yakalanması, göl karnında bulunan on dan fazla yerleşkenin evsel atıklarının göle dökülmesi kerevit miktarında azalmaya sebep olmuştur.

Pazarlama

Çıldır Gölü balıkçıları, avladıkları balıkları az olması, nakliye sorunu, faklı pazar alanlarına uzaklık, ve kooperatif bünyesinde su ürünlerini stoklayacak buzhanelerin olmaması nedenleri ile avladıkları ürünleri (balık), Çıldır ilçesinde, bulundukları köyde veya kendilerine en yakın köye götürerek satmaktadır. Doğruyol Su Ürünleri Kooperatif Başkanı, Yener Şaran'ın ifadesinde "kooperatife kayıtlı balıkçıların, avladıkları ürünlerini (kerevit ve balık) toplayarak, balıkları Kars İlindeki balıkçılara, kereviti ise Isparta'da bulunan kerevit işleme fabrikasına gönderdiğini ifade etmiştir.

Balıkçılar avladıkları su ürünlerini, farklı pazar alanlarına götürmek yerine, ikamet ettikleri İl, ilçe ve beldelerde satışa sunmaktadır. Bunun sebebi olarak, balıkları bozulmadan saklayabilecek buzhanelerin kooperatif bünyesinde olmaması, su ürünleri nakil araçlarının olmaması, illerin Çıldır Gölüne uzak olması maliyeti yükselttiğinden ürünler faklı pazar alanlarına ulaşmamaktadır. Bu olumsuzluklara rağmen, avlanan kerevitleri kooperatif toplayarak Isparta'daki anlaşmalı kerevit fabrikasına sevki sağlanmaktadır.

Tekirdağ ilinde balıkçıların %55'i komisyonculara, %23'ü konserve fabrikalarına, %12'si kooperatif ve birliklere, %9'u seyyar satıcı ve direkt tüketiciye satış yaptıklarını belirtmişlerdir [12]. Gökçeada balıkçılarının yakaladıkları balıkları satış şekillerinin %70,8'i kabzımal aracılığıyla, %29,2'sinin ise perakende olarak satıldığı görülmüştür [10]. Bu çalışmada balıkçıların tamamına yakını pazar sorunu yaşamadıklarını ancak üretim maliyetinin üstünde, istedikleri fiyata ürünlerini satamadıklarını, fiyatın yetersiz olduğunu belirtmektedirler

Balıkçıların Mesleği Seçme Nedenleri ve Balıkçılıkla İlgili Görüşleri

Çıldır Gölü balıkçıları, bölgenin uzun ve yoğun kış ayları geçirmesi, ekilebilecek arazilerinin azlığı, kışa bağlı olarak hasattaki düşük verimin etken olması ile beraber, balıkçıların göl kenarına yakın ikamet etmeleri, babadan kalma alışkanlığın olması, balıkçılık mesleğini ek gelir kaynağı olarak görmeleri onları balıkçılığa yöneltmiştir. Balıkçılığı babadan kalma alışkanlık, ek gelir, tutku olduğu için devam ettiren 14 balıkçı olduğu görülmektedir.

Çıldır Gölü balıkçıları mesleklerinin ekonomik olarak yetersiz bulsalar dahi, %60,87 orana sahip 14 balıkçının, ek gelir kaynağı, alışkanlık, tutku/hobi, babadan kalma meslek ve suya yakın olmaları nedenlerinden bir veya bir kaçının içinde barınması nedeni ile bu işi yapmaktan mutlu oldukları saptanmıştır.

Çıldır Gölü balıkçılarının aile fertlerinden bazıları tayfa olarak çalışmaktadır, fakat % 73,91 oranla balıkçılık mesleği babalarından sonra devam ettirmek istemedikleri tespit edilmiştir. Baba mesleği olarak balıkçılığı devam ettirmek isteyen balıkçı sayısının 6 olduğu tespit edilmiştir.

İzmir İli balıkçılarının %66'sının sadece yalnız balıkçılıkla uğraşmakta, geri kalanları ise balıkçılık dışında başka işler de yaptıkları görülmüştür [13], Bu oran Ege Bölgesi su ürünleri kooperatiflerinde %54,1 [14], İstanbul İli kooperatiflerinde %44,3 [15], Gökçeada balıkçılarının %54,2 [10] olduğu görülmüştür. Keban Baraj Gölü'nde kerevit avcılığı yapan balıkçıların tamamı balık avcılığı da yapmaktadır. Balıkçıların yarıya yakın kısmının (%46) balıkçılık dışında herhangi bir geliri bulunmazken, %32'lik kısmının balıkçılığın yanında çiftçilikle de uğraştığı görülmüştür [16]. Mevsimsel av yasakları ve yeterli gelirin elde edilememesi durumunun balıkçıları diğer işleri de yapmaya ittiği görülmektedir.

Balıkçıların Mesleki Tecrübeleri

Balıkçılarının mesleki tecrübesinin 15-45 yıl arasında değiştiği ve ortalama 29, 30 yıl olduğu tespit edilmiştir.

Balıkçıların İşlerini Büyütme ile İlgili Düşünceleri

Çıldır Gölü balıkçılarının tamamı göl etrafındaki belde ve köylerde ikamet etmektedir. Suya olan yakınlık, balıkçılığın babadan kalma bir alışkanlık olması, tarım alanlarının az olması ve balıkçılığın ek gelir kaynağı olarak görülmesi balıkçılık mesleğine yönelmelerinin başlıca nedenleridir. Balıkçıların ek gelir olarak gördüğü bu mesleklerini kendi imkanları dahilinde yapabildikleri süre kadar devam ettirmek istemektedir.

Çıldır Gölü balıkçılarının devlet katkı ve destek primleri hakkında bilgi sahibi olmadıkları, yüz yüze yapılan anket sonucundan tespit edilmiştir. Kullandıkları av malzemeleri (tekne, fanyalı ip ağ, kerevit pinteri)'nin idamesini sağlayamamanın sıkıntıları içerisinde avcılığa devam etmektedirler. Kullandıkları tekneleri bakım ve onarım masrafları, yıpranan sepetlerinin yenilenmesi için teşvik primlerinin verilmesi ve mazottaki Ö.T.V indiriminin bir an önce sağlanması mesleklerini büyütme yolunda büyük katkı sağlayacaklarını bildirmişlerdir. Balıkçıların %65,22 si işlerinin büyütmeyi düşünürken, %34,78'i ise mevcut şartlarını korumayı ve bu şekilde devam etmeyi istemektedir.

İstanbul balıkçıları ile yapılan bir çalışmada %44,3'ünün işsizlikten, %17,3'ünün aile bütçesine katkı sağlamak amacıyla, %15,0'inin hobi ve %14,4'ünün de babamesleğinden dolayı balıkçılığı seçtikleri bildirilmiştir [15]. Gökçeada balıkçıları üzerine yapılan çalışmada balıkçılığı seçme nedenleri sorulduğunda %45,8'lik en yüksek oranla deniz kenarında yaşamasından kaynaklandığı görülmüştür [10]. Keban Baraj Gölü balıkçılarının balıkçılığı seçme nedenlerinin ise %67 ile işsizlik olarak en yüksek oranda belirlenmiştir [17]. Balıkçılık mesleği seçiminin işsizlik nedeniyle zorunlu bir durum haline geldiği, bu çalışmada ve diğer çalışmalarda ortaya çıkmaktadır.

SONUÇ VE ÖNERİLER

Balıkçıların avladığı su ürünleri arasında bulunan alabalığın (Salma turutta capıus) özel bit tür olması ve koruma altına altında bulundurulması gerektiği halde, bu türün balıkçılar tarafından avlanılmaması gerektiğinin anlatılması için gerekli çalışmaların başlaması önem arz etmektedir.

Bölgede bulunan iki kooperatife üye alan, faal halde balıkçılığı yürüten 23 balıkçının kooperetif memnuniyetleri %100 olarak tespit edilirken, meslekteki memnuniyetlerinin %60'lık bir oranda kalması dikkat çekici bir bulgu olarak karşımıza çıkmıştır.

Kooperatife üye aktif balıkçıların, işlerini büyütmeyi hedeflerken, kullandıkları teknelerin bakım ve onarım masraflarını, yıpranan sepetlerinin yenilenmesi için teşvik primlerinin verilmesi ve mazottaki Ö.T.V indiriminin bir an önce sağlanması mesleklerini büyütme yolunda büyük katkı sağlayacakları tespit edilmiştir. Bunun için gerekli müracaatların nasıl yapılacağının anlatılması ve balıkçıların bilinçlendirilmesi için gerekli çalışmaların başlaması önem arz etmektedir.

Çıldır Gölü üzerinde 'Can 1 HES' ve 'Çıldır HES' olmak üzere toplam 2 adet Hidro Elektrik Santrali (HES) bulunmaktadır. Bu santrallerin elektrik üretimi maksadı ile Çıldır Gölünden zaman zaman su çekildiği, çekilme neticesinde balık üreme alanlarının azalmasına ve popülasyonun yok olmasına sebep olmaktadır. Bu durumun önlenmesi göl faunasının korunmasına katkı sağlayacaktır.

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Sağım Döneminde Alabalıklarin Trout (*Oncorhynchus mykiss)* Kan Parametrelerinin Araştırılmsı

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Özet
Bu çalışmada Doğanşehir Sürgü, Malatya'da bulunan tesislerden Kasım 2017 ile Ocak 2018 arasında alınan alabalık (*Oncorhynchus mykiss*) kullanılmıştır.. Çalışma sırasında her dönemde 10 dişi, 10 erkek olmak üzere toplam 60 balık çalışıldı. Balıkla r% 0.25 fenoksietanol ile anestezi edildikten sonra, enjektör yardımı ile kuyruk ucundan kan alındı. Alveoler damarlardan kan örnekleri alındı ve PROKAN 6800 VET cihazı ile ölçüldü. Kan parametrelerini belirlemek için Hematolojik analizler Hücre DN 1700 cihazı kullanılarak yapıldı. Sağımden önce erkek balıkların ağırlığı 359.5 ± 32.7 g, sağım döneminde 453 ± 74.09 g'a çıkmış ve sağım dönemi sonunda 354 ± 99.35 gr'a düşmüştür. Dişilerde sağım öncesi ağırlıkları 421 ± 28.46 gr, sağım döneminde 375 ± 54.62 gr'a düşmüş ve sağım döneminden sonra 392 ± 75.69 g'a çıkmıştır. Erkek balıklar için elde edilen kan parametreleri aşağıdaki gibidir; Beyaz kan hücreleri (WBC): Sağım öncesi 50.8 ± 14.82 103 / µL, sağım sırasında 55.79 ± 2.79 103 / µL, sağım sonrası 54.61 ± 3.052 103 / µL; kırmızı kan hücreleri (RBC): Sağım öncesi 1.95 ± 0.59 106 / µL, sağım sırasında 2.25 ± 0.20 106 / µL, sağım sonrası 2.24 ± 0.35 106 / µL; Hemoglobin (HGB): Sağım öncesi 10.11 ± 3.07 g / dl, sağım sırasında 11.02 ± 1.02 g / dl, sağım sonrası 9.79 ± 0.84 g / dl; hematokrit (HCT): Sağım öncesi % 26.38 ± 8.04, sağım sırasında% 28.73 ± 2.70, sağım sonrası % 29.62 ± 3.77; leucocyte (GRAN): Sağım öncesi 1.664 ± 0.81 103 / µ, sağım sırasında 1.22 ± 0.29 103 / µ, sağım sonrası 1.33 ± 0.36 103 / µ. Dişi balıklar için elde edilen kan parametreleri aşağıdaki gibidir; Beyaz kan hücreleri (WBC): Sağım öncesi 54.57 ± 4.86 103/ µL, sağım sırasında 47.2 ± 8 103 /µL, sağım sonrası 42.65 ± 7.11 103 / µL; kırmızı kan hücreleri (RBC): Sağım öncesi 1.94 ± 0.18 106 / µL, sağım sırasında 1.75 ± 0.33 106 / µL, sağım sonrası 1.39 ± 0.33 106 / µL; hemoglobin (HGB): Sağım öncesi 10.17 ± 0.78 g / dl, sağım sırasında 8.89 ± 1.59 g / dl, sağım sonrası 6.74 ± 1.57 g/dl; hematokrit (HCT): Sağım öncesi % 26.18 ± 2.07, sağım sırasında % 22.44 ± 4.54, sağım sonrası % 18.04 ± 4.03; lökosit (GRAN): Sağım öncesi 1.54 ± 0.47 103 / µ, sağım sırasında 1.18 ± 0.26 103 / µ, sağım sonrası 1.09 ± 0.22 103 / µ.

Anahtar Kelimeler: Oncorhynchus mykiss,, alabalık, kan parametreleri, ağırlık

Investigation of Changes in The Weight and Blood Parameters of Trout (*Oncorhynchus mykiss*) During Mating Period

Abstract
In this study, trout (*Oncorhynchus mykiss*) from the facilities located in Doganşehir Sürgü, Malatya was used. Samples were received between November 2017 and January 2018. During the study, a total of 60 fish, 10 female, 10 male, 10 female, 10 male and 10 female, were studied in the pre-milking period. After the fish were anesthetized with 0.25% phenoxyethanol, blood was taken from the tail end with the help of the injector. Blood samples were taken from the alveolar vessels and measured with the PROKAN 6800 VET device. Hematological analyzes were performed using the Cell DN 1700 coulter counter to determine blood parameters. The weight of male fishes before mating was 359.5 ± 32.7 g, increased to 453 ± 74.09 g during the mating period and decreased to 354 ± 99.35 g at the end of mating period. In females, before mating period weights were 421 ± 28.46 g, decreased to 375 ± 54.62 g during the mating period and increased to 392 ± 75.69 g after the mating period. The blood parameters obtained for male fish are as follows; white blood cells (WBC): 50.8 ± 14.82 103/µL before mating, 55.79 ± 2.79 103/ µL during mating, 54.61 ± 3.052 103/µL after mating; red blood cells (RBC): 1.95 ± 0.59 106/µL before mating, 2.25 ± 0.20 106/µL during mating, 2.24 ± 0.35 106/µL after mating; hemoglobin (HGB): 10.11 ± 3.07 g/dl before mating, 11.02 ± 1.02 g/dl during mating, 9.79 ± 0.84 g/dl after mating; hematocrit (HCT): 26.38 ± 8.04 % before mating, 28.73 ± 2.70 % during mating, 29.62 ± 3.77 % after mating; leucocyte (GRAN): 1.664 ± 0.81 103/µ before mating, 1.22 ± 0.29 103/µ during mating, 1.33 ± 0.36 103/µ after mating. The blood parameters obtained for female fish are as follows; white blood cells (WBC): 54.57 ± 4.86 103/µL before mating, 47.2 ± 8 103/µL during mating, 42.65 ± 7.11 103/ µL after mating; red blood cells (RBC): 1.94 ± 0.18 106/µL before mating, 1.75 ± 0.33 106/µL during mating, 1.39 ± 0.33 106/µL after mating; hemoglobin (HGB): 10.17 ± 0.78 g/dl before mating, 8.89 ± 1.59 g/dl during mating, 6.74 ± 1.57 g/dl after mating; hematocrit (HCT): 26.18 ± 2.07 % before mating, 22.44 ± 4.54 % during mating, 18.04 ± 4.03 % after mating; leucocyte (GRAN): 1.54 ± 0.47 103/µ before mating, 1.18 ± 0.26 103/µ during mating, 1.09 ± 0.22 103/µ after mating.

Keywords: Oncorhynchus mykiss, Trout, Blood Parameters, Weight

GİRİŞ

Klinik kan testleri toksik maddelere maruz kalmış balıklar üzerinde 1950'lerden beri uygulanmaktadır [1]. Kan biyokimya profilleri ve hematoloji genellikle balık, amfibi, sürüngen ve kuş gibi alt omurgalıların fizyolojik durumlarını değerlendirmek için kullanılır [2]. Hemogram, toplam beyaz kan hücresi sayısının (WBC), hematokritin (PCV), hemoglobin konsantrasyonunun (Hb), eritrosit indeksinin, WBC diferansiyel sayısının ve lekeli periferik kan filmlerinin değerlendirilmesinin, hemogram sayısının tayini, hemogram sayısının tayinini içerir [3].

Kültür balıkçılığı, nüfus artışına paralel olarak, artan besin ihtiyacını karşılamak amacıyla son yıllarda gelişme gösteren sektörlerden biridir. Nüfus artışını yanında avlama yoluyla elde edilen su ürünleri miktarının azalması ve yeterli düzeyde olmaması özellikle bazı balık türlerinin kontrol altındaki ortamlarda üretim ve yetiştiriciliklerinin yapılmasını gerekli hale getirmiştir [4].

Bu çalışmada üreme ve sağım dönemlerinde alabalıkların bazı kan parametrelerinin değişiminin incelenmesi amaçlanmıştır.

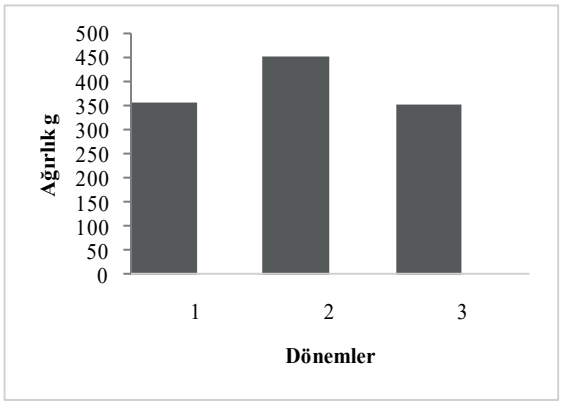
MATERYAL VE YÖNTEM

Bu çalışmada kullanılan Alabalıklar Malatya Doğanşehir Sürgü'de bulunan tesislerden alınmıştır. Örnekler Kasım-

Ocak döneminde alınmıştır. Araştırma süresince ortalama total boy 32,97 ± 1.65 cm, ortalama ağırlık 392,42± 6.98gr olmak üzere üreme dönemi öncesinde 10 dişi 10 erkek, sağım döneminde 10 dişi 10 erkek, sağım sonrası 10 dişi 10 erkek toplam 60 balık incelenmiştir. Balıklar % 0.25 fenoksietonol ile anesteziye bırakıldıktan sonra enjektör yardımı ile kuyruk ucundan kan alınmıştır [5]. Örnekler edtalı tüplere kayularak PROKAN 6800 VET cihazı ile petomolojik parametreleri ölçülmüştür. 0.5 ml hacmindeki kan 75 µl'lik mikrohematokrit tüplere alınmıştır. Kan parametrelerini belirlemek amacıyla hematolojik analizler Cell DN 1700 coulter counter cihazı kullanılarak yapılmıştır. Bu çalışmada aşağıda belirtilen kan parametreleri beyaz kan hücreleri (WBC), kırmızı kan hücreleri (RBC), hemoglobin (HGB), hematokrit (HCT) ve lökosit (GRAN) değerleri belirlenmiştir.

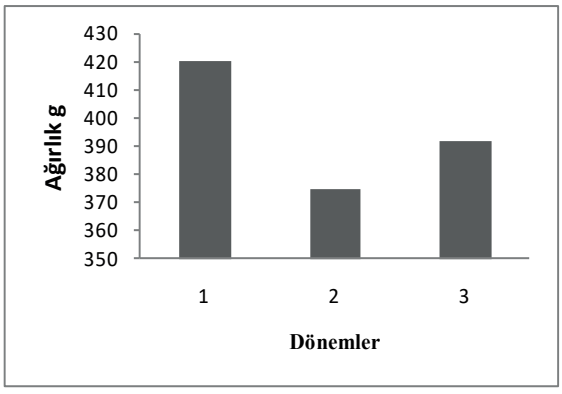
BULGULAR VE TARTIŞMA

Erkek balık ağırlığı üreme dönemi öncesi ortalama 359.5 g olarak tartılmıştır. Üreme dönemi esnasından artarak ortalama 453 g'a çıkmıştır. Bununla berabert üreme döneminden sonra balık ağırlığı tekrar ortalama 354 g seviyelerine düşmüştür (Şekil 1).



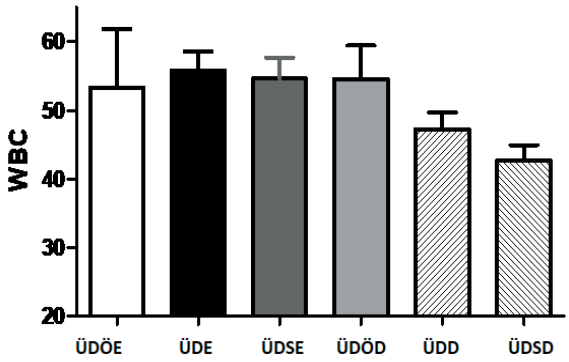
Şekil 1. Üreme dönemi öncesi ve sonrası erkek balıkların ortalama ağırlık değişimleri.

Dişi balıkların ağırlığı üreme dönemi öncesi ortalama 421 g olarak tartılmıştır. Üreme döneminde azalarak ortalama 375 g seviyelerine düşmüş ve üreme döneminden sonra tekrar erkek balıkların aksine 392 g seviyelerine yükselmiştir (Şekil 2).



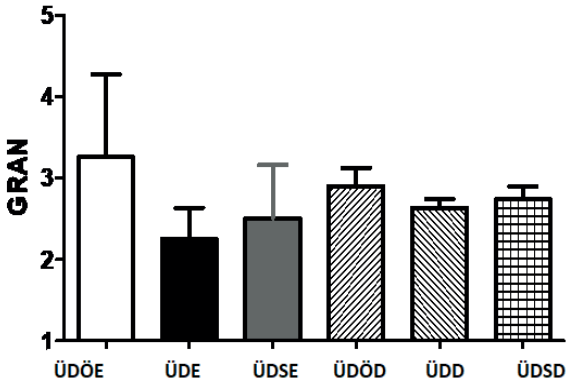
Şekil 2. Üreme dönemi öncesi ve sonrası dişi balıkların ortalama ağırlık değişimleri.

Çalışmamızda erkek balıklarda üreme döneminde WBC değerleri önce artmış, üreme döneminden sonra ise bir miktar azalma görülmüştür. Dişi balıkların değerlerinde ise sağım dönemi ani bir düşüş görülmüş ve bu düşüş sağım dönemi sonrası devam etmiştir (Şekil 3).



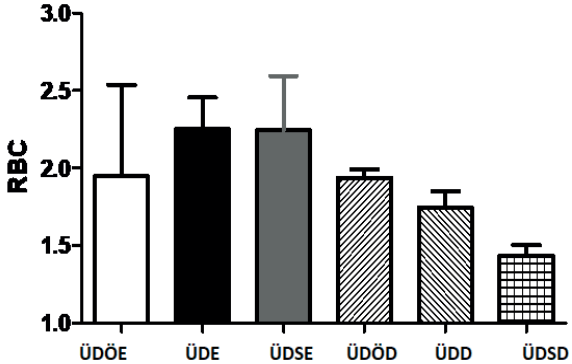
Şekil 3. Üreme dönemi öncesi ve sonrası tüm balıkların ortalama WBC değerleri değişimleri.

Üreme döneminde erkek balıkların GRAN değerleri ani bir düşüş göstermiş ve üreme dönemi sonrası ilk değerlerini bulmasa da yükselme göstermiştir. Dişi balıklarda ise erkek balıklarda olduğu kadar şiddetli olmasa da bir miktar düşüş görülmüş ve üreme dönemi sonrası tekrar yükselmiştir (Şekil 4).



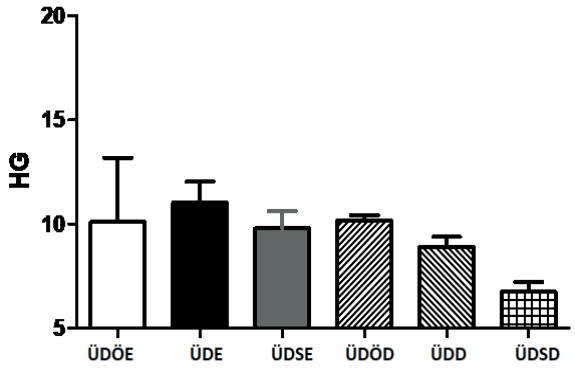
Şekil 4. Üreme dönemi öncesi ve sonrası tüm balıkların ortalama GRAN değerleri değişimleri.

RBC değerleri erkek balıklarda üreme döneminde artış göstermiş ve üreme dönemi sonrası ise üreme dönemindekine yakın değerlerde kalmıştır. Dişi balıklarda ise erkeklerin tam aksine üreme döneminde değerlerin düştüğü ve üreme döneminden sonra bu düşüşün aynı şekilde devam ettiği belirlenmiştir (Şekil



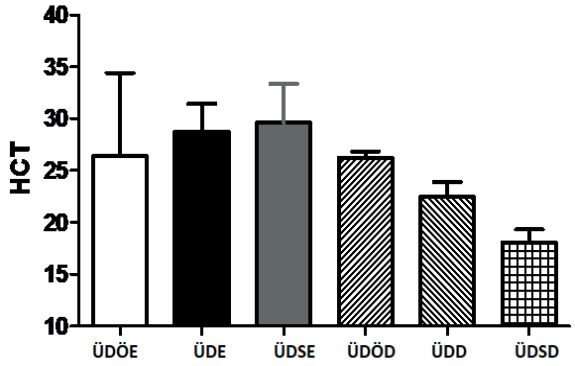
Şekil 5. Üreme dönemi öncesi ve sonrası tüm balıkların ortalama RBC değerleri değişimleri.

HG değerlerine bakıldığında erkek balıklarda üreme döneminde artış sonrasında ise üreme dönemi öncesine göre azalma tespit edilmiştir. Dişi balıklarda ise üreme döneminde azalma ve üreme dönemi sonrası daha fazla azalma belirlenmiştir (Şekil 6).



Şekil 6. Üreme dönemi öncesi ve sonrası tüm balıkların ortalama HG değerleri değişimleri.

HTC değerlerinde ise erkek balıklarda üreme döneminde bir miktar artış görülmüş ve bu artış üreme dönemi sonrası devam etmiştir. Dişi balıklarda tam tersine üreme dönemine azalma olmuş ve bu azalma üreme dönemi sonrası devam etmiştir (Şekil 7).



Şekil 7. Üreme dönemi öncesi ve sonrası tüm balıkların ortalama HTC değerleri değişimleri.

Yaş, cinsiyet, üreme döngüsü gibi faktörler balıkların fizyolojik durumunu etkiler [5]. Çalışmamızın sonuçları göstermektedir ki çalışılan parametrelerden lökosit ve granülosit değerleri erkek ve dişi bireylerde aynı yönde eğilim gösterirken eritrosit, hematokrit ve hemoglobin değerleri zıt bir şekilde çizgi takip etmiştir. Üreme sezonu öncesi, üreme sezonu ve üreme sezonu sonrası RBC, Hg ve Htc değerleri erkeklerde yükselirken dişilerde düşüşe geçmiştir. Erkek balıkların kanındaki RBC, Hg ve Htc değerlerinde ki bu artışın temel sebebinin, sudak balığında yapılan benzer bir çalışmada da ortaya koyulduğu gibi artan testosteron hormonunun beraberinde eritropoietinin uyarılmasına ve de daha fazla oksijene ihtiyaç duyulmasına yol açmaktadır. Bu uyarım sonucu ise kan üretimi artmaktadır [6]. Üreme döneminde *Schizothorax niger* balığında yapılan bir diğer çalışmada da erkek balıkların Hg ve htc değerlerinin dişilere göre daha yüksek;dişilerin lökosit değerlerinin erkeklerinkinden daha yüksek olduğu tespit edilmiştir [7]. Sazanlarda (*Cyprinus carpio*) yapılan bir diğer çalışmada ise bizim çalışmamızdakine benzer şekilde [8]. RBC, hg, htc erkek balıklarda yüksek iken, lökosit seviyesi dişilerde yüksek bulunmuştur. Artan kan yapımı için harcanan enerji ve rekabet stresi erkek balıklarda direnci düşürmektedir. Bu ise lökositte artış ve granülositde yükseliş olarak yansımıştır. Oositlerin büyüme ve olgunlaşma için gerekli enerji miktarlarıdişinin bağışıklık sisteminde düşüşe neden olur. Çalışmamızda da dişilerde WBC üretimindeki düşüş üreme sezonu sonrası da devam etmiştir.Çalışmamızdakine benzer şekilde yapılan bir başka çalışmada da yüksek lökosit üretiminin normale indirgenmesinin dişilerde erkeklerden daha iyi olduğu tespit edilmiştir [9].

SONUÇ VE ÖNERİLER

Sağım öncesinde 10 dişi 10 erkek, sağım döneminde 10 dişi 10 erkek, sağım sonrası 10 dişi 10 erkek toplam 60 balık incelenmiştir. Bu çalışmada beyaz kan hücreleri (WBC), kırmızı kan hücreleri (RBC), Hemoglobin (HGB) ve Hematokrit (HCT) değerleri belirlenmiştir. İnceleme sonucunda balıkların sağım öncesinde sağım döneminde ve sağım sonrasında kanlarında, davranışlarında ve fizyolojik değişimleri incelenmiştir. Dişi ve erkek balıkların sağım dönemlerinde hassaslaştığı stres girdikleri ve çok fazla efor harcadıkları belirlenmiştir. Sağımdan sondaki dönemlerde strese ve sağım döneminde yaşanan etkenlerden dolayı fizyolojik değişimlerini toparlamaya çalışmaktadırlar. Sağımdan sonra balıkların vitaminlere çok fazla ihtiyacı olduğu görülmüştür. Vücutlarının enfeksiyonlara karşı hızlı bir şekilde koruma ihtiyaçları için gerekli besin, stresiz ortamlara ve vitaminlere ihtiyaç duymaktadır. İncelenen balıklarda ki kan parametreleri incelendiğinde sağım dönemleri ve sağımdan sonraki dönemlerde balıkların hassaslaştığı ve bu dönemlerde bakım konusunda desteklerin artması gerektiği görülmüştür.

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Occurrence of the Burrowing goby *Trypauchen vagina* (Bloch and Schneider, 1801) in Southeastern Mediterranean, Turkey

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Abstract

A single male specimen of the burrowing goby, *Trypauchen vagina* (Bloch and Schneider, 1801), was caught at a depth of 30 m from the Arsuz coast, Turkey by a trammel net on 17 October 2017. Total length (TL) of the specimen measured as 206 mm. Measurements of the specimen were given and the geographical distribution of the species in the Mediterranean was documented. Although this is the third record of *T. vagina* from the Mediterranean coast of Turkey, the paper is the first report of an adult male specimen of *T. vagina* from southern coast of Turkey and confirms the extension of the species towards southeastern Mediterranean in the region. The finding of *T. vagina* in Arsuz coast suggests the habitat expansion of the species. As a result of this study a gap is filled relating to the geographic distribution of this species in the eastern Mediterranean coast of Turkey.

Keywords: Burrowing goby, Record, Arsuz coast, Mediterranean Sea

INTRODUCTION

The Suez Canal is the most important route of invasion for Erythrean organisms entering the Mediterranean [1]. There is a number of records of non-indigenous species entering the Mediterranean from the Red Sea via the Suez Canal [2], [3].

The burrowing goby *Trypauchen vagina* (Bloch and Schneider, 1801) belonging to the family Gobiidae is a demersal species inhabiting burrows in coastal waters as well as estuaries [4]. It feeds on mainly small crustaceans [5]. The species is originally found in tropical waters of western Pasific to Indian Ocean [5] Nevertheless, *T. vagina* is also reported from New Caledonia [6], South Africa [7] and Iranian coast of the Persian Gulf [8] as well as the Red Sea coasts of Isreal [5] and Turkey [9] in eastern Mediterranean.

Northward extention of the distribution range of the species by migrations via Suez Canal was confirmed with the first report of *T. vagina* from Red Sea [5] and then, from eastern Mediterranean, Turkey [9]. Later, Yaglioglu et al. [10] reported this species from northeastern Mediterranean Sea (Mersin Bay, Turkey).

The present study is the first report of a male specimen of *T. vagina* from the southeastern Mediterranean. Although the species has reported a couple of times along the Mediterranean coast of Turkey, present study resulted in the filling of the gap in geographic distribution of this species in the eastern Mediterranean Sea.

MATERIALS AND METHODS

On 17 October 2017 a single male specimen, 206 mm TL, of *Trypauchen vagina* was captured with a trammel net on sandy-muddy substrate at a depth of 30 m from Konacık location of Arsuz coast (Fig. 1).

The specimen was taken to the Laboratory of Basic Sciences, Faculty of Marine Sciences and Technology, Iskenderun Technical University (Turkey) for further examination, where the main morphometric measurements were collected by means of a digital calliper (to the nearest 0.01 mm). Sex was determined by macroscopic examination of the gonads.

All counts and measurements agree with the identification of *Trypauchen vagina* given by Randall [11], Murdy [12] and Salameh et al. [5].

Captured specimen was deposited with museum number of MSM-PIS/2017-7 in the Museum of the Faculty of Marine Sciences and Technology, Iskenderun Technical University. (Fig. 2)

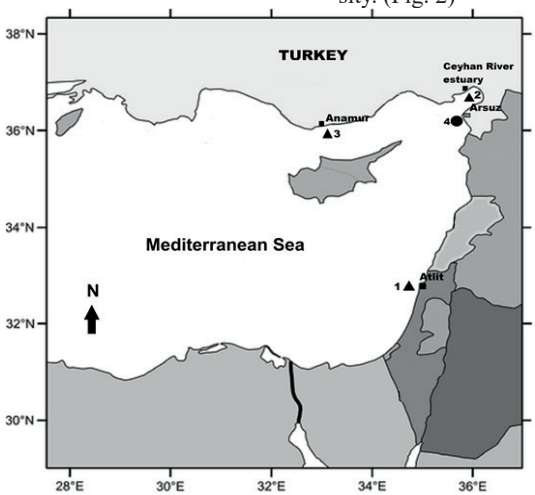

Figure 1. Distribution of *Trypauchen vagina* in the Mediterranean: 1 Salamah et al. [5]; 2 Akamca et al. [9]; 3 Yaglioglu et al. [10]; 4 This study

Figure 2. The male specimen of *Trypauchen vagina* (206 mm TL) captured from Arsuz coast in the Southeastern Mediterranean of Turkey

RESULTS AND DISCUSSION

Description of the specimen. Body is slender and compressed, head is small and slightly convex in its upper profile with median crest originating at vertical of anterior of orbit and terminating less than half predorsal distance. Mouth is slightly oblique, reaching back to vertical of anterior of orbit. Lower jaw is slightly protruding. Both upper and lower jaws are compiled with ten recurved canine teeth in outer raw and much smaller sharp teeth in inner row. A small pouch with a horizontal slit-like opening is located at dorsal margin of operculum. Pelvic fin is located under pectoral fin base, shaped like small funnel with interradial membrane, median rays being clearly longest [5]. Body is covered with cycloid scales, approximately 69 in longitudinal row [12].

Color of description. The entire body and head were uniformly red. All fins except the pectoral fin are translucent to off-white.

The morphometric characters used for identification are as follows; Total length (TL): 206 mm, standard length (SL): 185.4 mm, SL of TL: 90.00%, head length (HL) of SL: 14.52%, pelvic fin length (PEL) of SL: 4.52%, PEL of HL: 31.12%, pectoral fin length (PEC) of SL: 4.27%, PEC of HL: 29.38%, head width of SL: 7.61%, jaw length of SL: 4.45%, body depth of SL: 10.42%, pre-dorsal length of SL: 19.16%, pre-pelvic length of SL: 16.00%, pre-anal length of SL: 33.50%.

Morphometric measurements were taken according to Murdy [12] and presented in Table 1.

The geographical distribution of the species in the Levantine Sea and Persian Gulf was documented in Table 2.

Trypauchen vagina is an Indo-Pacific species widely distributed from the Arabian Gulf to the Philippines and China [13]. The species mostly inhabits silty and muddy bottoms at depths of 20-90 m [12].

The habitat of male specimen, collected from Konacık, west of Arsuz coast in Iskenderun Bay, agrees with the literature and is a shallow silty and muddy coastline showing characteristics of an eustarine region due to the discharges of the River Asi (Orontes). Ecological conditions are similar for the other two records from the Mediterranean coast of Turkey. First one was from Yumurtalık Bight in Iskenderun Bay close to Ceyhan River's estuary [9] and the second was from Anamur in Mersin Bay close to Dragon Stream estuary [10]. Hence, it can be claimed that *T. vagina* inhabits shallow estuaries and silty and muddy coastal waters of Turkey.

Table 1. Morphometric measurements of the specimen of *Trypauchen vagina* from from Arsuz coast (Iskenderun Bay), Turkey

Measurements	Values (mm)
Total length	206.0
Standart length	185.4
Head length	26.92
Head width:	14.10
Jaw length	8.25
Body depth	19.31
Pre-dorsal length	35.52
Pre-pelvic length	29.66
Pre-anal length	62.10
Pelvic fin length	8.38
Pectoral fin length	7.91
Meristic	
Dorsal fin	58
Anal fin (Anal-fin pterygiophores preceding the first hemal spine 3-4)	45
Pectoral-fin rays	18
Caudal fin rays	16
Caudal vertebral count	24
Longitudinal scale rows	69

Table 2. Records of *Trypauchen vagina* from differ locations in 2009-2017

References	Number of Samples	Date	Location	Country	Depth	Length, TL (mm)
Salamah et al. (2010) [5]	1	01.12.2009	Atlit and Hadera	Israel	90	164
Akamca et al. (2011) [7]	2	24.08.2010-03.10.2010	Ceyhan River Estuary, North Eastern Mediterraean	Turkey	20-27	210-217
Yaglioglu et al. (2013) [8]	1	28.10.2012	Anamur coast, Mersin Bay	Turkey	25-30	230
Alavi-Yeganeh et al. (2015) [6]	4	2015	North of Qeshm Island Persian Gulf	Iran	5-10	165-185
Present study	1	17.10.2017	Arsuz, Iskenderun Bay	Turkey	30	206

CONCLUSION

The present paper confirms the presence of the species in southern coast, Turkey and is the third record of specimen of *T. vagina* from the Mediterranean coast of Turkey. This paper is also the first report of an adult male specimen of T. vagina in the region. The importance of this study is that it confirms the presence of additional populations of the species in the Mediterranean Sea and the species has expanded to the coast of Arsuz in the south coast of Turkey (Southeastern Mediterranean Sea.

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The Scrutinising of Changes in the Aquaculture Supports

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Abstract
In the world, aquaculture is seen as the fastest growing and developing food production sector and however, in the near future, it is estimated that the rates of fisheries and aquaculture will be equalized. In 2015, the fisheries production of the world amounted to 170,345,641 tons (fisheries; 93,704,616 tons and aquaculture; 76,641,025 tons) according to the FAO records.
The aquaculture in Turkey started in 1970s and its rate in total fisheries production has rapidly increased as of 2000. In our country, the amount of aquaculture, which was 79,943 tons in 2003, reached 253,395 tons in 2016. The aquaculture rate in the total production of our country has increased by more than 310%. As one of the most important reasons for this rate increase, it is seen to be providing some support policies with various incentive systems by the government for support and encourage the aquaculture in country.
Directly product support for aquaculture farmers was started in 2003. According to the total capacity of the farms, total product and fry supports were provided. In 2008, the total capacity supported was limited to 2000 tons/year. However, in 2012, different tonnage application (whole unit price to 250 tons/year and ½ unit price from 251 to 500 tons/year) were brought to the total product support and the fry support was removed. At the same time, the processed product support was brought at the rate of twice the amount specified in the invoices of the total product. In the present, the support system is still continuing.
The types of product support, prices, supported capacities and the expense criteria are applied annually by issuing the "Aquaculture Support Communiqués" in the Official Gazette.

Keywords: Aquaculture, Fisheries, Support, Communiqués.

INTRODUCTION

Food resources have declined for various reasons, while world's population has increased by 1.6% per year. The expert analysis shows that food production in the world will increase by 1.2% per year and the general demand by 1.3%. In the reports of the United Nations, it is stated that the world's population growing at a mean rate of 78 million per year, will reach 8 billion by 2030; the global animal product needs in the next 20 years will increase twice depending on the growth of total population; and about 20% of the total animal protein needs will supply by fish [1]. However, it was reported that 81% of the world's aquaculture production is consumed by people as food [2].

Archaeological remains indicate that fish hunting and aquaculture are used as basic food source by humanity, since ancient times. It is known that in B.C. 3000 thousand years, Chinese people cultured the mullet in pond-like areas, and Romans also cultured the freshwater mullet and carp species in aquariums and pond water [3].

In recent years, it has become important that the total fish production should be supported not only by natural stocks, but also by aquaculture, as it is an important animal protein source and a very important food for human health. The nutritional and environmental problems that arise from the regional and fisheries and the related subjects taking into consideration the conditions that will be required in the coming years must be investigated extensively; they must be evaluated under the new findings and information; and the future plans and programs must be prepared according to these results [4]. Scientific and technological developments related to aquaculture have benefited the development of the industry in the last 50 years [5].

The development of aquaculture sector has been faster than the lower branches of agriculture. The aquaculture sector has been in a very important position in human nutrition due to provide the quality and cheap animal protein. The sector, which has grown by more than 11% on average since 1984, has been launched by the World Food and Agriculture Organization (FAO) as the fastest-growing food industry [6].

It has been reported by FAO that, the world's aquaculture production has reached 170 million tons in the 2015, while the aquaculture sector has shown rapid growth in the last 10 years in the world. The amount of aquaculture accounts for approximately 45% of world fisheries production [7].

However, Turkey has a potentially important fisheries production. Turkey has 8.300 km coastline, approximately 24 million hectares of seaside, and a total surface area of more than 1.4 million hectares of inland waters including over 220 dams, 200 natural lakes and more than 1000 ponds. In addition to this, it has a total of 26 million hectares of aquaculture production field with 33 rivers and streams of 178 thousand km long [8]. With this potential, aquaculture has become one of the most important elements of agriculture in our country [4].

In Turkey, the total fisheries production is totally 588.715 tonnes including 335.320 tonnes of fishing production and 253.395 tonnes of aquaculture in the year 2016 (Table 1).

Table 1. The aquaculture amounts of Turkey [9]

Years	Aquaculture (Tons)				TOTAL (Tons)
	Sea (Tons)	Percentage in Total (%)	Inland Waters (Tons)	Percentage in Total (%)	
2000	35.646	45.1	43.385	54.9	**79.031**
2001	29.730	44.2	37.514	55.8	**67.244**
2002	26.868	43.9	34.297	56.1	**61.165**
2003	39.726	49.7	40.217	50.3	**79.943**
2004	49.895	53.1	44.115	46.9	**94.010**
2005	69.673	58.9	48.604	41.1	**118.277**
2006	72.249	56.0	56.694	44.0	**128.943**
2007	80.840	57.8	59.033	42.2	**139.873**
2008	85.629	56.3	66.557	43.7	**152.186**
2009	82.481	52.0	76.248	48.0	**158.729**
2010	88.573	53.0	78.568	47.0	**167.141**
2011	88.344	46.8	100.446	53.2	**188.790**
2012	100.853	47.5	111.557	52.5	**212.410**
2013	110.375	47.3	123.018	52.7	**233.393**
2014	126.894	54.0	108.239	46.0	**235.133**
2015	138.879	57.8	101.455	42.2	**240.334**
2016	151.794	59.9	101.601	40.1	**253.395**

Evaluating the Turkey's recent history of last 25 years related to aquaculture, there is no data on statistics about aquaculture until 1985. However, it is known that the studies on aquaculture start carp and rainbow trout towards the end of the 1960s-1970s, and sea bream and sea bass culture since the 1980s [10], and the alternative fish culture researches with the species such as particularly trout, ell and carp in the inland water of our country and sea bream and sea bass in our sea, and other species (turbot, tuna, white grouper, dentex, sharpsnout sea bream, common sea bream, etc.) [11] (Table 2.).

Table 2. The culture amounts of the most cultured fish species in Turkey (tons) [12]

Years	Trouts			Sea Bream	Sea Bass
	Inland Waters	Sea	Total		
2000	42.572	1.961	44.533	15.460	17.877
2001	36.827	1.240	38.067	12.939	15.546
2002	33.707	846	34.553	11.681	14.339
2003	39.674	1.194	40.868	16.735	20.982
2004	43.432	1.650	45.082	20.435	26.297
2005	48.033	1.249	49.282	27.634	37.290
2006	56.026	1.633	57.659	28.463	38.408
2007	58.433	2.740	61.173	33.500	41.900
2008	65.928	2.721	68.649	31.670	49.270
2009	75.657	5.229	80.886	28.362	46.554
2010	78.165	7.079	85.244	28.157	50.796
2011	100.239	7.697	107.936	32.187	47.013
2012	111.335	3.234	114.569	30.743	65.512
2013	122.873	5.186	128.059	35.701	67.913
2014	107.983	5.610	113.593	41.873	74.653
2015	101.166	6.872	108.038	51.844	75.164
2016	101.297	5.716	107.013	58.254	80.847

There are many sea and inland water fish farms with different capacity in Turkey. The total number of these farms is 2,308 (Table 3.), and they have a total project capacity of 487,859 tons/year, according to records by the year of 2017 [9].

Table 3. The numbers and capacities of aquaculture farms in Turkey [9]

Group	Capacity Group (tons)	Farm Number	Total Project Capacity (tons/year)
Sea	0-50	173	4.008
	51-100	17	670
	101-250	18	3.144
	251-500	68	23.298
	501-1000	71	54.374
	1001>	80	151.470
	TOTAL	**427**	**254.440**
Inland	0-50	1.352	21.159
	51-100	108	4.515
	101-250	175	36.044
	251-500	118	38.909
	501-1000	125	134.289
	1001>	3	7.400
	TOTAL	**1881**	**233.419**

Aquaculture Supports

The aquaculture in Turkey started in 1960-70s and its rate in total fisheries production has rapidly increased as of 2000. In our country, the amount of aquaculture, which was 79,943 tons in 2003, reached 253,395 tons in 2016 (Table 1.). The aquaculture rate in the total production of our country has increased by more than 310%. As one of the most important reasons for this rate increase, it is seen to be providing some support policies with various incentive systems by the government for support and encourage the aquaculture in country.

In order to benefit from the development of the aquaculture sector in our country together with all stakeholders, the government has started directly product support for aquaculture farmers from 2003 on the basis of support policies. According to the total capacity of the farms, total product and fry supports, and the IPARD supports were provided. As a result, the aquaculture industry has achieved substantial growth, as mentioned above. Thus, the target of production has been reached before the time schedule prescribed by the State Planning Organization in the 9th Development Plan. From the date the supports start to be awarded, the aquaculture rate in the total production of our country has increased by more than 310%. In today, our country ranks first place in the trout culture in European Countries and second place in sea bream and sea bass culture.

Firstly, the product support was given to aquaculturist who culture the trout, sea bream and sea bass and have the “Fisheries Aquaculture Document”, when they applied to the Provincial/District Directorates, in the framework of “the Communiqué on Implementation Principles of the Council of Ministers by Decree No. 2000/467 on the Support of Animal Husbandry (Communiqué No: 2003/16 [13])". The IPARD support has been in operation since August 30, 2011, with the aim of expanding micro and small scale farms (currently producing or new ones), achieving EU standards and ensuring good fish culturing practices. With the provision of these incentives/supports, it is aimed to increase the total production and to increase the employment and at the same time increase the societal consumption of the fish, which is a reliable food.

Until today, some changes on the conditions and characteristics of aquaculture supports were made over the years. In the communiqués (Communiqué No: 2005/13 [14], 2006/9 [15] and 2007/20 [16]), product support amounts are given according to total farms production capacity in the 2005, 2006 and 2007 years, respectively. The fry supports for the 1 kg fish were operated as 4 fries for the trout and sea trout culture; 3 fries for the sea bream, sea bass, common sea bream, blackspot seabream, dentex, white grouper, sharpsnout sea bream, red drum, white sea bream, mullet, striped seabream, meagre and corb culture; and 2 fries for the turbot, sturgeon and catfish species.

In 2008, the total farm capacity supported was limited to 2000 tons/year for having the higher capacity by changing of the “Aquaculture Support Communiqué (Communiqué No: 2008/31 [17])". For the fry support, the supportable amount was limited the project or farm capacity in the Fisheries

Aquaculture Document (Communiqué No: 2009/44 [18], 2010/13 [19]). In the 2011, the limitation of 2000 tons/year was applied to the fry supports (Communiqué No: 2011/26 [20]).

However, in 2012, different tonnage application (whole unit price to 250 tons/year and ½ unit price from 251 to 500 tons/year) were brought to the total product support and the fry support was removed (Communiqué No: 2012/50 [21]). At the same time, the processed product support (fillet or smoked fish) was brought at the rate of twice the amount specified in the invoices of the total product. The support of the recirculation system culture in the 2016, and the supports of trout above kg and fish marks in the 2017 were added to content of the support policy. In the present, the support system is still continuing (Communiqué No: 2013/26 [22], 2014/27 [23], 2015/20 [24], 2016/33 [25], 2017/38 [26], 2018/33 [27]).

In order to benefit from the support in the present, the following documents are requested;

a. To have "Fisheries Aquaculture Document/ Certificate",

b. To be registered with the Aquaculture Registration System (SKS),

c. To join association in places where the Producer Association is established according to the Agricultural Producer Association (Law No: 5200) and/or the cooperatives related to aquaculture production,

d. The petition of application for the supports,

e. The sales document showing the purchase of the product and/or fisheries fry determination form (when requested until the last application date),

f. The sales document showing the purchase of the harvesting product and/or fisheries harvesting determination form (when requested until the last application date),

g. The feed invoice (when requested in year until the last application date).

The changes in the fisheries support system between 2003 and 2018 years were summarized in Table 4. The types of product support, prices, supported capacities and the expense criteria are applied annually by issuing the “Aquaculture Support Communiqués” in the Official Gazette.

Table 4. The changes in the fisheries support system between 2003 and 2017 years

Years	Supported capacity	Fry Supports	Processed Product	Trout Above kg	Recirculation System	Fish Mark
2003	Farm capacity amount	Based on 1 kg fish equivalent fish number	-	-	-	-
2004	Farm capacity amount	Based on 1 kg fish equivalent fish number	-	-	-	-
2005	Farm capacity amount	Based on 1 kg fish equivalent fish number	-	-	-	-
2006	2000 tons/year limitation	The amount of fries corresponding to 2000 tons/year	-	-	-	-
2007	2000 tons/year limitation	The amount of fries corresponding to 2000 tons/year	-	-	-	-
2008	2000 tons/year limitation	The amount of fries corresponding to 2000 tons/year	-	-	-	-
2009	2000 tons/year limitation	The amount of fries corresponding to 2000 tons/year	-	-	-	-
2010	2000 tons/year limitation	The amount of fries corresponding to 2000 tons/year	-	-	-	-
2011	2000 tons/year limitation	The amount of fries corresponding to 2000 tons/year	-	-	-	-
2012	unit price to 250 tons/ year and ½ unit price from 251 to 500 tons/ year	-	Twice the amount specified in the invoice for the product	-	-	-
2013	unit price to 250 tons/ year and ½ unit price from 251 to 500 tons/ year	-	Twice the amount specified in the invoice for the product	-	-	-
2014	unit price to 250 tons/ year and ½ unit price from 251 to 500 tons/ year	-	Twice the amount specified in the invoice for the product	-	-	-
2015	unit price to 250 tons/ year and ½ unit price from 251 to 500 tons/ year	-	Twice the amount specified in the invoice for the product	-	-	-
2016	unit price to 250 tons/ year and ½ unit price from 251 to 500 tons/ year	-	Twice the amount specified in the invoice for the product	-	Up to the amount of culture	-
2017	unit price to 250 tons/ year and ½ unit price from 251 to 500 tons/ year	-	Twice the amount specified in the invoice for the product	Addition price to culture amount	Up to the amount of culture	Addition price to culture amount
2018	unit price to 250 tons/ year and ½ unit price from 251 to 500 tons/ year	-	Twice the amount specified in the invoice for the product	Addition price to culture amount	Up to the amount of culture	Addition price to culture amount

CONCLUSION

The aquaculture supports has played a major role to prevent unregistered and unregistered production, to create a competitive sector, to develop environment-friendly and sustainable production techniques and systems, to increase the production, fisheries amounts, its quality and consumption in the country [28]. With the granting of supports, in the aquaculture sector increasing capacity of farms and the establishment of new farms have gained momentum, has been regarded as a sign of this [6].

Furthermore, by introducing an inspection mechanism, informal sales have been relatively avoided and price stability has been achieved in the supply of fish to domestic and foreign markets. The registration rate of farmers to the registration system was reached to 95% now, while it is 10% in the 2003 [29]. In addition, the sector employs more than 250.000 people and the growth rate of the industry is seen to be twice as much compared to sectors such as agriculture, fishing and forestry [28].

It has been determined that supports play an important role in bringing and using modern and advanced technologies in order to strengthen the substructures of the farms. However, it has been shown that the supports policies have been developed every year since 2003, were useful for providing to entry and offshore operations and equipment of the new production techniques, even if it is not enough for transition [30].

However, the content of support Communiqué applied in recent years, has created disappointment among most farmers, failing to meet their expectations.

Prepared programs have received a great deal of reaction from farmers, because in the preparing of support policies, it was thought that the ideas of the farmers who are the most important parts of the aquaculture sector is not taken into consideration and without making useful economic analyses about the sector.

The support policies applied in Turkey, is the belief that inadequate when compared with the example in the European Union. It is stated that it is necessary to liberate existing policies from inadequacy in order to evaluate our country's current potential in the best way.

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Length-Weight Relationship and Condition of Redcoat *Sargocentron rubrum* (Forsskål, 1775) in Iskenderun Bay (Southeastern Mediterranean, Turkey)

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Abstract

In this study a total of 165 (10.0-21.0 cm TL, 17.40-180.10 g TW) Redcoat, *Sargocentron rubrum* (Forsskål, 1775) were caught in Iskenderun Bay between September 2017 and April 2018 using a longline As a result, length-weight relationships (LWRs), sex ratio and condition the estimates for b parameter of the LWR ranged between and 3.098 3.096 and 3.100 for males, females and both sexes, respectively. Positive allometric growth were observed for male, female and both sexes. Fulton's condition (KF) factor values also revealed not significant variations (P>0.001) for females (1.904) and males (1.926) specimens of *S. rubrum.* No information currently exists on the length-weight relationship and condition of *S. rubrum* in the southeastern Mediterranean coast of Turkey. This paper is an important contribution to the science and fisheries management applications for this species.

Keywords: Redcoat, Length-weight parameters, condition factor, Mediterranean Sea

INTRODUCTION

The Redcoat, *Sargocentron rubrum* (Forsskål, 1775) is a reef associated marine fish species and belongs to the family Holocentridae, that occur in coastal reefs; silty reefs or wrecks in lagoons, bays, or harbor [1], [2] at depths ranging from 1 m to 84 m [1], [3], also found hidden in caves and cracks of rocks during the day [4], [5].

Length-weight data are useful and standard results of fish sampling programs. These data are essential for a wide number of studies, for example estimating growth rates, age structure and other aspect of fish population dynamics [6], [7]. It is also helpful in local and interregional, morphological and life historical comparisons in species and populations [8], [9].

Condition factors are also important parameters for the evaluation of fish stocks and Fulton's condition factor (CF) is widely used in fisheries and fish biology studies.

To date, *S. rubrum* biology has not been studied along coasts of the southeastern Mediterranean. In the present study, we was first reported length-weight relationships (LWRs) and condition for the redcoat from Iskenderun Bay (S.E. Mediterranean, Turkey).

Figure 1. Sampling area

MATERIALS AND METHODS

The redcoat S. *rubrum* specimens were collected at depths of 20 to 30 m by commercial trammel net and longline from Cevlik, Arsuz and Iskenderun coast (Iskenderun Bay) between September 2017 and April 2018 (Fig. 1). After capture, all fish samples were immediately transported to the laboratory in the Department of Marine Sciences, University of Iskenderun Technical, Iskenderun, Turkey (Fig. 2).

Total length (TL) was measured to the nearest 0.1 cm using digital slide calipers and total body weight (W) was measured using an electronic balance with 0.01 g accuracy. Each species lengths were categorized from the smallest to the largest to determine the existing ranges.

The isometric (b = 3) or allometric growth relationship between total length (TL, cm) and total body Weight (W, g) was described for these fishes growing with their bodies becoming heavier using a plotted power function [10]. $W = aTL^b$ in which a is the power function coefficient (the regression intercept) and b the exponent (the regression slope).

Fulton's Condition Factor (CF) [11] was calculated using the equation $K= (W/L^3)*100$, where W is total body weight (g) and L is total length (cm).

Figure 2. The redcoat, *Sargocentron rubrum* (Forsskål, 1775) from the Southeastern Mediterranean Sea, Turkey

RESULT AND DISCUSSION

A total of 165 (73 female and 92 male) specimens were collected and measured. Total length values of female, male and overall specimens were ranged from 10.0-20.5 cm, 11.4-21.0 cm and 10.0-21.0 cm respectively. Average total length and weight values of all individuals of *S. rubrum* were 15.95±0.15cm and 82.11±2.45g respectively (Table 1). Within the population of this species, most of the individuals in our samples were ranged from 15.0 to 17.0 cm (Fig. 3). The ratio of males to females (M: F) was estimated as 1.29:1.00 and this was not statistically significant (P > 0.05).

Table 1. Descriptive statistics and estimated parameters of length-weight relationships for *S. rubrum* from southeastern Mediterranean, Turkey

Sex		Total length (TL, cm)	Weight (g)	W=aTL^b				
	n	TL_{min}-TL_{max} Mean±SD	W_{min}-W_{max} Mean±SD	a	b	95% CI of b	SE(b)	r2
Female	73	10.00-20.50 (15.89±2.19)	17.4-169.90 (81.25±2.19)	0.0146	3.096	2.942-3.249	0.077	0.958
Male	92	11.40-21.00 (15.99±1.71)	29.6-180.10 (82.79±28.60)	0.0148	3.098	2.932-3.264	0.083	0.939
Both	165	10.00-21.00 (15.95±1.93)	17.4-180.10 (82.11±31.57)	0.0146	3.100	2-989-3.211	0.056	0.949

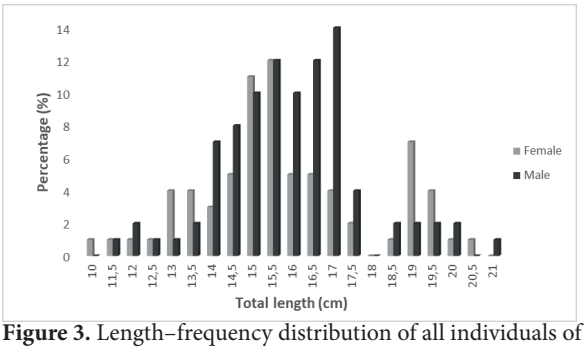

Figure 3. Length–frequency distribution of all individuals of *S. rubrum*

The length-weight relationships (LWRs), of *S. rubrum* calculated as W=0.0146xTL3.096 (R2=0.958) for females, W=0.0148xTL3.098 (R2=0.939) for males and W=0.0146xTL3.100 (R2=0.949) for all individuals (Fig. 4, Fig. 5 and Fig. 6).

The present study, the length-weight relationships for b parameter ranged between and 3.098 3.096 and 3.100 for males, females and both sexes, respectively (Table 1). Our data suggested that *S. rubrum* showed positive allometric growth for all sexes. The parameter "b"of length–weight relationships was significantly different from 3 (P < 0.05). Conversions among length measurements are given in Table 2.

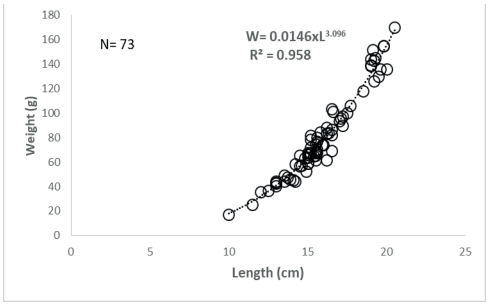

Figure 4. Length weight relationship for female specimens of *S. rubrum* from the Iskenderun Bay

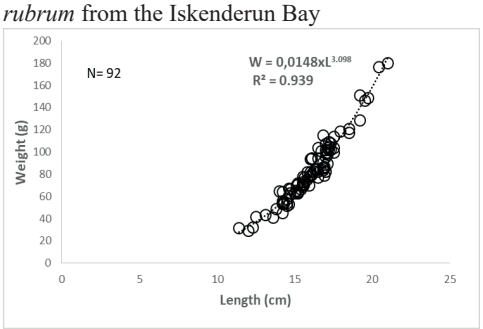

Figure 5. Length weight relationship for male specimens of *S. rubrum* the Iskenderun Bay

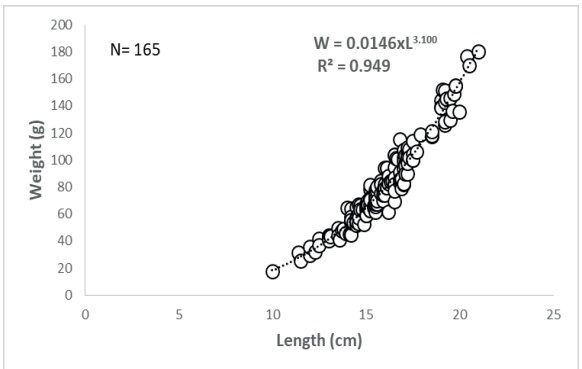

Figure 6. Length weight relationship for all individuals of *S. rubrum* from the Iskenderun Bay

Fulton's condition (KF) factor values also revealed not significant variations (P>0.001) for females (1.904±0.173) for males (1.926±0.262) and all sexes (1.929±0.172) of *S. rubrum.* The highest condition factor for males and for females were in November (Fig. 7).

Figure 7. Monthly condition factor for individuals of *S. rubrum* from the Iskenderun Bay during September 2017 to April 2018

Table 2. The LWRs results of previous studies for *S. rubrum* from different locations

Authors	Country	Sex	n	L_{min}-L_{max}	Length Type	a	b	r^2
Letourneur et al. (1998) [12]	Lagoon, new Caledonia	unsexed	217	1.0-23.0	FL	0.18800	2.294	0.792
Yanagawa (1994) [13]	Thailand Rayong, Gulf of Thailand	unsexed	8	12.4-18.4	TL	0.05710	2.658	0.870
Kulbicki et al. (2005) [14]	New Caledonia	mixed	371	2.9.23.0	FL	0.02752	2.998	0.986
Taşkavak and Bilecenoglu (2001) [15]	Turkey, eastern Mediterranean	unsexed	38	12.6-16.7	TL	0.00174	3.015	0.940
Govindarao et al. (2015) [16]	Visakhapatnam coastal waters, India	mixed	62	14.0-21.0	TL	0.00880	3.204	0.845
Özvaraol and Tatlıses (2017) [17]	North Cyprus, Medıterranean Sea	mixed	148	11.1-20.1	TL	0.00130	3.091	0.977

In the present study, the values found for *S. rubrum* showed positive allometry in the growth of both sexes. The results received were compared with previous LWRs studies in other geographic locations [12], [13], [14],]15}, [16] and [17], Table 2. The values of b for Iskenderun Bay (southeastern Mediterranean) were close to the data marked from Taşkavak and Bilecenoglu [15] and Özvarol and Tatlıses [17] for Turkey and Cyprus and also for Indian waters [16]. However, Letourneur et al. [12] and Yanagawa [13] reported b values differ to negative allometric growth for S. rubrum in Caledonia and Gulf of Tailand. The differences are possibly originated from the differences in habitat, temperature, food availability and size [18].

In Iskenderun Bay, condition factor values also showed not significant variations (P>0.001) for female and male specimens of *S. rubrum*. The condition factor of fish population presents changes with gonad development, age, seasonal changes in growth and net mesh size]19], [20].

For this specimens of *S. rubrum* the data were not representative for all months. Thus these estimated parameters should be considered to represent only a particular season or time of the year. According to Bagenal and Tesch [21] the parameters of b generally do not vary significantly through the year, unlike parameter a which may vary seasonally, daily and between habitats. Besides the length-weight relationship in fishes is affected by a number of factors including season, habitat, gonad maturity sex, diet and stomach fullness, health and preservation techniques [22], all of which were not accounted for in the present study.

CONCLUSION

To best of our knowledge, no information is available on the LWRs and condition of *S. rubrum* in the southeastern Mediterranean Sea coast of Turkey. This paper is an important contribution to the science and fisheries management applications for this species.

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Rehabilitation of Streams, Rivers and Fish

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Özet

Bu çalışmada, dünyadan, ülkemizden elde edilen veriler, yerinde yapılan gözlemler ve çekilen fotoğraflar sonucunda ülkemizde dere ıslahının balıklara etkisi karşılaştımalı olarak irdelenmiş, sonuç ve öneriler getirilmiştir. Ülkemizde dere ıslah çalışmaları faaliyetlerinde mülga Orman ve Su işleri Bakanlığı Doğa Koruma ve Milli Parklar Genel Müdürlüğü, DSİ, mülga Çevre ve Şehircilik Bakanlığı, Karayolları Genel Müdürlükleri yetkisindedir. Dere ıslah çalışmaları toplum refahı artırma amaçlı yapılmaktadır. Ancak yapılan yanlış projeler sonucu buralarda yaşayan balık varlığı olumsuz etkilediği belirlenmiştir. Yapılan projeler daha çok HES'ler, dere ıslahı, hezeyan derelerinin olumsuz etkilerini azaltacak ve toprak kaybını engelleyecek şekilde, yol yapımı, alan kazanma faaliyetleri olarak görülmüştür. Doğa ve yaban hayatı göz ardı edilerek planlandığı belirlenmiştir. Sonuç olarak, akarsu yataklarında balık populasyonları açısından geri dönüşümü olmayacak kayıplara neden olan değişimlerin yapıldığı belirlenmiştir.
Anahtar Kelimeler: Akarsu ıslahı, dere, balık, rehabilitasyon

Rehabilitation of Streams, Rivers and Fish

Abstract

In this study, it was aimed to explain the rehabilitation of streams, rivers and fish and the data obtained from the world and our country, as well as on-site observations and photographs taken as a result of comparative analysis and conclusions and recommendations have been made. DSİ, Ministry of Forestry and Water Works, General Directorate of Nature Conservation and National Parks, Ministry of Environment and Forestry are in charge of stream improvement works in our country. It has seen that the river improvement work started with good intentions but the wrong projects made negatively affect the natural habitats, aquatic plant and animal communities, especially fish. They have lost their original form and functions to make for humanity fever. It was determined that the projects were planned in such a way that the negative effects of the delirium were reduced and the nature and wildlife were ignored so as to prevent the loss of soil. Consequently, changes could lead to loss that would not be recycled if it does not take due precautions.

Keywords: Rehabilitation, streams, rivers, fish

GİRİŞ

Akarsuların restorasyonu, çok çeşitli ekolojik, fiziksel, mekansal ve yönetim önlemleri ve uygulamaları anlamına gelir. Bunlar, biyoçeşitlilik, rekreasyon, taşkın yönetimi ve peyzaj gelişimini desteklemek için akarsu sisteminin doğal durumunu ve işleyişini iyileştirmeyi amaçlamaktadır. Kentsel nehir parkları, yerel sakinler için yaşam kalitesini artırmakta, önemli yatırım ve gayrimenkul değeri sağlamakta, ziyaretçileri çekmekte ve ekonomik büyümeyi teşvik etmektedir.

Akarsular, çok çeşitli mikro ve makro hayvan ve bitki türleri için önemli habitatlardır. Balıklar, amfibiler, kuşlar, böcekler, omurgasızlar ve sürüngenler buralarda yaşarlar ya da yiyeceklerini orada bulurlar. Akarsular habitatları birbirine bağlarken aynı zamanda çok önemli bir rol oynamaktadır. Bu habitat bağlantı, hem yukarı hem de aşağı havza alanları arasında ve akarsuyun her iki tarafını birbirine bağlayarak çalışır. Bundan dolayıdır ki, arkarsu havzasını sadece akarsuyu hesaba katmaktan ziyade bir bütün olarak ele alan yönetim anlayışını gerektirmektedir [1].

Sucul biyoçeşitlilik sadece balık, amfibi ve böceklerin yırtıcı hayvanlardan saklanabileceği düzensiz şekilli akarsu yatakları ve kıyılarında gelişebilir. Balık yaşamı ve diğer sucul flora ve faunanın akarsu kıyılarında doğal (yer altı) su akışına ve yaşam alanları için daha geniş bir çevrede yaşam alanlarına bağlanması gerekmektedir. Doğal su akışları, temiz suya katkıda bulunan biyolojik arıtma süreçlerini de teşvik eder. Bu hem insan kullanımı hem de yaban hayatı için önemlidir [2].

Bazen akarsu yatağı restorasyonu, yoğun olarak değiştirilen ekosistemleri ve ekosistem süreçlerini geri yükleyerek biyoçeşitliliğe katkıda bulunur. Ancak bu her zaman böyle olmaz. Fiziksel restorasyon çalışmaları arasında yeniden menderesleme (yani doğal bir nehrin kıvrımlarını geri getirme) içerir daha önce kıyıların betonla kaplandığı yeşil-doğal akarsu kıyıları oluşturmak ve balıkların set, baraj ve diğer engellerden geçmesine izin veren balık geçişleri inşa edilmektedir [3].

İklim değişikliği, akışları azaltarak, kuraklık-taşkın olaylarını arttırarak ve akarsuları ısıtarak su biyoçeşitliliğini etkileyebilir. Akarsu restarosyonu, biyoçeşitliliğin, çeşitli yollarla uyumunu desteklemeye yardımcı olabilir. Örneğin; su akışını iyileştirme ve su depolama kapasitesinin artmasına yardımcı olacak şekilde yeniden düzenleme, gölge sağlamak böylece su sıcaklığını düşürmek için akarsu kıyısı ağaçlandırılması, bağlantıyı arttırmak için engellerin kaldırılması, göçmen balıklar için yukarı veya aşağı habitata geçişin sağlanması gibi olabilir.

Dahası, biyolojik çeşitlilik için koşulların sürdürülmesine ve iyileştirilmesine yönelik katkıları sayesinde akarsu

restorasyonu, Habitat ve Kuş Direktifleri ile Su Çerçeve Direktifi'nin hedeflerine ulaşmak için güçlü bir materyal olabilir [4].

Bu çalışmada, Düyadan örneklerle Türkiye'de bulunan dere ıslahlarının durumu tespit edilmiş, çevresi ile karşılıklı etkileşimleri ortaya konulmuş, sürdürülebilir kullanımını sağlamaya yönelik politikalar geliştirilmiştir.

MATERYAL VE YÖNTEM

Türkiye'de bulunan 7 havzada 125 akarsu ve nehirden örnekleme yapılmıştır (Tablo 1). Nehirlerin fiziksel özellikleri ve balık türleri belirlenmiştir. Balıklar elektroşok (12 Volt DC ve 5-60 A, 650 W) ve serpme ağıyla (W 4,5 kg, L: 16 mm) avlanmıştır. Nehirlerin sınıflandırılması fiziksel özelliklerine göre yapılmıştır. Arazi kapsamında ıslah yapılan dereler yerinde gözlem yapılarak fotoğraflanmış ve kayıt altına alınmıştır. Bilgiler toplandıktan sonra nehir ve ırmakların sağlıklı olup olmadıkları tespit edilmiştir. Ülkemizde günümüze kadar yapılmış tüm dere ıslah çalışmaları, kurumsal düzeydeki faaliyetler ile yürürlükte olan mevzuat hakkında kaynak araştırmaları eşliğinde durum değerlendirmesi yapılmıştır. Bu bağlamda dere ıslah çalışmalarıyla ilgili; ıslah yapılan dereler hakkında veri, bilgi alınmıştır. Yapılan çalışmalar hakkında kitapçıklar temin edilmiştir. İnternetten yazılmış kaynaklardan konuyla ilgili alanlarda yazılar, veriler toplanmıştır. Konu ile ilgili gazete haberlerinden yararlanılmıştır.

BULGULAR VE TARTIŞMA

Arazi çalışmaları sonucunda 66 balık türü yakalanmıştır. Yakalanan bazı balık türleri Tablo 2'de sunulmuştur. Bu balık türleri doğalarından dolayı suda aşağı yukarı yönlü hareket etmektedirler. Dolayısıyla derelerde yapılan ıslah çalışmaları bu canlıları etkilemektedir.

Dünyada çok büyük bütçeli ve sayıda dere ıslah çalışmaları yapılmıştır. Bunlara Seul Cheonggyecheon Deresinde yapılan örnek olarak verilebilir. Bu proje 1958 yılında nüfusu hızla artan Seul'ün ihtiyaçları doğrultusunda ıslah çalışmalarında, yol yapımı için derenin üzerine 5,6 km uzunluğundaki, 16 m genişliğindeki yerden yüksekte yükseltilmiş bir otoban inşa edilmeye başlanmıştır. Otoban 1978 yılında tamamlanmıştır. 2003-2005 yılında (2 yıla ve 281 milyon $) otobanı kaldırılmış ve derenin ıslah edilmiştir. Proje sonunda temiz bir dere ve etrafında doğal yaşam alanları ortaya çıkarılmıştır.

Tablo 1. Örnekleme yapılan havzalar ve nehirler

	Ceyhan Havzası	X Koordinatı WGS84	Y Koordinatı WGS84	İlçe	Şehir
1	Ceyhan Nehri	35,62678583	36,95722293	YÜREĞİR	ADANA
2	Ceyhan Nehri (Aslantaş Barajı' nı Besleyen Kollar)	36,21325822	37,30850268	KADİRLİ	OSMANIYE
3	Aslantaş Barajı' nı Besleyen Kollar (Böcekli Yakını)	36,31451967	37,25105370	DÜZİÇİ	OSMANIYE
4	Aslantaş Barajı' nı Besleyen Kollar (Kaşobası Yakını)	36,36761174	37,30206000	DÜZİÇİ	OSMANIYE
5	Ceyhan Nehri	36,53221763	37,47701168	MERKEZ	K.MARAS
6	Ceyhan Nehri	36,95315774	37,80905013	MERKEZ	K.MARAS
7	Erkenez Çayı (Ayvalı Barajı' nı Besleyen Kollar)	37,18684987	37,59412150	MERKEZ	K.MARAS
8	Kartalkaya Barajı' nı Besleyen Kollar	37,34869716	37,53992864	PAZARCIK	K.MARAS
	Fırat Havzası				
9	Sürgü Çayı	37,85894383	38,04317425	DOĞANŞEHİR	MALATYA
10	Aksutlu Çayı	37,97750000	38,74250000	HEKİMHAN	MALATYA
11	Tohma Çayı	37,98740840	38,52511594	YAZIHAN	MALATYA
12	Karasu Deresi	41,86246232	39,70577993	KARAYAZI	ERZURUM
13	Ilıgöze Deresi	41,57179283	39,59540851	TEKMAN	ERZURUM
14	Aras Nehri	41,83861111	39,83777778	KÖPRÜKÖY	ERZURUM
15	Handere Çayı	42,24857341	40,12708420	HORASAN	ERZURUM
16	Arpaçay	43,64867638	40,13222963	TUZLUCA	IĞDIR
17	Aras Nehri	43,48468318	40,10661806	KAĞIZMAN	KARS
18	Egritaş Deresi	43,60500000	39,91500000	TUZLUCA	IĞDIR
19	Aras Nehri	43,19531115	40,16326402	KAĞIZMAN	KARS
20	Karakoyunlu Deresi	44,20924291	39,98026930	MERKEZ	IĞDIR
21	Sarısu Deresi	44,38777778	39,44944444	DOĞUBEYAZIT	AGRI
22	Arpaçay	43,63328344	40,52845716	TUZLUCA	IĞDIR
23	Bozkus Deresi - Bayburt Barajı Giriş	42,78471624	40,61770856	SELİM	KARS
24	Çot Suyu	42,94917989	41,17566121	HANAK	ARDAHAN
	Doğu Karadeniz Havzası				
25	Fırtına Deresi	40,97988602	41,17118841	ARDEŞEN	RIZE
26	Çağlayan Deresi	41,23746593	41,25442824	FINDIKLI	RIZE
27	İyidere-İkizdere-Karadere	40,35453028	40,97337577	İYİDERE	RIZE
28	Solaklı Çayı	40,27782400	40,89929075	OF	TRABZON
29	Kara Dere	40,02735600	40,88811828	ARAKLI	TRABZON
30	Atasu Barajı	39,70711915	40,84791052	MAÇKA	TRABZON
31	Uzungöl	40,29487171	40,62063314	ÇAYKARA	TRABZON
32	Harşit Çayı	39,32105653	40,54732351	TORUL	GUMUSHANE
33	Harşit Çayı	39,18265243	40,64463512	KÜRTÜN	GUMUSHANE
34	Harşit Çayı	38,85170028	41,00478652	TİREBOLU	GIRESUN
35	Gelivera Deresi	38,73611568	40,92516381	ESPİYE	GIRESUN
36	Torul Barajı	39,23475291	40,63344975	TORUL	GÜMÜŞHANE

Tablo 1'in devamı

37	Aksu Çayı (Dereli-Keşap)	38,47069907	40,84213064	MERKEZ	GIRESUN
38	Melet Irmağı (Mesudiye)	37,67250047	40,56881187	MESUDİYE	ORDU
39	Melet Irmağı (Ulubey)	37,81238855	40,84882502	ULUBEY	ORDU
40	Turnasuyu	38,00194444	40,95527778	GÜLYALI	ORDU
41	Bolaman Çayı (Gölköy)	37,48182009	40,77982551	KABATAŞ	ORDU
42	Bolaman Çayı (Aybastı)	37,47079123	40,78220216	KABATAŞ	ORDU
43	Bolaman Çayı (Fatsa)	37,52156122	41,00530728	FATSA	ORDU
44	Ceviz Deresi	37,30500000	41,06027778	ÜNYE	ORDU
Batı Karadeniz Havzası					
45	-	35,38845519	41,68034888	DİKMEN	SINOP
46	-	34,00965621	41,95768580	BOZKURT	KASTAMONU
47	-	33,60176480	41,98576655	İNEBOLU	KASTAMONU
48	-	33,57755191	41,61414523	SEYDİLER	KASTAMONU
49	-	33,08497387	41,92482008	CİDE	KASTAMONU
50	-	32,94009858	41,87847795	CİDE	KASTAMONU
51	Çerkeş Çayı	32,63819624	40,86550516	ESKİPAZAR	KARABUK
52	-	32,37270545	41,20153722	YENİCE	KARABUK
53	-	32,76891338	41,21480012	SAFRANBOLU	KARABUK
54	-	33,22583333	40,95666667	BAYRAMÖREN	CANKIRI
55	Kozcağız Deresi	32,33120242	41,62985886	MERKEZ	BARTIN
56	Devrek Çayı	32,06946510	41,28339975	GÖKÇEBEY	ZONGULDAK
57	-	31,79430187	41,44386892	MERKEZ	ZONGULDAK
58	-	31,81566020	41,39416103	MERKEZ	ZONGULDAK
59	Filyos Çayı	32,08985457	41,52228878	ÇAYCUMA	ZONGULDAK
60	Kızılcapınar Çayı	31,68515192	41,23252388	EREĞLİ	ZONGULDAK
Sakarya Havzası					
61	Çarksuyu	30,50062625	40,97174951	FERİZLİ	SAKARYA
62	Sakarya Nehri	30,60205185	41,02615204	KARASU	SAKARYA
63	Sapanca Gölüne giren kol	30,18783123	40,77759245	İZMİT	KOCAELI
64	Sapanca Gölüne giren kol	30,14877745	40,71644160	İZMİT	KOCAELI
65	Sakarya Nehri	30,05508165	40,44169141	OSMANELİ	BILECIK
66	Sakarya Nehri	30,33182160	40,62616458	GEYVE	SAKARYA
67	Sapanca Gölüne giren kol	30,24392405	40,69376646	SAPANCA	SAKARYA
68	-	30,20754484	40,09461763	İNHİSAR	BILECIK
69	Saryar Barajına giren kol	31,35258561	39,99560399	SÖĞÜT	BILECIK
70	-	29,64587838	40,25731791	YENİŞEHİR	BURSA
71	Porsuk Barajına giren kol	30,13681670	39,63360418	KUTAHYA	KUTAHYA
72	Karasu	30,02637446	40,28576005	BİLECİK	BILECIK
73	Porsuk Çayı	30,03565065	39,47463521	KUTAHYA	KUTAHYA
74	Porsuk Çayı	30,48352084	39,76096924	ESKİŞEHİR	ESKISEHIR
75	Bardakçı Deresi	31,12971621	39,39361566	ÇİFTELER	ESKISEHIR
76	-	31,32652437	39,27773433	EMİRDAĞ	AFYON
77	-	30,58728123	39,35138857	SEYİTGAZİ	ESKISEHIR
78	Porsuk Çayı	31,20537702	39,68360658	BEYLİKOVA	ESKISEHIR
79	Pürlek Deresi	31,77754026	39,63428423	SİVRİHİSAR	ESKISEHIR
80	Sakarya Nehri	31,89932000	39,19551027	POLATLI	ANKARA
81	Ilıcaözü Deresi	32,05766725	39,32690819	POLATLI	ANKARA
82	Sakarya Nehri	31,94493881	39,74130805	POLATLI	ANKARA
83	Balıkdamı	31,65537442	39,20450665	SİVRİHİSAR	ESKİŞEHİR
84	-	31,95885255	38,69689657	YUNAK	KONYA
85	Battal Deresi	31,89761967	38,25489286	ILGIN	KONYA
86	Mogan Gölüne giren kol (Çölova Deresi)	32,78564819	39,73028339	GÖLBAŞI	ANKARA
87	Ankara Çayı	32,35703240	39,76755521	POLATLI	ANKARA
88	Çubuk II Barajına giren kol	33,03398947	40,32525666	ÇUBUK	ANKARA
89	Çamlıdere Barajına giren kol	32,30967954	40,45915941	ÇAMLIDERE	ANKARA
90	Eğrekkaya Barajına giren kol	32,70398333	40,52292132	KIZILCAHAMAM	ANKARA
91	Saryar Barajına giren kol	31,35258561	39,99560399	MİHALIÇCIK	ESKISEHIR
92	Gökçekaya Barajına giren kol	31,34446080	40,18768077	NALLIHAN	ANKARA

Tablo 1'in devamı

Ege Havzası					
94	Bakır Çayı	27,63416707	39,18816774	SOMA	MANISA
95	Bakır Çayı	27,06916667	39,02333333	BERGAMA	IZMIR
96	Bakır Çayı	27,46005641	39,17115229	SOMA	MANISA
97	Sevişler Barajı	27,55269966	39,26777838	SOMA	MANİSA
98	Havran Çayı	27,16750000	39,57138889	HAVRAN	BALIKESIR
99	Zeytınlı Deresi	26,95483273	39,62319816	EDREMİT	BALIKESIR
100	Madra Çayı	27,03894277	39,26704390	BERGAMA	IZMIR
101	Sahın Deresi	26,75022975	39,59676077	EDREMİT	BALIKESIR
102	Menderes Çayı	26,26649809	39,90420529	EZİNE	CANAKKALE
103	Geme Deresi	26,41694444	39,58638889	AYVACIK	CANAKKALE
104	Menderes Çayı	26,82275683	39,82401703	BAYRAMİÇ	CANAKKALE
105	Bayramiç Barajı	26,67705585	39,81169429	BAYRAMİÇ	ÇANAKKALE
106	Ayvacık Barajı	26,47837086	39,60825038	AYVACIK	ÇANAKKALE
107	Sarıçay	27,88893315	37,38266049	MİLAS	MUGLA
108	Namnam Çayı	28,60843983	36,94301098	KÖYCEĞİZ	MUGLA
109	Kargıcak Deresi	28,68692676	36,97782639	KÖYCEĞİZ	MUGLA
110	Koca Çay/Kanlı Dere	27,94697591	37,04293633	MİLAS	MUGLA
111	Tersakan Deresi	28,80873140	36,70171123	DALAMAN	MUGLA
112	Dalaman Çayı	28,76320076	36,76278383	ORTACA	MUGLA
113	Seki Çayı	29,41404595	36,77557954	FETHİYE	MUGLA
114	Çayiçi Deresi	29,38450932	36,63002444	FETHİYE	MUGLA
115	Eşen Çayı	29,40331602	36,47388141	KAŞ	ANTALYA
116	Eşen Çayı	29,35543504	36,58348142	FETHİYE	MUGLA
117	Elmalı Çayboğazı	29,67385814	36,52261504	KAŞ	MUĞLA
118	Boğluca Çayı	29,82022372	36,33159972	KAŞ	ANTALYA
119	Akçay	30,07341774	36,49076332	FİNİKE	ANTALYA
120	Alakır Çayı	30,23121007	36,42706559	FİNİKE	ANTALYA
121	Kocadere/Kızılöz Deresi	29,80000000	36,73333333	ELMALI	ANTALYA
122	Dalaman Çayı	29,34815678	37,30513054	ACIPAYAM	DENIZLI
123	Dalaman Çayı	29,08127160	37,09046227	ACIPAYAM	DENIZLI
124	Dalaman Çayı	29,15602478	37,13813201	ACIPAYAM	DENIZLI
125	Çavdır Çayı	29,58850661	37,15073232	GÖLHİSAR	BURDUR

Uzun yıllardır şehrin içine girmeyen kuşlar, balıklar ve diğer yaban hayatı projenin tamamlanmasıyla birlikte tekrar geri gelmiştir. Böylece dere etrafındaki bölgenin sıcaklığının ortalama 3,6 °C düşmesini sağlamıştır. Seul merkezine giren araç sayısı %2,3 düşmüş, toplu taşıma kullanan insan sayısı yaklaşık %5 artmıştır. Bütün bunların sonucunda bölgenin havası da daha temiz bir hale gelmiştir. Sonuçta şehre kazandırdıklarını maddi olarak ölçmek mümkün değildir [5].

Colorado Nehri, Los Angeles Nehri ve Singapur Bishan Park ıslah çalışmalarında, restorasyon projesi, insan etkileşimine ve sağlıklı ve güzel bir ekosistem oluşturan bir kıyıdaş koridoruna bağlantı sağlayan bir topluluk yönetimi modelidir [6].

Akarsu yatakları restorasyonu, ekosistem sağlığını, su kaynaklarını, sel koruması sağlamak için alternatif bir yol olduğundan dolayı kurumlar açısından dolaylı bir ilgi ya da iş nedeni olmaktadır.

Ülkemizde dere ıslah çalışmaları faaliyetlerinde DSİ, mülga Orman ve Su işleri Bakanlığı Doğa Koruma ve Milli Parklar Genel Müdürlüğü (DKMPGM), Mülga Çevre ve Şehircilik Bakanlığı, Karayolları Genel Müdürlüğü görev almaktadır. Ayrıca dere ıslah çalışmaları faaliyetlerinde yerel belediyeler ve özel firma kuruluşlarının da faaliyet gösterdiği belirlenmiştir. Ülkemizde dere ıslah çalışmalarına örnekler Şekil 1'de verilmiştir. Yapılan çalışmalarda en çok Doğu Karadeniz Bölgesi Havzasındaki akarsu yataklarının zarar gördüğü belirlenmiştir [7, 8]. Karadeniz'de sel, taşkın ve heyelanları önlemek için dere kenarlarına yapılan yüksek beton duvarların karadaki canlıların suyla irtibatını keserek doğal yaşamı olumsuz etkilediği görülmüştür. Yöredeki arazi yapısı sebebiyle yolların dere kenarlarından geçtiği belirlenmiştir. Dere kenarlarında karayolu için beton duvarlar ile derelerle bağlantılı olan HES'ler için çeşitli betonlama çalışmaları yapıldığı gözlemlenmiştir. Su kaynaklarının geliştirilmesi maksadıyla yapılan baraj, gölet, taşkın koruma ve dere ıslahı projelerinde ve karayolu iyileştirme projelerinde yaban hayatının korunması ve geliştirilmesi için her hangi bir tedbir alınmadığı ve mevcut projelere de ilave edilmediği tespit edilmiştir. Devlet Su İşleri'nin (DSİ) yörede son yıllarda özellikle denize yakın kısımlarda ve yerleşim yerlerinde dere ıslahı yapmak için yüksekliği 6 m'ye varan kilometrelerce uzunlukta beton duvarlar yapmış oldukları tespit edilmiştir. Derelere ben yaptım oldu şeklinde enine yapılar yapılmış, dere kenarları betonlanmış ve dere yatakları iş makinalarıyla düzenlenmiş olduğu tespit edilmiştir. Bu çalışmalar derelerde yaşayan balık varlığını en azından ıslah sahalarında tamamen yok olmasına neden olduğu yapılan saha çalışmalarında belirlenmiştir. Dere kenarı ve yatağında yapılan bu çalışmalar fazla ve dengesiz yağış alan yörede suyun sürekli bulanmasına ve burada yaşayan başta balık olmak üzere tüm sucul canlılara olumsuz bir habitat sunduğu tespit edilmiştir. Dere yataklarının ütülenmiş gibi iş makinalarıyla düzeltilmesi sucul canlıların barınabileceği doğal yuvaları tamamamen yok ettiği görülmüştür. Dere kenarlarına yüksek beton duvarlar içerisine dereye inmek isteyen hayvan geçişlerini sağlayacak menfez yapılarının çok az olduğu, bunlarında yaban hayvanlarının geçişine hiç

uygun olmadığı sadece yan taraftan su akışını yönlendirecek şekilde olduğu tespit edilmiştir. Dere boyunca yapılmış olan beton yapılar habitatleri böldüğü ve derenin her iki yakasında geçişleri engellediği belirlenmiştir

DSİ tarafından 09.09.2006 tarih ve 26.284 sayılı Resmi Gazete'de yayımlanan 2006/27 sayılı "Dere Yatakları ve Taşkınlar" ile 20.01.2010 tarih ve 27.499 sayılı Resmi Gazete' de yayımlanan 2010/5 sayılı "Akarsu ve Dere Yataklarının Islahı" konulu Başbakanlık Genelgeleri yürürlükle ilave; yağış, akış ve baraj seviyeleri günlük olarak izlenerek taşkın önleme çalışmalar etkin bir şekilde sürdürülmesi bildirilmiştir. Taşkın öncesi yapılacak işler, rasat istasyonları, uyarı sistemleri, haberleşme sistemlerinin kurulması, taşkın planlarının hazırlanması olarak belirtilmiştir. Taşkın sırasında yapılacak işler, bölge taşkın planının uygulanması, taşkın planında olmayan işlerin koordinasyonu ve uygulaması olarak bildirilmiştir. Taşkın sonrası yapılacak işler, taşkın zararlarının saptanması, geçici ve acil tedbirlerin alınması, taşkın koruma tesislerindeki zararların tespit edilmesi olarak belirtilmiştir.

DSİ Genel Müdürlüğü toprak ve su kaynaklarının sürdürülebilirliğinin sağlanması ve etkinliğinin artırılması maksatlarıyla; yukarı havzalardaki erozyondan kaynaklanan ve akarsularla mansaba taşınan rüsubatın; yerleşim yerleri, taban tarım arazileri, DSİ'ye ait mansap tesisleri, baraj ve göletler ile diğer kamu kuruluşlarının tesislerinde oluşturacağı zararların önlenmesine yönelik olarak taşkın ve rüsubat kontrolü konularında etütler yapmakta, buna yönelik projeler hazırlayarak uygulamaya koymaktadır. DSİ'ce işletilen baraj, gölet, regülatör gibi rezervuarlar ve su yapıları ile sosyal tesislerin çevresinin prezante edilmesi kapsamında yapılan aktif ve pasif reaktif gereksinimi karşılayacak alanların tespiti, planlaması ve ağaçlandırma çalışmalarını yürütmektedir.

Antalya'nın Konyaaltı ilçesi sınırlarında bulunan kentin son sulak alanlarından Boğaçayı'nda DSİ tarafından yapılan taşkın önleme çalışmasıyla nehir yatağı doldurulmuştur. Antalya gibi büyük bir turizm kentinin ortasında ağaçlarıyla önemli bir doğal park olan Boğaçayı'nda yıl boyunca kuş gözlemcileri görülebilmektedir.

Son yıllarda Anadolu'nun bilinen önemli nehir yataklarında milyonlarca lira harcanarak ıslah çalışmaları yapılmaktadır. Ülkemizdeki birçok akarsu yatağı yaban hayatından arındırılarak, açık kanallara dönüştürülmekte, diğer bir deyişle akarsular boşaltılmakta, yapılan bu kanallarla boşa aktığı görülmüştür. Dolayısıyla nehirler geçtiği toprakları beslemeden, oradaki doğaya ve insana hayat vermeden akıp gitmektedir.

Akarsular fazla gelen yağmur suyunu, yer altı sularına ve toprağa katıyordu. Ancak yapılan ıslah çalışmaları ile resmen kanallara dönüştürülen derelerin fazla suları taşımada yetersiz kaldığı görülmüştür [9].

Rize'nin Pazar İlçesi Yeni Irmak Köyünde DSİ tarafından başlatılan dere ıslah çalışmaları, köylüler tarafından gereksiz yatırım olarak görüldüğü yörede yaşayanlar tarafından söylenmektedir. Öreneğin Yeni Irmak Köyü sakinlerinden Enver Türkücü, 52 yaşında olduğunu ve bu derede şimdiye kadar taşkın neticesinde bir hasar oluştuğunu duymadığını dile getirmiştir. Yapılan ıslah çalışması ile derenin bütün doğallığının bozulduğu ve son derece israfa yönelik bir çalışma olduğu belirlenmiştir. 3 km boyunca dere olmaktan çıkarılıp kanal haline getirilmeye çalışılmış, dere yatağında bulunan bütün balık yataklarının zarar gördüğü ve yuvalarının yok edildiği tespit edilmiştir [10].

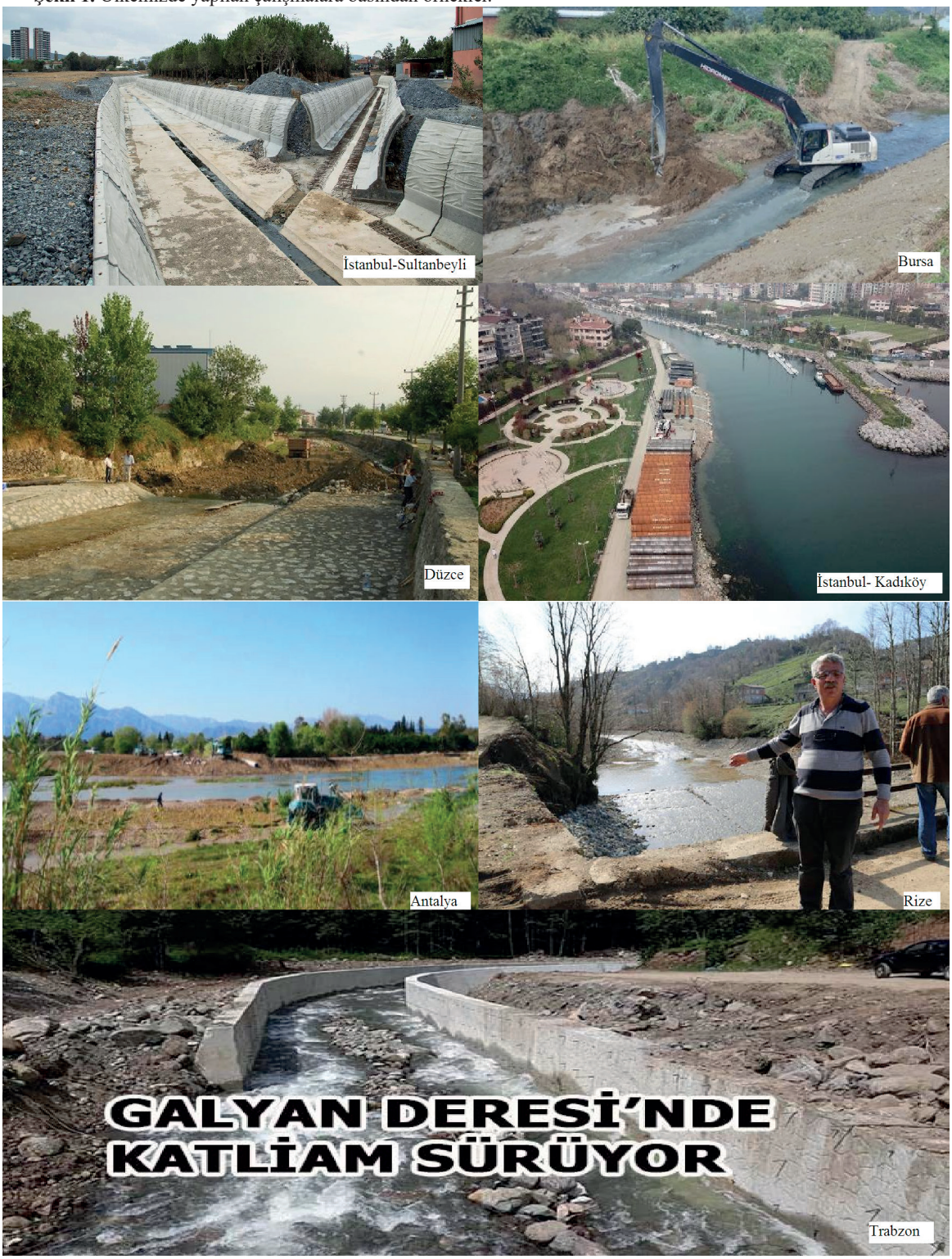
Devlet Su İşleri'nin (DSİ) yörede son yıllarda özellikle denize yakın kısımlarda ve yerleşim yerlerinde dere ıslahı yapmak için yüksek, kilometrelerce uzunlukta beton duvarlar yaptığı tespit edilmiştir. Yöredeki arazi yapısı sebebiyle yollar derelerin kenarlarından geçmektedir. Dere kenarlarında karayolu için beton duvarlar ile derelerle bağlantılı olan HES'ler için çeşitli betonlama çalışmaları yapıldığı görülmüştür. DSİ'nin derelerdeki taşkınları önlemek ve arazileri korumak amacıyla yaptığı tersip bentleri ve ıslah duvarlarının sucul ekosistem ve akarsuların kenarında yaşayan yaban hayatı açısından çok ciddi anlamda tehdit oluşturmaya ve ekosistemi tahrip eden yapı haline gelmekte olduğu gözlemlenmiştir.

Tablo 2. Yakalanan balık türlerinin bazıları

No	**Tür**	
1	*Salmo trutta*	Kahverengi alabalık
2	*Oncorhynchus mykiss*	Gökkuşağı alabalığı
3	*Salmo rizeensis*	Anadolu alabalığı
4	*Salmo coruhensis*	Karadeniz alabalığı
5	*Salmo trutta fario*	Dere alabalığı
6	*Cyprinus carpio*	Sazan
7	*Silurus glanis*	Yayın balığı
8	*Squalius cephalus*	Tatlı su kefali
9	*Capoeta tinca*	Saçaklı sıraz
10	*C. banarescui*	Sıraz
11	*European vimba*	Eğrez
12	*Vimba vimba*	Eğrez
13	*Barbus plebejus*	Bıyıklı balık
14	*Alburnoides bipunctatus*	Noktalı inci balığı
15	*Alburnus chalcoides*	Tatlı su kolyozu
16	*Rutilus rutilus*	Kızılgöz
17	*Abramis brama*	Çapak
18	*Perca fluviatilis*	Tatlı su levreği
19	*Exos lucius*	Turna balığı
20	*Alburnus alburnus*	İnci balığı
21	*Rodeus amarus*	Acı balığı
22	*Atherina boyeri*	Gümüş balığı
23	*Cobitis* sp.	Çamur balığı
24	*Oxynemacheilus angorae*	Ankara çamur balığı
25	*Gambusia holbrooki*	Sivrisinek balığı
26	*Ponticola rizeensis*	Kaya balığı
27	*Carassius gibelio*	İsrâil sazanı
28	*Lepomis gibbosus*	Güneş balığı
29	*Aphanius* sp.	Dişli şazancık
30	*Gobio gobio*	Kaya balığı
31	*Gobio sakaryensis*	Kaya balığı
32	*Gasterosteus aculeatus*	Üç dikenli balığı

**Bazı alt türler ya da aynı türün yeni tür olarak verilenleri burada ayrıca verilmemiştir.*

Şekil 1. Ülkemizde yapılan çalışmalara basından örnekler.



1960'ların sonuna kadar Eskişehir'lilerin balık tuttuğu, yüzme öğrendiği Porsuk Çayı daha sonraki yıllarda, çok fazla kirlenmiştir. Porsuk Çayı doğal yatağı önceki belediye yönetimlerince park yapmak için doldurulmasından dolayı kent için taşkın tehdidi ile karşı karşıya kaldığı görülmüştür. Bunun üzerine yapımı 3,5 yıl süren Porsuk Çayı ıslah projesi yapılmıştır.

DSİ tarafından dere yatağı ıslah çalışmaları günümüzde de devam etmektedir. Bu bağlamada, dere kenarları ve yatağı ıslahı, dere yolu yapımı, taş tahkimatı ve brit yapısı inşaatları da son sürat devam etmektedir.

Ülkemizde dere yatakları ıslahı tamamen taklit yöntemi ve inşaat mühendisliği hesaplamalarıyla yapılmaktadır. Biyolojik süreç göz ardı edilmekte olduğu tespit edilmiştir. Doğal materyallerin ise neredeyse hiç kullanılmadı gözlemlenmiştir. Bu çalışmalara ek olarak su kaynaklarının sucul canlılar ve özellikle de balıklar açısından rehabilitasyon yapılmadığını bu konuda dikkate değer bir iş yapılmadığı görülmüştür. Çünkü kurum bu konuda çalışan ve bilgi sahibi çalışanlardan profosyonel bir yardım almamaktadır. Ku-

rumda çalışan politik bağlantılı yetkili projede ne olacağına karar verdikten sonra taşeron son taşı kendine göre bir yere koymaktadır. Hatalar silsilesi sonucu bir örneği Solaklı Vadisi verilebilir [11]. Güzel bir görsel rekreasyon sahası üretilmiştir. Yetkili kişiler bu bölgenin turizm potansiyelinden dolayı görsel öneminin olduğu ve dolayısıyla görselliğin son derece önemi olduğunu vurgulumaktadırlar. Halbuki bu projelerin daha masa başında iken araştırılması ve sucul canlılarda hesaba katılarak planlanması gerekmektedir. Proje bittikten sonrasa bu canlıların hayatının nasıl etkilendiği ya da etkienip etkilenmediğidünyanın gelişmiş ülkelerinde olduğu gibi takip edilmeleri gerekmektedir.

SONUÇ VE ÖNERİLER

Ülkemizdeki yapılan çalışmalar incelendiğinde gelişmiş ülkelerde yapılanlardan çok geride olduğu görülmektedir.

Metotlarda da vurgulandığı gibi dünyada dere yatakları ıslahında daha çok doğal yöntemler kullanıldığı halde bizdeki örnekler betonlaşma ve orjianl yatağın tamamen değiştirilmesi ile yapılmaktadır. Bu durum gelecekte başka olumsuzluklarıda beraberinde getireceği aşikârdır. Su kaynaklarının geliştirilmesi maksadıyla yapılan baraj, gölet, taşkın koruma ve dere ıslahı projelerinde ve karayolu iyileştirme projelerinde yaban hayatının korunması ve geliştirilmesi için her hangi bir tedbir alınmadığı görülmüş bu durumun mevcut projelerde ve yapılması planlanan projelerde yaban hayatını olumlu etkileyecek küçük ilavelerle rehabilite edilmesi gereklidir. Özellikle dere yataklarında uzman görüşü alınanarak doğal görünümlü değişken şekilli kaya parçalarının konması balık ve diğer sucul canlılara yaşama ortamı sunacaktır. Dere kenarlarına yüksek beton duvarlar içerisine dereye inmek isteyen hayvan geçişlerini sağlayacak uzman görüşü alınanarak menfezlerin koyulması su kaynaklarını kullanmak isteyen memeli türleri için son derece yararlı olacaktır. Dere boyunca yapılmış olan beton yapılar habitatlari böldüğü için, habitat bölünmesini azaltacak tünel geçilerinin uzman görüşleri alınanak projede uygun yerlere yapılması sağlanmalıdır. Dolayısıyla yaban hayvanlarının yaşam alanlarını veya göç yollarını bölen uygulamalardan kaçınılması, zorunlu olan durumlarda yaşam alanı ve göç yollarında sağlıklı bir yaban hayatı sürekliliği sağlayacak geçitlerin yapılması hayati önem taşıyacatır. Projelere bu tip doğal hayatı olumlu etkileyecek küçük ilavelerle rehabilite edilmesi gereklidir. Bu problemlerin çözümleri aranırken, teknik ve etik hataların olmasından kaçınarak, mühendis, biyolog, botanikçi ve mimarların ortak bir yaklaşım içinde olmaları gerekmektedir. Dere ıslahı çalışmalarında oluşturulan yeni ekosistemin olumlu bir evrimini (yeniden doğallaştırma) teşvik etmelidir.

Kentsel akarsu park yollarının, diğerlerinin yanı sıra, hastalık riskinin azalmasına, yaşam süresinin uzamasına, daha iyi ruh hallerine, ruh sağlığına ve fiziksel güce, daha az strese ve daha az iş ve okul gününe yol açabileceği bilimsel olarak ispatlanmış ancak balık varlığı ülkemizde dikkate alınmamıştır.

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Gökkuşağı Alabalığının *Oncorhynchus mykiss* Sperminin Kısa Sure Muhafazası: Farklı Ekstendırların Etkilerinin Belirlenmesi

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Özet
Gökkuşağı alabalığının 4°C'de kısa sureli muhafazasında sperm motilitesi üzerinde farklı sulandırıcıların etkilerini belirlemek için denemeler kurulmuştur. Sperm toplaması abdominal masaj yoluyla gerçekleştirilmiştir. Sperm farklı sulandırıcılarla 1:3 oranında sulandırılmıştır. Sperm hücrelerinin motilitesi ve süresi tüm denemelerde günlük olarak belirlenmiştir. Sonuçlar, glukoz ve dimetilsülfoksit (DMSO) bazlı sulandırıcıda spermin 6 gün motil kaldığını göstermiştir. Bu çalışma kriyoprezervasyon ve üreme yönetimi için yararlı olacaktır.

Anahtar Kelimeler: *Oncorhynchus mykiss*, sperm, motilite, yaşama süresi

Abstract
Experiments were designed to clarify the effect of different extenders on sperm motility of rainbow trout *Oncorhynchus mykiss* after short-term cold storage at 4°C for 6 days. Sperm collection was performed through gentle abdominal massage. Sperm was suspended in different extenders at 1:3 dilution ratio. The motility and survival of sperm cells were assessed in all the treatments daily. Our results indicated that sperm remained as motile in glucose and dimethyl sulphoxide (DMSO) based extender at day 6. This study would be beneficial for cryopreservation and reproduction management.

Keywords: *Oncorhynchus mykiss*, sperm, motility, survival

GİRİŞ

Kısa sureli muhafaza, balık çiftliklerinde ve yetiştiricilik uygulamalarında yaygın olarak kullanılan bir yöntemdir [1]. Özellikle, gamet kalitesi döllenme ve yumurta açılım oranını etkilediğinden dolayı büyük ölçekli kuluçkahanelerde kısa mesafelerde gametlerin taşınmasında büyük önem taşımaktadır [1-6]. Bu yöntemde, sulandırılmamış ya da iyonik/multi-komponent içeren ortam ile sulandırılmış sperm 4ºC'de farklı atmosferik koşullarda (O_2 desteği ya da CO_2 varlığı) farklı sürelerde muhafaza edilmektedir [1,2]. Bu yöntemin başarısı, atmosfer kompozisyonu, sulandırıcı içeriği, sulandırma oranı, sıcaklık kontrolü, ilave maddeler (antibiyotik, antioksidan) gibi çeşitli faktörlere bağlı olarak değişmektedir [1,2,7].

Gökkuşağı alabalığı, Oncorhynchus mykiss, yetiştiricilik potansiyeli, ekonomik değeri ve tüketici talebinden dolayı dünyada önemli balık türlerinden birisidir. Bu nedenlerden dolayı, bu çalışmada gökkuşağı alabalığının sperminin kısa süreli muhafazasında farklı sulandırıcıların etkilerinin belirlenmesi amaçlanmıştır.

MATERYAL VE YÖNTEM

Anaçlar (2 yaş ve üstü) Göktepe Alabalık Üretim Tesisi'nden temin edilmiştir. Anaçlar 2-fenoksietanol (0.6 ml L^{-1}) ile bayıltıldıktan sonra abdominal masaj yöntemiyle sperm toplanmıştır. Sperm toplamada, kontaminasyonu ve aktivasyonu önlemek için sperme su, kan, üre ve fekes karışmamasına dikkat edilmiştir. Sperm 50 ml'lik tüplere sağılmış ve analiz edilene kadar buz üstünde tutulmuştur.

Sperm örneklerinin makroskobik (sperm rengi ve hacmi) ve mikroskobik (sperm konsantrasyonu ve motilite) analizi yapılmıştır. Motilite (%) Nikon E50i mikroskop (Nikon CI, Tokyo, Japan, Basler A312fc dijital camera, Microptic S.L., Barcelona, Spain) ile Sperm Class Analyser (SCA) programı kullanılarak belirlenmiştir. Sperm motilite süresi ise kronometre ile belirlenmiştir. Motilitesi >80% olan sperm örnekleri denemeler için seçilmiş ve havuz oluşturulmuştur. Sperm yoğunluğu hemasitometrik yöntemle belirlenmiştir. Spermatokrit Rurangwa et al. [8]'ın yöntemine göre belirlenmiştir.

Kısa sureli muhafaza işlemi için, sperm örnekleri 1:3 oranında 5 farklı sulandırıcıyla sulandırılmıştır; 1) Glukoz (0,15 mM), MeOH (%9), 2) Glukoz (0,18 mM), MeOH (%9), 3) Glukoz (0,3 mM), MeOH (%10), yumurta sarısı (%11), 4) Glukoz (0,2 mM), MeOH (10%) ve 5) NaCl (103 mM), KCl (40 mM), $CaCl_2$ (1 mM), $MgSO_4$ (0,8 mM), Hepes (20 mM), MeOH (%10), BSA (%1,5), Sukroz (%0,5) ve yumurta sarısı (%7). Sperm, NaCl (52 mM) ile aktive edilmiştir. Sperm örnekleri 4°C'de muhafaza edilmiş ve günlük olarak motilite yüzdeleri ve süreleri takip edilmiştir. Sonuçlar ortalama ± standart sapma (S.D.) olarak sunulmuştur.

BULGULAR VE TARTIŞMA

Gökkuşağı alabalığının sperm kalite parametreleri Tablo 1' de sunulmuştur. Taze spermin motilite yüzdesi ve süresi sırasıyla %95,09±0,01 ve 47,02±3,54 s olarak belirlenmiştir.

Table 1. Gökkuşağı alabalığının sperm kalite parametreleri (ortalama ± SD).

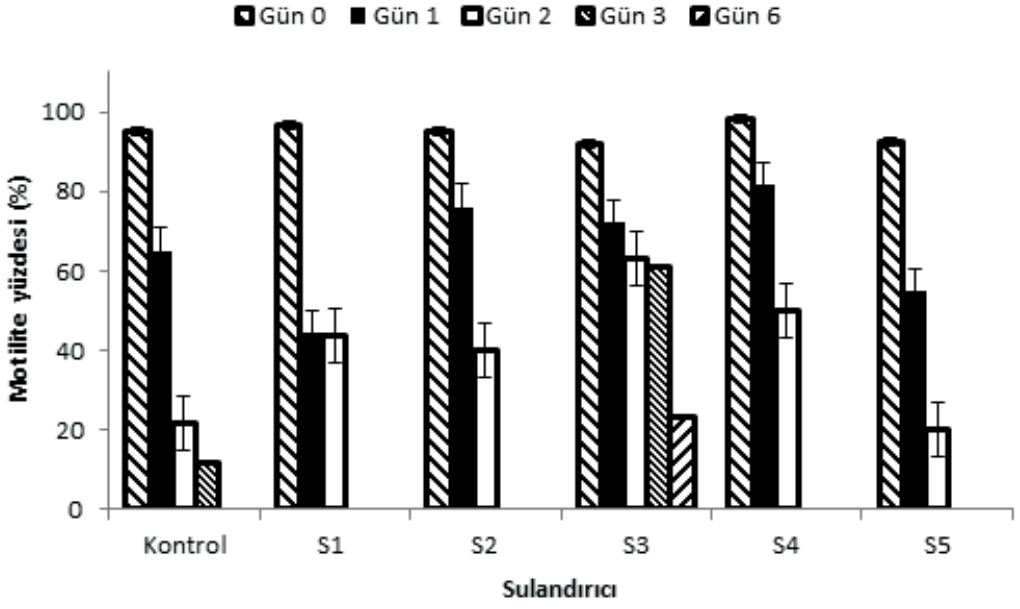
Parametre	Ortalama±SD	Dağılım
Renk	Beyaz	
Hacim (ml)	4,25±1,26	1-6
pH	7,28±0,15	7,25-7,59
Spermatokrit (%)	58,20±2,35	55,00-60,00
Sperm yoğunluğu ($\times 10^9$)	8,34±0,34	8,15-8,65

Salmonidlerde sperm kalitesiyle ilgili yapılan çalışmaların karşılaştırılması Tablo 2'de verilmiştir. Bu çalışmadaki sonuçlar önceki çalışmalardan farklıdır. Bu farklılığın sebebi, anacın yumurtlama davranışı ve ekolojisi, boy ve ağırlığı, örnekleme zamanı ve yöntemi olabilir [9-13].

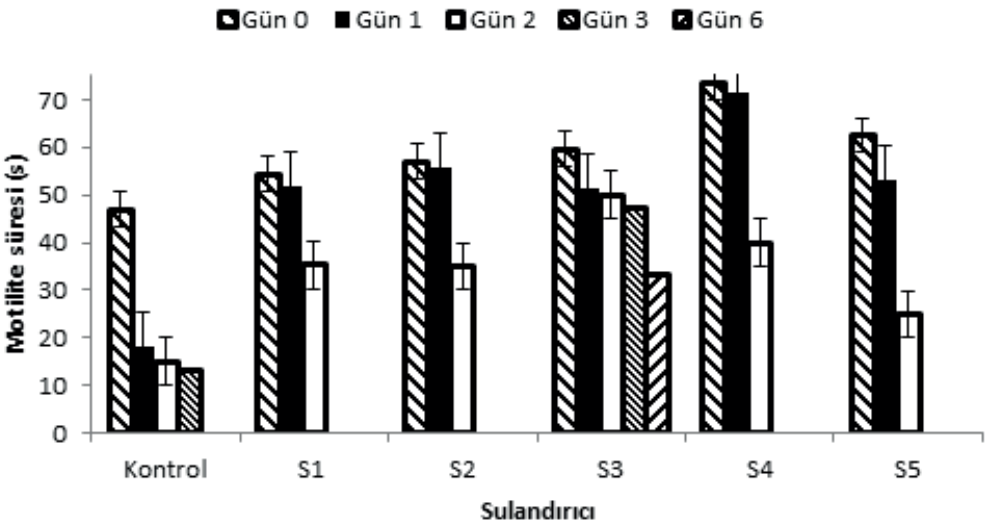
Table 2. Salmonidlerde yapılan çalışmalar

Tür	Sperm hacmi (ml)	pH	Spermatokrit (%)	Sperm yoğunluğu ($\times 10^9$)	Araştırmacı
Oncorhynchus mykiss				8,9	Ciereszko and Dabrowski [14]
Salmo trutta caspius			28,8-45,6	6,02	Hajirezaee ve ark. [15]
Salmo trutta macrostigma	13,93±0,84	7,53±0,20	55,6 (24-72)	0,8 – 5,3	Bozkurt ve ark. [16]
Salmo cettii	0,2-5		63,2	6,5-14,7	Iaffaldano ve ark. [17]
Oncorhynchus mykiss	7,33±0,18	7,17±0,34	40,00±0,18	3,81±0,24	Kocabaş and Kutluyer [3]
Salmo rizeensis	7,00±0,25	7,76±0,22	55,33±0,24	9,27±0,56	Kutluyer and Kocabaş [4]
Salmo coruhensis	6,67±0,53	7,71±0,14	50,00±0,35	6,18±0,52	Kocabaş and Kutluyer [5]
Salmo coruhensis	6,78±0,12	7,89±0,14	49,87±0,24	6,25±0,29	Kutluyer [19]
Oncorhynchus mykiss	7,49±0,36	7,36±0,24	45,25±0,39	4,58±0,22	Kutluyer [19]
Salmo rizeensis	7,25±0,15	7,80±0,15		9,67±0,43	Kutluyer ve ark.[18]
Salmo coruhensis	6,76±0,23	7,70±0,12		6,24±0,22	Kutluyer ve ark. [18]
Oncorhynchus mykiss	7,35 ±0,19	7,27±0,41		3,95±0,21	Kutluyer ve ark. [18]
Oncorhynchus mykiss	8,50±4,24	7,26±0,10	31,64±4,38	7,26±0,18	Bu çalışma
Salvelinus fontinalis	4,25±1,26	7,28±0,15	58,20±2,35	8,34±0,34	Bu çalışma

Çalışmada en iyi sonuçlar 3. sulandırıcıdan elde edilmiş ve 6 günden sonra motilite gözlenmemiştir. Motilite süresi ve yüzdesi gün geçtikçe düşmüştür (Şekil 1 ve 2).



Şekil 1. Farklı sulandırıcılarla muhafaza edilen gökkuşağı alabalığının sperminin günlük motilite yüzdeleri (%)



Şekil 2. Farklı sulandırıcılarla muhafaza edilen gökkuşağı alabalığının sperminin motilite süreleri (s)

Şimdiye kadar, gökkuşağı alabalığının sperminin kısa süreli muhafazasıyla ilgili çok sayıda çalışma yapılmıştır [12, 20-28]. Sperm oksijen desteğiyle daha uzun süreler muhafaza edilmiştir. Bu çalışmada sperm 6 gün muhafaza edilebilmiş ve bu süre spermin sağımının sezon sonunda yapılmış olmasından olabilir.

SONUÇ VE ÖNERİLER

Sonuç olarak, en iyi sonuçlar glukoz ve DMSO bazlı sulandırıcıdan elde edilmiştir. Daha iyi sonuçlar antioksidan, antibiyotik gibi maddelerin sulandırıcılara ilave edilmesiyle elde edilebilir. Bu çalışma, uzun süreli sperm muhafazası çalışmaları ve anaç yönetimi için yararlı olacaktır.

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Kaynak Alabalığının *Salvelinus fontinalis* Semeninin Bakteriyel Florasının Belirlenmesi

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Özet
Kaynak alabalığının semeninin bakteriyel florasını belirlemek için denemeler kurulmuştur. Semen örnekleri balıklardan toplanmış ve bakteriyel floranın belirlenmesi için standart mikrobiyoloji teknikleri uygulanmıştır. Semen örnekleri fizyolojik solusyonla (NaCl:%0,85) seri bir şekilde sulandırılmıştır. Her bir örnekten 0,1 ml, Plate Count Agar (PCA) (Toplam Bakteri Sayısı), Rose Bengal Agar (RBC) (Maya-küf sayısı), VRBD (*Enterobacteriaceae* sayısı) ve Mannitol Salt Agar'a (MSA) (*Micrococcus/Staphylococcus* sayısı) ekim yapılmıştır. *Micrococcus/Staphylococcus* grup bakteri (%11,11) kaynak alabalığı semeninde (*S. fontinalis*) sayılmıştır. Semendeki toplam bakteri sayısının 10^3-10^5 cfu ml^{-1} arasında değiştiği belirlenmiştir.

Anahtar kelimeler: Bakteri sayısı, kaynak alabalığı, *Salvelinus fontinalis*, semen.

Abstract
Experiments were designed to evaluate bacterial flora in semen culture of brook trout (*Salvelinus fontinalis*). Herein, semen samples were collected from fish and standard microbiology techniques were processed for bacterial flora. The samples were serially diluted in physiological saline (NaCl: 0.85%). Aliquots of 0.1 ml of each dilution were spread-plated onto Plate Count Agar (PCA) (Total Bacteria Count), Rose Bengal Agar (RBC) (Yeast-Mold Count), VRBD (*Enterobacteriaceae* count) and Mannitol Salt Agar (MSA) (*Micrococcus/Staphylococcus* count). *Micrococcus/Staphylococcus* group bacteria (11.11%) were counted from brook trout (*S. fontinalis*) semen. Total bacteria count varied between 10^3-10^5 cfu ml^{-1} in semen.

Keywords: Bacterial count, brook trout, *Salvelinus fontinalis*, semen

GİRİŞ

Semenin bakteriyel kontaminasyonunun belirlenmesi, döllemede hastalıkların yayılma riskinden dolayı önemlidir [1]. Bakteriyel kontaminasyon uygun olmayan sperm toplama yöntemlerinden kaynaklanabilir [2]. Sperm motilitesi ve yaşayabilirliği, dölleme, kısa sureli ve uzun süreli muhafaza işlemlerinde anaerobik koşullar ve mikrobiyal kontaminasyon sonucunda azalabilir [3]. Dahası, bakteri yükünün artması oksijen tüketimine ve hücredışı enzimlerin salgılanmasına neden olabilir [3,4]. Bu nedenlerden dolayı, patojenik kontaminasyon ve bakteriyel bozulmanın azaltılması, yüksek sperm kalitesi ve dölleme başarısının arttırılması için gereklidir [2].

Kaynak alabalığı, *Salvelinus fontinalis*, yetiştiricilik potansiyeli, ekonomik değeri ve tüketici talebinden dolayı dünyada önemli balık türlerinden birisidir. Sperm kalitesi, dölleme başarısı ve açılma oranını etkilediğinden dolayı önemlidir. Bu nedenlerden dolayı, bu çalışmada kaynak alabalığının semeninin bakteriyel florasının belirlenmesi amaçlanmıştır.

MATERYAL VE YÖNTEM

Anaçlar (2 yaş ve üstü) Sürmene Deniz Bilimleri Fakültesi'nden temin edilmiştir. Anaçlar 2-fenoksietanol (0,6 ml L^{-1}) ile bayıltıldıktan sonra abdominal masaj yöntemiyle sperm toplanmıştır. Sperm toplamada, kontaminasyonu ve aktivasyonu önlemek için sperme su, kan, üre ve fekes karışmamasına dikkat edilmiştir. Sperm 50 ml'lik tüplere sağılmış ve analiz edilene kadar buz üstünde tutulmuştur. 18 anaçtan alınan örnekler 3 tekrarlı olarak mikrobiyolojik analizlere tabi tutulmuştur.

Semen örnekleri fizyolojik solusyonla (NaCl:%0,85; 10^{-1}-10^{-7}) seri bir şekilde sulandırılmıştır. Her bir örnekten 0,1 ml yayma plak yöntemine göre, Plate Count Agar (PCA) (Toplam Bakteri Sayısı), Rose Bengal Agar (RBC) (Maya-küf sayısı), VRBD (*Enterobacteriaceae* sayısı) ve Mannitol Salt Agar'a (MSA) (*Micrococcus/Staphylococcus* sayısı) ekim yapılmıştır. Toplam bakteri sayısı ve *Enterobacteriaceae* sayısı için 37°C'de 48 saat, Maya-küf sayısı için 25°C'de 5 gün, *Micrococcus/Staphylococcus* sayısı için 37°C'de 36-48 saat inkübasyon sağlanmıştır. Sayımlar 3 ve 5'lik dilüsyonlarda yapılmıştır.

BULGULAR VE TARTIŞMA

Kaynak alabalığının semeninde yapılan sayımlara göre *Micrococcus/Staphylococcus* grup bakteri (%11,11) kaynak alabalığı semeninde (*S. fontinalis*) sayılmıştır. Semendeki toplam bakteri sayısının 10^3-10^5 cfu ml^{-1} arasında değiştiği belirlenmiştir. *Enterobacteriaceae* ve Maya-küf sayısı belirlenmemiştir.

Yapılan literatür incelemesinde semen ve yumurta mikrobiyolojisi ile ilgili sınırlı sayıda araştırmaya rastlanmıştır. Silver barb (Barbodes gonionotus) sperminde yapılan bir araştırmada hayvansal orijinli kontamine semende toplam heterotrofik bakteri sayısı $5.03 \pm 1.84 \times 10^4$ CFU mL^{-1} bulunmuştur [11]. Çalışmada elde edilen sonuçlar benzerlik göstermektedir. Balık yumurtası ile ilgili olarak yapılan bir araştırmada [7] Yayın balığı yumurtalarında toplam bakteri sayısının $7x10^3$ ile $2x10^5$ kob/g arasında olduğu bildirilmektedir. Bu araştırma sonuçları da çalışma verileri ile uyum göstermektedir. Patır ve ark. [10] tarafından yapılan araştırmada, kullanılan havyar örneklerinin, toplam mezofilik aerobik bakteri sayısı incelendiğinde, ham yumurtada ortalama olarak 2,05 $\log_{10}$ kob/g olan bakteri bulunmuştur. Bu sonuç çalışma sonuçları ile benzerlik göstermektedir.

Göktan [8] tarafından belirtildiğine göre Koliformlar

çeşitli gıdalarda bulunabilen aranan bakterilerdir ve temiz sularda avlanan balıklarda bulunmazlar. Çalışmada da Koliformların bir grubu olan *Enterobacteriaceae*'ya rastlanmamıştır.

Jay [9]'a göre *Staphylococcus*'lar doğada yaygın olarak bulunmalarına rağmen deniz ürünleri doğal olarak *Staphylococcus* mikroorganizmalarını içermez. Çalışmada incelenen örneklerin (%11.11)'inde *Staphylococcus/Micrococcus* belirlenmiştir. Benzer olarak, [12]'de yapılan araştırmada incelenen 68 adet Osetra, Sevruga, Beluga ve İran havyar örneğinin yalnız birinde *Staphylococcus aureus*'un tespit edildiği bildirilmiştir.

Göktan ve Jay [8,9] belirttiğine göre küfler genellikle toprak orijinli olup, balıkların avlandığı anda sudan ya da avlanma sonrasında bulaşabilmekte ancak su ürünlerinin florasında bulunmamaktadır. Çalışmada da örneklerde küf-maya bulunmamıştır. Bu durum semenin elde edilmesi sırasında herhangi bir bulaşının olmadığı ve sonraki işlemlerde de hijyenik olarak çalışıldığının bir göstergesi olabilmektedir.

Sperm motilitesi ve süresi anaerobik koşullarda mikrobiyal kontaminasyondan dolayı azalabilir [5]. Bakterinin salgıladığı enzimler hücre yapısının bozulmasına ya da ölümüne neden olmaktadır [6]. Sperm toplama yöntemi, döllemede ve muhafaza işlemlerinde siteril olmayan solusyonların kullanılması, muhafaza süreci mikrobiyal kontaminasyona neden olabilmektedir [5, 6]. Bu çalışmada elde edilen sonuçlar, bakteriyel floranın sperm kalitesini etkileyebilecek seviyede olmadığını göstermiştir.

SONUÇLAR VE ÖNERİLER

Sonuç olarak, çalışmadaki koşullar ve sağım yönteminin hijyen ve sanitasyon açısından uygun olduğu belirlenmiştir. Bu çalışma, dölleme, uzun süreli sperm muhafazası çalışmaları ve anaç yönetimi için yararlı olacaktır.

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Comparative Toxicity Of Paraquat And 2, 4-Dichlorophenoxy Acetic Acid In Adult Artemia Franciscana

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Abstract
Herbicides are being used widely in agriculture and aquaculture for controlling noxious weeds. Paraquat and 2, 4-Dichlorophenoxyacetic acid (2,4-D) have been the most widely used herbicide during the past three decades. Toxicological properties of Paraquat are attributed to its ability to produce reactive oxygen species such as superoxide anion that may directly or indirectly cause cell death. 2,4-Dichlorophenoxyacetic acid (2,4-D) is a broad-leaf, systemic, phenoxy herbicide used as the active ingredient in several commercially available aquatic herbicide products. Bioassay technique has been the cornerstone of programs on environmental health and chemical safety. The application of environmental toxicology studies on non-mammalian vertebrates is rapidly expanding. So the present study investigated the acute toxicity of Paraquat and 2,4- Dichlorophenoxy acetic acid (2,4-D) as aquatic ecosystems pollutants on Artemia franciscana. Artemia is one of the most suitable test organisms available for ecotoxicity testing and research and most commonly used live food in aquaculture. Acute toxicity (48 h LC50) of two herbicides (Paraquat, 2, 4-dichlorophenoxy acetic acid) was determined. A. franciscana exposed to Serial concentrations of both mentioned herbicides. Mortalities at 12, 24, 36 and 48 hours after exposure were recorded and LC50 were calculated using Probit software. The results obtained indicate that the acute toxicity of these herbicides is significantly different in adult A. franciscana. The lethal concentration of Paraquat and 2,4-D were calculated 2.701, 14.475 mg/L in A. fransiscana respectively. So The LC50 of two examined herbicides was significantly different and the mortality rate was increased by increasing exposure time. Finally, these data support the hypothesis the possible risks associated with the presence of herbicides particularly Paraquat residues in the aquatic animals and their environment.

Keyword: Artemia franciscana, herbicides, toxicity

INTRODUCTION

Unfortunately, most aquatic ponds in some country (i.e.: Iran) are located close to agricultural areas. Large amounts of herbicides are commonly used in agricultural practices to control unwanted weeds [1]. However, they are of ecological concern since they are toxic to non-target species at low concentrations [2]. Herbicides may reduce environmental quality and influence essential ecosystem functioning by reducing species diversity and community structures, modifying food chains changing the stability of ecosystems. Utilization of herbicides in agricultural purposes represents 49% of total consumption of agrochemicals in the world [3].

Paraquat is one of the most popular herbicide, which acts fastly on a broad spectrum of weeds and it has been shown to be a highly toxic compound for humans and animals, and many cases of acute poisoning and death have been reported over the past few decades. It has a long half-life in the environment and poses a threat to aquatic organisms and human health because of its bioavailability, resistance to microbial degradation [4]. Severe Paraquat poisoning is characterized by multi organ involvement, mainly the lungs, kidneys, liver, myocardium, and adrenal cortex. Absorbed paraquat is distributed via the blood to all organs and tissues of the fish. Due to the lipophilic property of this herbicide, it accumulates mainly in fatty tissues [5].

2,4-Dichlorophenoxyacetic acid (2,4-D) is widely used in agriculture as herbicide/pesticide, plant growth regulator and fruit preservative agent [2] and [6]. It progressively accumulates in the environment including surface water, air and soil. It could be detected in human food and urine, which poses great risk to the living organisms. It has a high water solubility and low soil binding affinity, increasing its transport to aquatic environments [6]. In addition, 2,4-D is widely used by federal and private agencies as an aquatic herbicide for the control of invasive aquatic plants in lakes, ponds, and natural waterways. It is used in its ester, acid, and amine salt formulations globally; but in aqueous environments it is typically found in its free anion form through either dissociation (amine salts) or hydrolyzation (ester forms) [7].

The brine shrimp Artemia is zooplankton, like copepods and daphnia, which are used as live food in the aquarium trade and for marine finfish and crustacean larval culture [8], [9] and [10]. Artemia is subdivided into six generally recognized bisexual species and a large number of parthenogenetic populations, is characterized by common features such as adaptability to wide ranges of salinity (5-250 g L^{-1}) and temperature (6-35°C), short life cycle, high adaptability to adverse environmental conditions, high fecundity, bisexual/parthenogenetic reproduction strategy (with nauplii or cysts production), small body size, and adaptability to varied nutrient resources as it is a non-selective filter feeder [8], [9] and [11]. There are few studies on comparison of different herbicide toxicity in aquatic animals [12]. The aim of the present work is to assess the adverse effect of of Paraquat and 2, 4-Dichlorophenoxy Acetic Acid in Adult *Artemia franciscana.*

MATERIALS AND METHODS

Standard artificial seawater of (35 ± 1‰) was used for the culture to *Artemia* as well as for the toxicity test. Cysts were hatched in seawater (38 g/l), at 28 °C, under conditions of continuous illumination and aeration [12]. Then, adult Artemia were transferred into a multi-well test plate with the respective concentrations of the tested formulations, prepared in artificial seawater. The toxicity of the two herbicides on *Artemia fransiscana* adults was tested at 12, 24, 36 and 48 h of exposure. The rate of toxicity, based on LC50, was calculated. The lethal concentration (LC50) was tested by exposing 30 adults *Artemia fransiscana* per group (in triplicates), the control group was kept in experimental water

without herbicides with all of the other conditions kept constant. Then the adult Artemia was exposed to 4-6 sequential rising concentrations of each herbicide (in triplicates) in a way that zero and 100% mortality yield after 48 hours in selected concentrations. The mortality rate was recorded every 6 hours and until 48 hours.

The concentration of herbicides to induce 10-100 percent mortality was estimated after 12, 24, 36, and 48 hours using probit software version 1.5 designed by U.S. EPA [13].

ferent life stages of *A. salina* to several phenolic compounds.

Table 1: Experimental design table: concentration range tested on the adult *A. franciscana*

Tested herbicides	Concentration range (mg/L)	Number of treatments	Number of replicating	Total exposed Artemia
Paraquat	0.6, 1.25, 2.5, 5, 10, 20, 40	7	3	30
2, 4 - D	0.3, 0.6, 2.5, 5, 25, 50, 100, 200	8	3	30

Table 2: Specifications of the survey herbicides

Herbicide	Chemical Name	Supplier	Purity Rate	Acute Oral LD50 For Rat	Statue
Paraquat	1,1-dimethyl-4,4‘-bipyridinium	Aria Shimi Co, Iran	20%	129-157 MG/KG	Water soluble green liquid.
2, 4 – D	2-(2,4-dichlorophenoxy)-acetic acid	Shimagro Co, Iran	67.5%	2100 MG/KG	Water-soluble brown liquid

RESULTS AND DISCUSSION

The Artemia mortality rate following the exposure to increasing concentrations of herbicides after 12, 24, 36, and 48 hours showed that the higher the herbicide concentration, the greater the mortality rate. 48 hours LC50 value was calculated at 2.701and 14.475 mg/l in *Artemia fransiscana.* In this study both tested herbicides were toxic for *A. fransiscana* but Paraquat was more toxic than 2, 4 – D.

In Khuzestan province of Iran, most fish ponds are built close to agricultural areas with shared water sources [1]. Water contamination by agricultural herbicides is a potential threat to productivity and a major cause of fish mortality. The main objective of this study was to investigate the effects of sub-lethal concentrations of paraquat and 2, 4 – D on adult *Artemia fransiscana.* The toxicity of various echotoxicants such as herbicides and their detrimental consequence on aquatic animals was mostly assayed by 48h LC50 in bio indicators. The results show differences toxicity varied between the two herbicides which used in our experiment. These results are in agreement with those reported in the literature for crustaceans [14] and [15] and pointed out the resistance of the two Artemia species to acute exposure to these herbicides. Among the evaluated herbicides Paraquat was more toxic than 2, 4 – D.

Besides, the acute toxicity (96 h LC50) of the herbicide paraquat for *Oreochromis niloticus* was 12.25 mg l-1 [16]. Deivasigamani et al. [12] reported that common carp weighing 300-400 g died within 15 min after exposure to paraquat at the concentration of 100 ppm, but they did not describe the source of the test chemical [12]. Based on the findings, the amount of lethal concentration of 2,4-D for 50 percent of Artemia was determined to be 14.475 mg/l after 48 hours. In toxicity studies, the sensitivity of organisms can be different, even using the same product [17]. The results indicated although toxicity of two tested herbicides was different for *A. fransiscana*, their toxicity revealed positive correlation to herbicide concentration and exposure duration. Alishahi et al., [1] have reported that toxicity of herbicides in *L. esocinus*, and the mortality rate of exposed fish to herbicides enhanced either by increasing herbicides concentration or duration of exposure like our result too. Barahona and Sa´nchezFortu´n [18] reported on the exposure of three different life stages of *A. salina* to several phenolic compounds. These data show that animals of clearly defined age classes must be used for toxicity assays; since the toxicity expression is directly influenced by the development stage of the test organisms [18].

For sustainable agricultural activity, especially in areas that fish ponds and agriculture farms use the same water sources, it is highly recommended to use Paraquat as an alternative to 2,4-dichlorophenoxy-acetic acid.

CONCLUSION

This study supports the study’s hypothesis because sub-lethal concentrations of paraquat had significant effects adult *Artemia franciscana*. Continuous exposure of adult *A. franciscana* to sub-lethal concentrations of paraquat leads to great mortality.

Also, for unwanted weeds, especially in areas that fish ponds and agriculture farms use the same water sources, it is highly recommended to use 2, 4-Dichlorophenoxy Acetic Acid as an alternative to Paraquat.

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Nay-Band Coastal - Marine National Park; Missed Opportunity for Iran

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Abstract

Nayaband coastal protected area with approximately 49815 ha area, south of Iran, was the best opportunity to became the first and only Iranian coastal-marine national park due to its special geographical location and ecological characteristics. However, with the establishing of natural gas extraction facilities in its neighboring as the largest and most important energy zone in Iran, since 1997, and the emergence of extensive environmental impacts of the project activities, today this opportunity should be considered forever to be lost. In this paper, the criteria for site selection of coastal-marine national parks have been determined through a literature review and then the ecological characteristics of the study area compared with these criteria. The most important criteria for site selection of coastal-marine national parks are biodiversity (including both species and habitat diversity) and ecological integrity. Based on the results Nayband coastal protected area benefits a diversity of habitats including mangrove forest habitats, river estuaries, creeks, coral reefs, small gulfs, tidal zones, sandy and rocky beaches, coastal lagoons and terrestrial savanna likes habitats. This diverse habitats encompass more than 300 species including plants, mammalian, aquatic and terrestrial birds, amphibians, reptiles, fishes, shrimps, lobsters, oysters, gastropods and corals species, and maybe more unknown species from invertebrates and insects. Overall, the study area in terms of biodiversity criteria could earn points for assigning the title of "National Park". Nevertheless, unfortunately, because of the development and industrial activities in the onshore and offshore, the second criteria, ecological integrity, has been affected drastically. Disturbing upstream-downstream surface runoff, blocking migratory corridors, receiving air and water pollutants, constructing bridges and closing or tightening water entrance of creeks have been led to the deterioration of ecological integrity. That is, the opportunity of establishing the first and only Marine – Coastal National Park of Iran has been lost.

Keywords: Asalouyeh, Biodiversity, Coastal-marine National Park, Mangrove

INTRODUCTION

Biodiversity conservation in Iran, in its modern form, was provided since 1967 with the allocation of parts of the country to national parks (at that time, called wildlife parks) and protected areas with defined definitions. At that time, the proposal for the establishment of two national parks and fifteen protected areas as the first group of protected areas of Iran was approved by the Supreme Council of the Hunters and the Hunting Supervision. So far in Iran, 30 national parks with a total area of 2056577 hectares, 37 national natural monuments with a total area of 40,939 hectares, 45 wildlife sanctuaries with a total area of 5864657 hectares and 170 protected areas with a total area of 9795013 hectares, have been established totally cover 10.77% of Iran's territory [1].

By definition A marine national park is a park consisting of an area of sea (or lake) sometimes protected for recreational use, but more often set aside to preserve a specific habitat and ensure the ecosystem is sustained for the organisms that exist there [2] and [3]. The official definition of "National Park" according to Iran's DOE is"Natural areas with relatively large extent and special characteristics with national significance in terms of geology, ecology, geography and landscape, with the aim of preserving the biological and natural conditions, Improvement of the plants and animal species and habitats, as well as recreational aspects. National parks are the right places for educational, research and tourism activities in nature. In the fundamental protection of biodiversity, genetic resources, ecological integrity and prospects, activities related to exploitation and residential uses are not permitted in these areas. For this reasons, for national parks, legal protection is projected to be more robust than other protected areas"[4].

Although, there are abundant coastal areas and lagoons with various titles of the Wildlife Refuge and Protected Area in the list of Iran's DOE protected areas, but due to the wide extent of the 5780 km coast of Iran, the lack of a title called Coastal-Marine National park is considerable. Therefore, Iran's DOE from the outset was looking for eligible coastal areas for the purpose of assigning the title of National Coastal-Marine Park. Considering the ecological characteristics of the Nayband beach, this region was the best candidate for this title and a good choice. This area is located on the southern coasts of Iran and the eastern part of Bushehr province. In the natural landscape of this area, there are numerous harbors, mangroves, sandy beaches and ancient trees of the temples, the plains of the deep and rocky valleys for them has been identified as a Protected Area since 1977.

MATERIALS AND METHODS

Study area

Nayband coastal - marine protected area located in the northern coast of Persian Gulf, 320 km southeast of Bushehr province, in the geographical location of 52° 27' 28" to 52° 52' 20" longitude and 27° 09' 25" to 27° 28' 15" latitude. This area has 49815 hectares area out of which 27815 ha is marine and the rest 22000 ha is land [5]. Figure 1 shows the boundary of the protected area in the region. The altitudinal range of this area differs from zero to 124 m above sea level. The mean annual precipitations are 94 mm and mean annual temperature is 28 °C. Overall, this area has a warm extra arid climate.

National parks site selection criteria

According to carry out literature review and mainly based on IUCN guidelines[6], there are two main criteria for site selection of national parks including marine – coastal parks; i)Biological Diversity (Biodiversity) and ii) Ecological Integrity. Biodiversity includes both habitat and species diversity. Ecological integrity means "The ability of

support and maintain ecological processes (energy, material and gene flows)" and/or "The ability of support and maintain diverse community of organisms [7], [8] and [9].

Data collection and processing

Data on both criteria collected through literature review of existing published and unpublished documents specially the reports of comprehensive management plan of Nayband protected area found in Bushehr provincial Department Of Environment [10].Then, collected data were controlled and completed or updated in some cases by field surveys and interviewing with local or national experts.

Data analysis and decision-making

Making decision on whether the study area has eligible for assigning the title of national park or not, requires the comparison of its ecological characteristics versus above-mentioned criteria one by one. Meanwhile, as we did not have data on the quantity of both ecological characteristics and site selection criteria, we did this comparison qualitatively and subjectively, for instance we used species richness in substitution of species diversity indexes such as Shannon-Weaner or Simpson etc. we also used a qualitative base (excellent, good, weak, etc) for the existing situation of ecological integrity.

Figure 1. Location of the study area

RESULT AND DISCUSSION

Biological Diversity (Biodiversity)

According to the literature carried out, study area, Nayband coastal protected area, benefits a diversity of habitats including mangrove forest, river estuaries, creeks, coral reefs, small gulfs, tidal zones, sandy and rocky beaches, coastal lagoons and terrestrial savanna-likes habitats. This diverse habitats encompass more than 300 species including 121 plants, 17 mammalian, 50 aquatic and 60 terrestrial birds, 2 amphibians, 16 reptiles, 54 fishes, 6 shrimps, 6 lobsters, 7 oysters (almost bivalves), 9 gastropods, 5 corals species, and maybe more unknown species from invertebrates and insects. Overall, the study area in terms of first criteria, biodiversity, could earn points for receiving the title of the national park.

Ecological integrity

Unfortunately, because of the development and industrial activities in the onshore and offshore, the second criteria, ecological integrity, affected drastically. Gas extraction and refinery facilities have been led to upstream – downstream surface water flow regime be disturbed and disconnected drastically. Constructing bridges and closing or tightening water entrance of creeks have been led to tidal process not be in its natural form.Infrastructure development (airport, roads, dumping areas, buildings, pipe routs, etc) have been led to blocking and missing migratory corridors to and from this protected area.Chemical pollutants flows from offshore-developed lands to coastal areas and creeks have been led to habitats and species diversity and richness diminished.

CONCLUSION

Nay-Band protected area has been the best candidate for receiving the title of first and only marine-coastal national park of Iran, as our research revealed. Although, this area upgraded to National park since2004 for its habitat and species diversity, but may diminish to a wildlife refuge or protected area if current threats for its ecological integrity continue. Both gas extraction and biodiversity conservation in the study area are important at national level, but, in the competition between economy and ecology, the economy has been preferred in this area. Considering the magnitude and persistence of the effects of the development of gas extraction and refining facilities, it seems that any attempt to restore the ecological conditions of the region to initial

situation would be fruitless. That is, the opportunity of establishing the first and only Marine – Coastal National Park of Iran has been lost.

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Comparative Toxicity of Paraquat and 2, 4-Dichlorophenoxy Acetic Acid in Adult *Artemia franciscana*

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Abstract
Herbicides are being used widely in agriculture and aquaculture for controlling noxious weeds. Paraquat and 2, 4-Dichlorophenoxyacetic acid (2,4-D) have been the most widely used herbicide during the past three decades. Toxicological properties of Paraquat are attributed to its ability to produce reactive oxygen species such as superoxide anion that may directly or indirectly cause cell death. 2,4-Dichlorophenoxyacetic acid (2,4-D) is a broad-leaf, systemic, phenoxy herbicide used as the active ingredient in several commercially available aquatic herbicide products. Bioassay technique has been the cornerstone of programs on environmental health and chemical safety. The application of environmental toxicology studies on non-mammalian vertebrates is rapidly expanding. So the present study investigated the acute toxicity of Paraquat and 2,4- Dichlorophenoxy acetic acid (2,4-D) as aquatic ecosystems pollutants on *Artemia franciscana*. Artemia is one of the most suitable test organisms available for ecotoxicity testing and research and most commonly used live food in aquaculture. Acute toxicity (48 h LC50) of two herbicides (Paraquat, 2, 4-dichlorophenoxy acetic acid) was determined. *A. franciscana* exposed to Serial concentrations of both mentioned herbicides. Mortalities at 12, 24, 36 and 48 hours after exposure were recorded and LC50 were calculated using Probit software. The results obtained indicate that the acute toxicity of these herbicides is significantly different in adult *A. franciscana*. The lethal concentration of Paraquat and 2,4-D were calculated 2.701, 14.475 mg/L in *A. fransiscana* respectively. So The LC50 of two examined herbicides was significantly different and the mortality rate was increased by increasing exposure time. Finally, these data support the hypothesis the possible risks associated with the presence of herbicides particularly Paraquat residues in the aquatic animals and their environment.

Keyword: *Artemia franciscana*, herbicides, toxicity

INTRODUCTION

Unfortunately, most aquatic ponds in some country (i.e.: Iran) are located close to agricultural areas. Large amounts of herbicides are commonly used in agricultural practices to control unwanted weeds [1]. However, they are of ecological concern since they are toxic to non-target species at low concentrations [2]. Herbicides may reduce environmental quality and influence essential ecosystem functioning by reducing species diversity and community structures, modifying food chains changing the stability of ecosystems. Utilization of herbicides in agricultural purposes represents 49% of total consumption of agrochemicals in the world [3].

Paraquat is one of the most popular herbicide, which acts fastly on a broad spectrum of weeds and it has been shown to be a highly toxic compound for humans and animals, and many cases of acute poisoning and death have been reported over the past few decades. It has a long half-life in the environment and poses a threat to aquatic organisms and human health because of its bioavailability, resistance to microbial degradation [4]. Severe Paraquat poisoning is characterized by multi organ involvement, mainly the lungs, kidneys, liver, myocardium, and adrenal cortex. Absorbed paraquat is distributed via the blood to all organs and tissues of the fish. Due to the lipophilic property of this herbicide, it accumulates mainly in fatty tissues [5].

2,4-Dichlorophenoxyacetic acid (2,4-D) is widely used in agriculture as herbicide/pesticide, plant growth regulator and fruit preservative agent [2] and [6]. It progressively accumulates in the environment including surface water, air and soil. It could be detected in human food and urine, which poses great risk to the living organisms. It has a high water solubility and low soil binding affinity, increasing its transport to aquatic environments [6]. In addition, 2,4-D is widely used by federal and private agencies as an aquatic herbicide for the control of invasive aquatic plants in lakes, ponds, and natural waterways. It is used in its ester, acid, and amine salt formulations globally; but in aqueous environments it is typically found in its free anion form through either disassociation (amine salts) or hydrolyzation (ester forms) [7].

The brine shrimp Artemia is zooplankton, like copepods and daphnia, which are used as live food in the aquarium trade and for marine finfish and crustacean larval culture [8], [9] and [10]. Artemia is subdivided into six generally recognized bisexual species and a large number of parthenogenetic populations, is characterized by common features such as adaptability to wide ranges of salinity (5-250 g L^{-1}) and temperature (6-35°C), short life cycle, high adaptability to adverse environmental conditions, high fecundity, bisexual/parthenogenetic reproduction strategy (with nauplii or cysts production), small body size, and adaptability to varied nutrient resources as it is a non-selective filter feeder [8], [9] and [11]. There are few studies on comparison of different herbicide toxicity in aquatic animals [12]. The aim of the present work is to assess the adverse effect of of Paraquat and 2, 4-Dichlorophenoxy Acetic Acid in Adult *Artemia franciscana.*

MATERIALS AND METHODS

Standard artificial seawater of (35 ± 1‰) was used for the culture to *Artemia* as well as for the toxicity test. Cysts were hatched in seawater (38 g/l), at 28 °C, under conditions of continuous illumination and aeration [12]. Then, adult Artemia were transferred into a multi-well test plate with the respective concentrations of the tested formulations, prepared in artificial seawater. The toxicity of the two herbicides on *Artemia fransiscana* adults was tested at 12, 24, 36 and 48 h of exposure. The rate of toxicity, based on LC50, was calculated. The lethal concentration (LC50) was tested by exposing 30 adults *Artemia fransiscana* per group (in triplicates), the control group was kept in experimental water without herbicides with all of the other conditions kept constant. Then the adult Artemia was exposed to 4-6 sequential rising concentrations of each herbicide (in triplicates)

in a way that zero and 100% mortality yield after 48 hours in selected concentrations. The mortality rate was recorded every 6 hours and until 48 hours.

The concentration of herbicides to induce 10-100 percent mortality was estimated after 12, 24, 36, and 48 hours using probit software version 1.5 designed by U.S. EPA [13].

Table 1: Experimental design table: concentration range tested on the adult *A. franciscana*

Tested herbicides	Concentration range (mg/L)	Number of treatments	Number of replicating	Total exposed Artemia
Paraquat	0.6, 1.25, 2.5, 5, 10, 20, 40	7	3	30
2, 4 - D	0.3, 0.6, 2.5, 5, 25, 50, 100, 200	8	3	30

Table 2: Specifications of the survey herbicides

Herbicide	Chemical Name	Supplier	Purity Rate	Acute Oral LD50 For Rat	Statue
Paraquat	1,1-dimethyl-4,4‘-bipyridinium	Aria Shimi Co, Iran	20%	129-157 MG/KG	Water soluble green liquid.
2, 4 – D	2-(2,4-dichlorophenoxy)-acetic acid	Shimagro Co, Iran	67.5%	2100 MG/KG	Water-soluble brown liquid

RESULTS AND DISCUSSION

The Artemia mortality rate following the exposure to increasing concentrations of herbicides after 12, 24, 36, and 48 hours showed that the higher the herbicide concentration, the greater the mortality rate. 48 hours LC50 value was calculated at 2.701and 14.475 mg/l in *Artemia fransiscana.* In this study both tested herbicides were toxic for *A. fransiscana* but Paraquat was more toxic than 2, 4 – D.

In Khuzestan province of Iran, most fish ponds are built close to agricultural areas with shared water sources [1]. Water contamination by agricultural herbicides is a potential threat to productivity and a major cause of fish mortality. The main objective of this study was to investigate the effects of sub-lethal concentrations of paraquat and 2, 4 – D on adult *Artemia fransiscana.* The toxicity of various echotoxicants such as herbicides and their detrimental consequence on aquatic animals was mostly assayed by 48h LC50 in bio indicators. The results show differences toxicity varied between the two herbicides which used in our experiment. These results are in agreement with those reported in the literature for crustaceans [14] and [15] and pointed out the resistance of the two Artemia species to acute exposure to these herbicides. Among the evaluated herbicides Paraquat was more toxic than 2, 4 – D.

Besides, the acute toxicity (96 h LC50) of the herbicide paraquat for *Oreochromis niloticus* was 12.25 mg l-1 [16]. Deivasigamani et al. [12] reported that common carp weighing 300-400 g died within 15 min after exposure to paraquat at the concentration of 100 ppm, but they did not describe the source of the test chemical [12]. Based on the findings, the amount of lethal concentration of 2,4-D for 50 percent of Artemia was determined to be 14.475 mg/l after 48 hours. In toxicity studies, the sensitivity of organisms

can be different, even using the same product [17]. The results indicated although toxicity of two tested herbicides was different for *A. fransiscana*, their toxicity revealed positive correlation to herbicide concentration and exposure duration. Alishahi et al., [1] have reported that toxicity of herbicides in *L. esocinus*, and the mortality rate of exposed fish to herbicides enhanced either by increasing herbicides concentration or duration of exposure like our result too. Barahona and Sa´nchezFortu´n [18] reported on the exposure of three different life stages of *A. salina* to several phenolic compounds. These data show that animals of clearly defined age classes must be used for toxicity assays; since the toxicity expression is directly influenced by the development stage of the test organisms [18].

For sustainable agricultural activity, especially in areas that fish ponds and agriculture farms use the same water sources, it is highly recommended to use Paraquat as an alternative to 2,4-dichlorophenoxy-acetic acid.

CONCLUSION

This study supports the study’s hypothesis because sub-lethal concentrations of paraquat had significant effects adult *Artemia franciscana*. Continuous exposure of adult *A. franciscana* to sub-lethal concentrations of paraquat leads to great mortality.

Also, for unwanted weeds, especially in areas that fish ponds and agriculture farms use the same water sources, it is highly recommended to use 2, 4-Dichlorophenoxy Acetic Acid as an alternative to Paraquat.

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The Status of Coral Reefs in The Larak Island, Persian Gulf, from 2012 to 2018

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Abstract

Coral reefs are one of the most important marine ecosystems around the world. This ecosystem is the breeding and living ground for vast of animals including corals, fish, mollusks and even sea turtles and dolphins. There is a disaster which is raising more and more by natural effects and more importantly by human origin. Global warming and consequently raising heat endangers the life of living organisms especially immobile ones. Coral reefs belong to the sessile animals that cannot move, migrate or defend themselves as strongly as advanced organisms. Different stressors such as thermal shock result in bleaching coral reefs so that the symbiont algae (zooxanthellae) does not return to the colony which ends to corals' death. Coral Reefs of the Persian Gulf are not the exception and they have been bleached severely during last few years. The study was done by direct observation and via SCUBA diving and photography. The Sea Surface Temperature (SST) data were achieved by NOAA satellite and they were analyzed by Microsoft Excel 2010. Typically, water temperature rises from March to middle of August and decreases again toward December. The most severe bleaching happened in August 2015 in Northern Larak Island while the water temperature was 32.60 °C. However, the water temperature was high even in January, February and March to 22.84 °C. The highest temperature during August 2017 (32.81 °C) was another bleaching peak for North and Eastern Larak Island corals. During this catastrophe in 2017, more than 90% of genus *Acropora* and more than 80% of genus *Porites* were bleached. There was a recovery status in bleached corals in 2018 but dead corals never recovered. Although there are resistant corals in the coral reef ecosystem, heat is a certain stress which can ruin the ecosystem.

Keywords: Coral bleaching, Larak Island, Heat shock

INTRODUCTION

Marine ecosystems provide valuable social - economic services; The sea moderates the Earth's climate through the absorption and storage of atmosphere carbon dioxide and it is the primary source of protein for one seventh of the world's population food [1]. Nevertheless, climate change is expected to have serious consequences for marine ecosystems that affect both the performance and structure in the sea environment [2].

A vast range of stressors including pollution, diseases, overfishing and climate change get many of coral communities away from coral ecosystems [3], [4] and [5]. The scleractinian population is going to reduce in response to various stressful factors including intensification of sea surface temperature around the world.

Tensions which result from climate change, are not equally tolerable among all species [3] and [6]. The species belong to genus *Porites* (Scleractinia: Poritidae) which are finger-like with small polyps show resistance against increasing of ocean temperatures. *Porites* individuals are found in all coral ecosystems around the world and some species of genus Porites show high levels of tolerance to salinity and temperature [7]. On the other hand, *Acropora* is another stony coral genus with small polyps that is structurally important and main maker of calcium carbonate skeletons in coral ecosystems [8]. Nevertheless, the species of this genus are sensitive and vulnerable to high temperatures and get severely bleached against stresses [9].

Coral bleaching is growing fast, and 40% loss of coral covers has been unprecedented for at least last 40 years [10]. The high levels of coral bleaching have increased over the past 20 years and this phenomenon is directly associated with extreme temperatures at sea [11] and [12].

Since there is a strong symbiotic relationship between photosynthetic zooxanthellae and corals, the coral bleaches when this relationship disintegrates due to some stresses [12] and [13]. The algae with high-temperature tolerance are more abundant in reefs that are heavily affected by climate change [14] that leads to less bleaching of corals.

Symbiodinium belong to clade D of phylogeny tree, known as the clade members that increase heat tolerance in their coral hosts, are found in the northwestern (Saudi Arabia) and northeastern (Iran) of the Persian Gulf [15] and [16].

On average, roughly 60-80% or even more than 80% of coral reefs are bleached in GBR (Great Barrier Reef of Australia) by 2016, and the difference in bleaching, in various parts, is attributed to the difference of coral taxa [17].

High temperature could be a tension by itself, in the Persian Gulf due to its semi-enclosed conditions, high evaporation and high salinity stress can have significant impacts on the creatures and ecosystems of this area. The highest known bleaching threshold has been observed in the Persian Gulf coral communities [18] and [19]. Despite the exceptional capacity of corals in the Persian Gulf to survive in high temperatures, compared to those in other regions, they are prone to bleach when the temperature exceeds the tolerance threshold [20] and [21]. However, in other regions, the same coral species usually bleach at temperatures above 32° C, while coral colonies in the Persian Gulf endure heat peaks more than 36° C [22] and [23]. The stony coral species of Persian Gulf, are considered to be resistant species in the world [19], which can be considered by many researchers and environmentalists [21].

Although there is little evidence that abnormal states of bleaching have permanent effects on organisms, it might be forever in the case of hot water coral populations [24].

Detailed studies can help to protect endangered species, especially the corals of Persian Gulf, in response to global warming.

MATERIALS AND METHODS

SCUBA diving

The study of corals' status and changes during 7 years was done by direct observation via SCUBA diving and photography.

SST Analysis

From January 2012 to April 2018 (more than 6 years), the monthly free Sea Surface Temperature (SST) anomaly (˚C) was achieved by satellite data. This dataset was downloaded monthly as csv files and analyzed by Microsoft Excel 2010. This product is a Multi-Scale Ultra-High Resolution (MUR). SST Analysis created by NOAA ERD and CoastWatch West Coast Regional Node, merged, multi-sensor L4, version 4.1 and by the resolution of 0.01 degree. Foundation SST analysis product is a part of the Group for High-Resolution Sea Surface Temperature (GHRSST) project. SST data were supported by CoastWatch website which were used on other previous studies such as Ramachandran et al. [25]. In order to download the nearest location to the stations (26˚ 53.240' N - 56˚ 20.135'E) (Station 1) and (26˚ 49.542' N - 56˚ 19.085'E) (Station 2), a script was written by Matlab (The MathWorks Inc., 2016, MATLAB and Statistics Toolbox 64-bit, Version 2016a, Release 2016a, Natick, Massachusetts, USA) to get the nearest four location of the station and averaged it for the cell. This average was used as the SST value of the station.

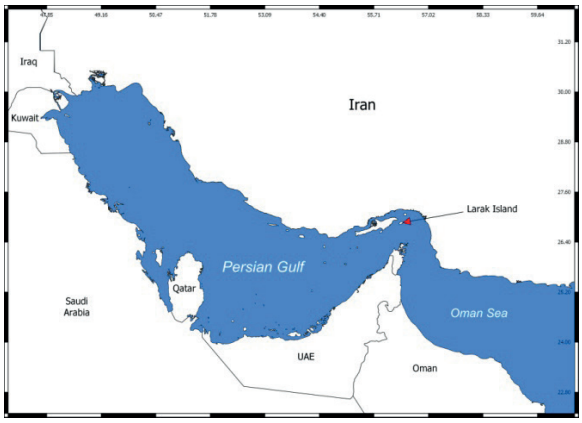

Figure 1. Map of Persian Gulf and Larak Island

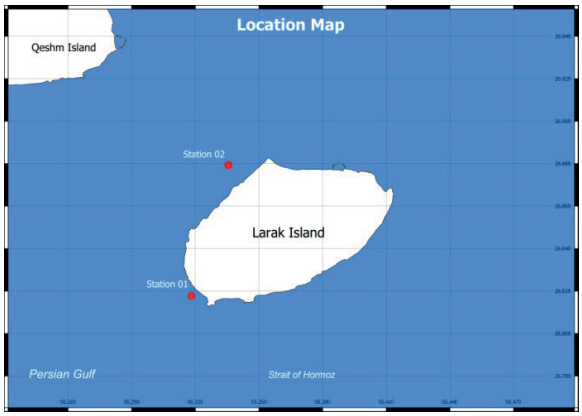

Figure 2. Map of Larak Island and desired stations on the North and Southwest.

RESULTS AND DISCUSSION

Sea Surface Temperatures (SST) in the Larak Island shows tolerances in different years from 2012 to 2018. As it is shown in Temp/Month diagram of Southwest (SW) of Larak Island (Figure 3), SST was the highest in mid-July 2017 (32.93 °C). Although the temperature decreased toward August 2017, it was the highest one comparison to other years. The year 2012 showed the lowest temperature during last winter and beginning of spring (22 – 23.80 °C), and it JUMPed to high temperatures in the summer (32.25 °C), nevertheless no special bleaching was shown during this year or moderate temperate in winter 2013 and heat decrease in summer 2013 may compensate the weaknesses. The sea surface temperature was the highest one in August 2015 in Northern (N) (Figure 4) and SW of Larak Island while the water temperature was 32.60 °C.

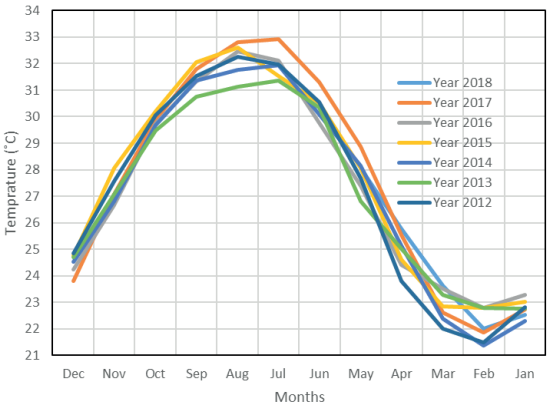

Figure 3. Sea Surface Temperature in the Southwest of Larak Island from 2012 to 2018

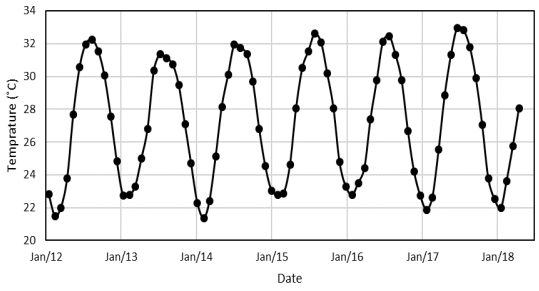

Figure 4. Sea Surface Temperature in the North of Larak Island from 2012 to 2018

However, the water temperature was high even in January, February and March to 22.84 °C. There was a sever bleaching in this period of time. Though the water temperature decreased in 2016, the heat decline was not as low as the status in which corals could recover again and high percentage of corals bleached. The other bleaching peak was during August 2017 while SST was 32.81 °C in the North and Eastern Larak Island corals. During high temperature in 2017, more than 90% of genus Acropora and more than 80% of genus Porites were bleached. There was a recovery status in 2018while the SST in the winter and summer was the lowest after 2012 and 2013 respectively, but dead corals never recovered.

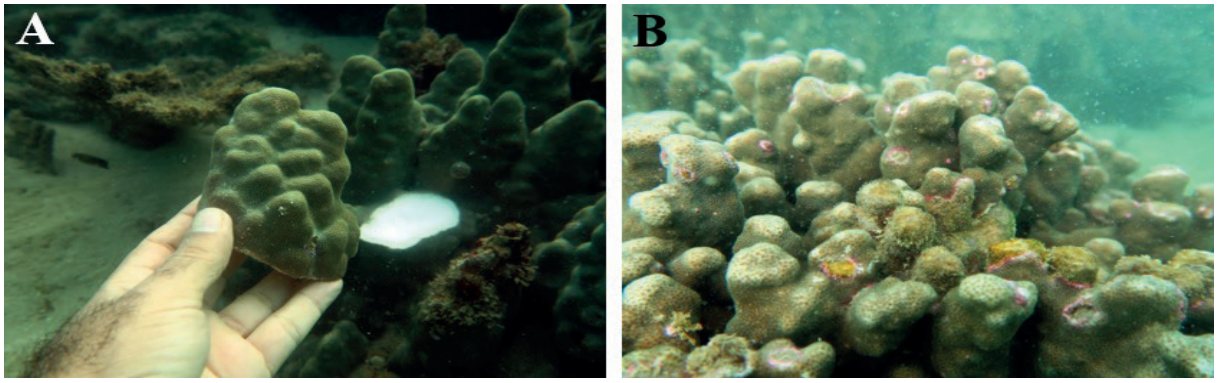

Figure 5. Colonies of genus Porites. January 2014, North of Larak Island(A,B)

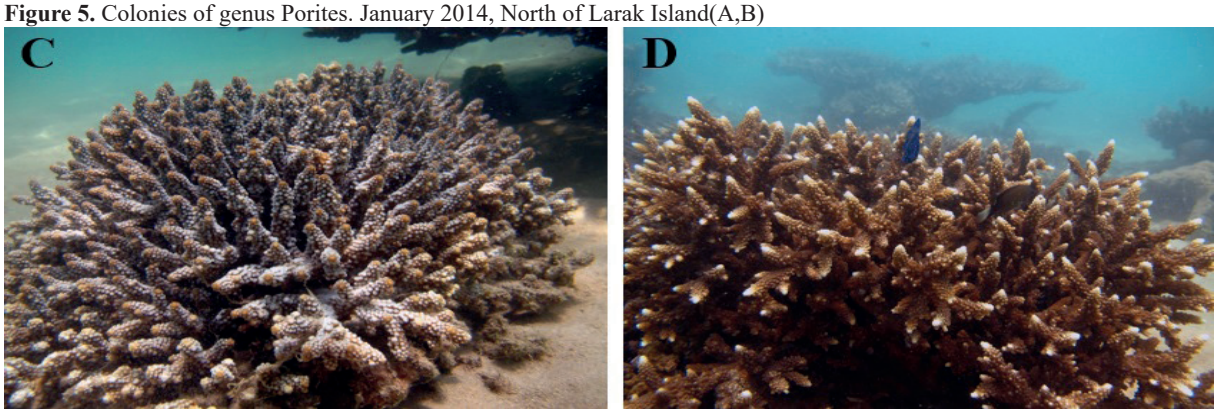

Figure 6. Colonies of genus Acropora. Left: April 2014 Southwest of Larak Island(C); Right: July 2014, North of Larak(D) Island

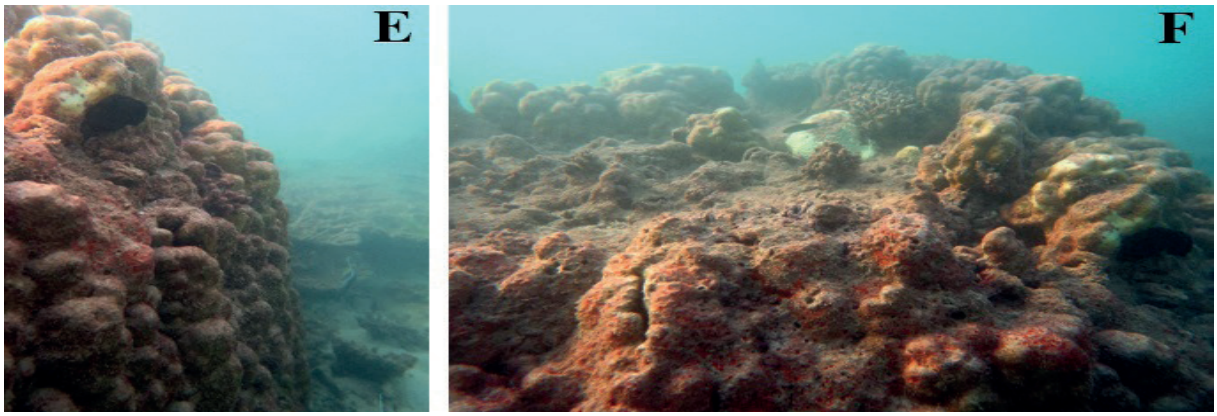

Figure 7. Dead colonies of genus Porites. May 2017 North(E) and Southwest of Larak Island(F)

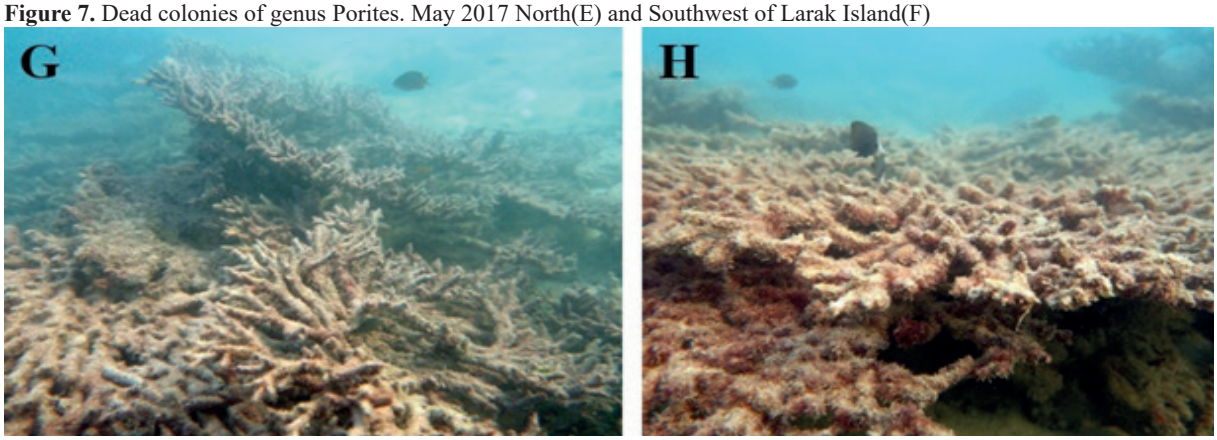

Figure 8. Dead colonies of genus Acropora. May 2017 North of Larak Island(G,H)

Climate models suggest that the sea temperature may eventually exceed the current thermal corrosion tolerance in almost all parts of the world and strongly affect the stability of coral reefs [12], [26] and [27]. Oculina *patagonica* bleaches every year, exactly in mid-June when the water temperature is above 24°C. Bleaching continues during spring and summer, where the water temperature reaches 32 °C and more than 80% of population has bleached [12] and [28].

Coral reefs are diverse group that show a wide range of responses to environmental changes, while some coral species may be reduced, others may be stable or even increased. In the past few decades, coral societies have experienced unprecedented changes [6] and [29]. In the Caribbean, for example, in the late 1970s and early 1980s, most of the structurally important acroporid corals were destroyed due to the white band disease [30]. Since then, the spread of some diseases, along with recent bleaching events and other biological disorders, has led to a high mortality rate in other reef-building species such as *Orbicella* spp. [31] and [32].

In the Bay of Thailand, *Porites lutea* tolerates about 10-30 ppt of salinity in diurnal tidal disturbances [33]. The bleached corals degrade physiologically, and the long-term prolongation of this bleaching without recovery will result in the complete destruction and death [34] and [35].

Since the corals obtain more than 95% of their energy from the photosynthesis of algae, disconnection of symbiotic relationship, damages the key function of coral calcification that is caused by light, tissue growth and reproduction [36]. Therefore, the survival of coral reefs strongly depends on adaptation and adaptive responses of corals to the global warming pressure [37].

CONCLUSION

Results of the present investigation indicate that although coral reef communities of the Persian Gulf are more resistant to heat stress according to the same species in other parts of the world, they have been declined due to sever high temperature.

Acknowledgment

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Identification of Some Rotifer Species in Hazar Lake (Elazığ-Turkey) with Electron Microscope

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Abstract

This study was conducted between March 2017 and February 2018 to determine the rotifer fauna of Hazar Lake provide clear diagnosis of suspected rotifers in electron microscopy. Totaly 24 species from Rotifera, were identified in our this study. In this study, scanning electron microscope photographs of some Rotifera species were taken. Scanning electron microscopy (SEM) of the trophi structure (SEM), which is an important part of the species identification of monogonont rotifers, has also been performed in this study.

INTRODUCTION

The phylum Rotifera is a group of microscopic animals, usually much shorter than 1 mm, living in any habitat where water is available: rotifers can be found in permanent water bodies such as lakes, ponds, and rivers, but also in the water layer between soil particles, mosses and lichens, and in the meltwater of glaciers [1]. Rotifers are very diverse, and occupy different dietary niches, with species that are filter-feeders, predators, browsers, piercers, parasites, etc. Such diversity in the feeding strategies is revealed in the wide variety of shape of the hard pieces that form the masticatory apparatus, the trophi reflect taxonomic differences (so that detailed differences are used for species identification), evolutionary relationships (trophi are used in the morphological classification of most taxonomic ranks), and ecological adaptations (trophi reflect different feeding adaptations).

The identification of Rotifera is difficult for many reasons; most species were described before 1950, and original descriptions do not report important taxonomical details that can be observed only with modern technological equipment such as scanning electron microscopy (SEM) and high-quality light microscopes. The scanning electron microscopy SEM has helped in the recognition of surfaces of cells, tissues, and structures, developing a new way of more detailed study.

In the case of limnology, the use of SEM has been of great importance for taxonomists as a tool that allows for a more detailed study of the different planktonic organisms that are mainly microscopic, and thus optical microscopy might not allow for a clear distinction of structures of taxonomical importance

One of the main problems faced by rotifer taxonomists is the insufficiency of useful morphological characteristics for classification. Initial examination of the external features of the body usually relies on the distinct shapes of the lorica, appendages or corona. However, structures of the internal trophi have also been used successfully for identification. In particular, for the identification of species of Filinia, Hexarthra and Synchaeta, it is not sufficient to use only the external features; ecological requirements and also trophal structures must be analysed. Trophi appear to be species-specific and therefore are a valuable taxonomic discriminator [2]. One of the most important features of trophi is the number of uncal teeth, but these structures are difficult to count using a compound light microscope, even at magnifications up to 1000 x. Scanning electron microscopy (SEM) permits finer resolution of structures and, as a consequence, has the potential to clarify much of the present systematic confusion within the Rotifera. Initial SEM studies involved examining large trophi of large rotifers e.g. Asplanchna [3,4] which are reasonably easily prepared. Trophi of smaller specimens need more refined techniques.

Purpose of this study is current rotifer fauna of Hazar Lake and make definite identify of rotifer species similar to each other.

MATERIALS AND METHODS

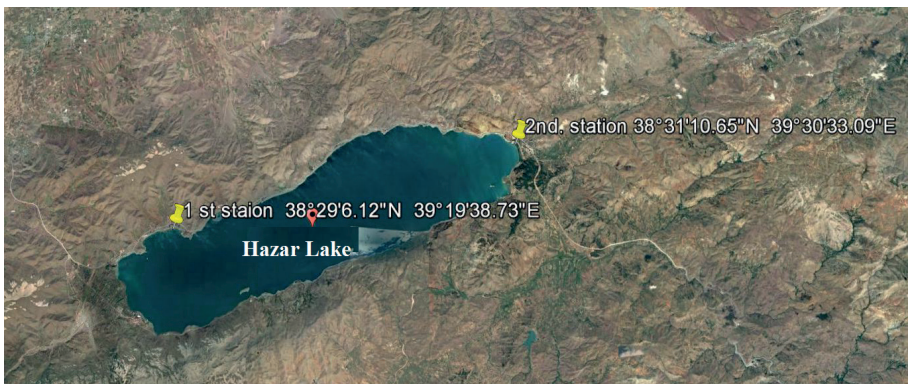


Figure 1. View of Hazar Lake

In this research rotifer distribution of Hazar lake were determined between March 2017 - February 2018. The samples were taken from 2 stations of lake. The rotifer 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 [5], Koste [6], Segers [7].

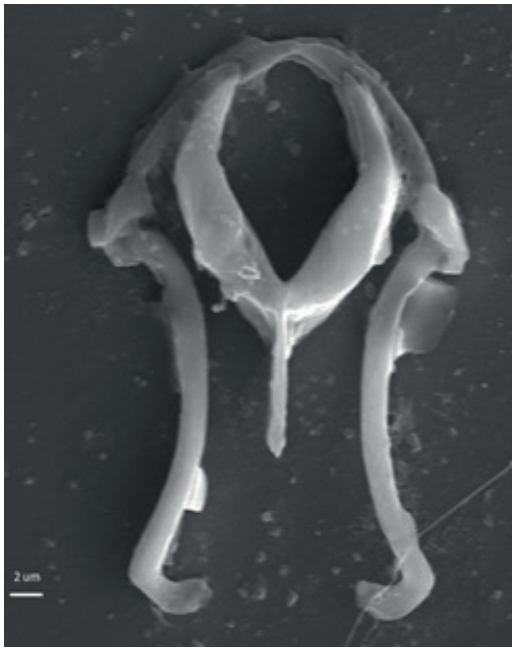
Preparation of the lorica of rotifers for the scanning electron microscopy (SEM):

1. Samples collected from the field and contained in 4% formaldehyde taking a designated individual on the glass slide,
2. General photos of the individual on the slide have been taken, diagnostic features of the species have been noted.
3. The sample washed about 10 times with distilled water (1 dropping the water and re-draining the water),
4. 18x18 mm glass coverslip divided into 4 equal parts,
5. The sample transferred on one of piece of coverslip.
6. The sample has been observed under microscope and the place of it marked with a red glass pen.
7. The coverslip placed the on the staple and sputtered and coated with gold.
8. After the gold covering, the photos have been taken with convenient magnification
9. Printing photos were taken on a CD.

The trophi structure's of Semi loricate or illoricate rotifers preparation for S.E.M

The procedure is same to number 5.

1. One drop of glycerin is added between slide and cover slide.
2. The washed sample transferred to cover slide.
3. 1 drop of NaOCl poured on the sample for removing of trophi from the body.
4. The separated trophi washed with distilled water several times.
5. The procedure is the same after this step with above procedure (6,7,8,9)



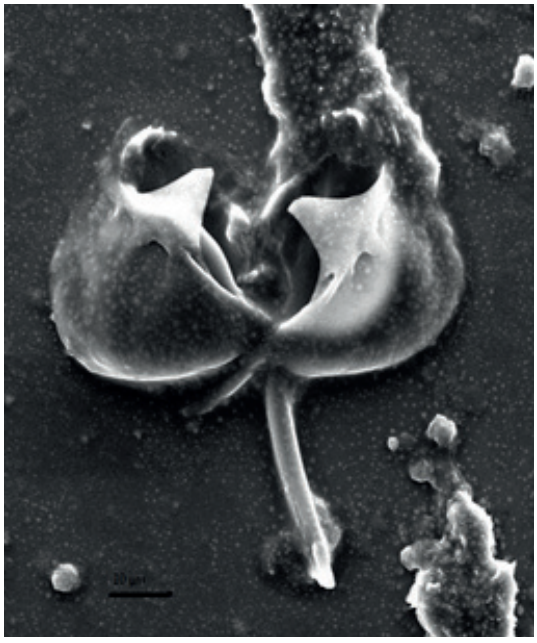
Encentrum saundersiae

RESULT AND DISCUSSION

In Hazar Lake 24 species from Rotifera were identified. The distributions of the species are given in Table 1.

Table 1. Distributions of rotifers according to stations in Hazar Lake

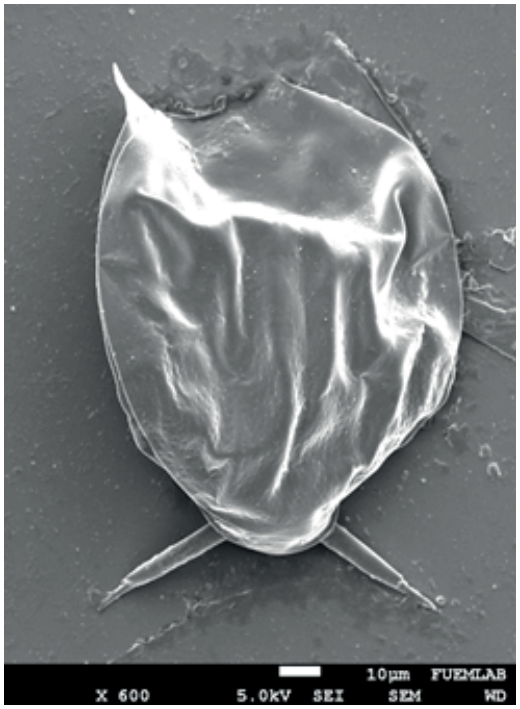
Stations	1	2
Rotifera species		
Ascomorpha saltans Bartsch,1870	+	-
Asplanchna priodonta Gosse, 1850	+	+
Asplanchna sieboldi (Leydig, 1854)	+	-
Brachionus angularis Gosse, 1851	+	+
Brachionus urceolaris Müller, 1773	-	+
Encentrum saundersiae (Hudson, 1885)	+	-
Epiphanes senta (Müller, 1773)	+	-
Euchlanis dilatata Ehrenberg, 1832	+	+
Filinia terminalis (Plate, 1886)	-	+
Hexarthra fennica (Levander, 1892)	+	+
Hexarthra mira (Hudson, 1871)	+	+
Keratella cochlearis (Gosse, 1851)	+	+
Keratella tecta (Gosse, 1851)	+	+
Keratella quadrata (Müller, 1786)	+	+
Lecane luna (Müller, 1776)	+	-
Lepadella ovalis (Müller, 1786)	-	+
Lepadella patella (Müller, 1773)	-	+
Notholca squamula (Müller, 1786)	+	-
Polyarthra dolichoptera Idelson,1925	+	+
Synchaeta oblonga Ehrenberg, 1832	+	+
Synchaeta pectinata Ehrenberg, 1832	+	+
Trichocerca similis (Wierzeski, 1893)	-	+
Trichotria tetractis (Ehrenberg, 1830)	+	-



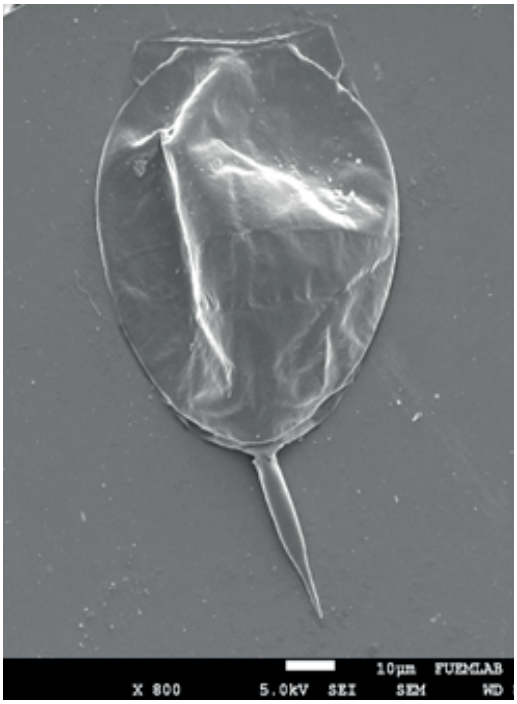
Sychaeta pectinata

The dominance of Brachionus and Keratella are common in freshwater bodies in Turkey [8]. In this study two species of Brachionus (*B. angularis* and *B.urceolaris*) and three species of Keratella (*K. cochlearis, K. quadrata, K. tecta*) have been identified. Ustaoğlu et al. [8] reported

Epiphanes senta



Lecane luna



Lecane closterocerca

15 Brachionus species and 6 Keratella species from Turkey. According to Radwan [9] and Sladecek [10], Branchionus species indicate eutrophic habitats. They also suggested the Brachionidae family and Brachionus species as indicators of highly trophic habitats. In the current study 8 species

Keratella cochlearis

(*Brachionus angularis, B. urceolaris, Euclanis dilatata, Keratella cochlearis, K. quadrata, K. tecta* and *Notholca squamula*) from Brachionidae have been identified.

The genera Keratella Bory de St. Vincent, 1822 was found to be the most dominant group (with 3 species), followed by the genus Asplanchna Gosse, 1850 (with 2 species), Brachionus Pallas, 1766 (with 2 species), Hexarthra Schmarda, 1854 (with 2 species), Lepadella Bory de St. Vin-

cent, 1826 (with 2 species) and Synchaeta Ehrenberg, 1832 (with 2 species).

Although many studies on rotifer fauna of Turkish inland waters have been conducted, in the most of these studies for identification of the species, light or inverted microscopes have been used. But the details of some diagnostic features of the species could not be observed under these kind of microscope. In recent years some researchers have been used electron microscopy for rotifer species identification. Altındağ et al., [11], identified *A.silvestrii, A.brightwellii, A.priodonta, A.girodi, Cephalodella segersi, Hexarthra polyodonta*; Kaya *et al.,* [12] *Sinantherina semibullata*; Kaya and Altındağ, [13], *C. forceps, C. misgurnus, Encentrum limicolo, E. mustela*; Bulut and Saler [14], *L. steenroosi*, *L.closterocerca, Platiyas quadricornis, Scaridium longicaudum, Squatinella rostrum, Proales fallaciosa* by using scanning electron microscopy. In this study different from above species *K.cochlearis, Encentrum saunsarsiae, Epiphanes senta* SEM photos have been taken.

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Use of Nettle (*Urtica dioica L.*) in the Treatment of Fish Diseases

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Abstract
The increase in demand for fish and fish products has led to the spread of the culture fish. Fish breeders have used some chemicals or plant extracts that stimulate or enhance the immune system to protect fish from diseases. Although the use of chemical medicines has many negative effects on the environment and human health, chemotherapy is widely used in the prevention and treatment of diseases. As an alternative to chemical treatments, the use of plant extracts in combating diseases seen in water products has become widespread. Various plant species such as thyme, garlic, fenugreek and nettle are used in the treatment of different diseases in traditional folk medicine as well as in fish health and increase disease resistance and efficiency in aquaculture.
Nettle is a perennial plant of the Urticaceae family, abundant in our country. Root, stem, leaves, flowers and seeds of nettle are used as herbal medicines. Nettle has many biocomponents such as polysaccharides, lignans, flavonoids, coumarins, terpenoids, phenol and *Urtica dioica* agglutinin (UDA) which is a lectin, and it has been reported that nettles generally have antiinflammatory, antiallergic, antibacterial, antifungal, antiviral and anticarcinogenic effects. There are studies in the literature that have found positive effects on the immune system and growth performance of nettle on experimental animals. In this review, a study has been conducted on the use of nettle weed as an alternative to chemical medicines in the prevention and treatment of fish diseases.
Keywords: Nettle, Fish Diseases, herbal medicine, immune system.

INTRODUCTION

In recent years interest in natural antimicrobials has increased significantly in order to prevent fungal and bacterial deterioration. Antimicrobial substances can naturally be obtained from plants, animals, algae and fungi. Many chemicals derived from plants have been associated with antimicrobial activity and the effects of pathogens have been investigated [1]. In traditional folk medicine many plant and plant extracts have been used in the treatment of various diseases. In order to combat diseases from past to present day, plant therapy was applied [2].

Concerns about the safety of synthetic chemicals used against pathogenic microorganisms have increased and disease-causing microorganisms have gained resistance. For this reason, it is observed that the use of plant extracts for combating diseases is of interest for the researchers [3]. In addition, interest in herbal medicines has increased because of the many side effects of synthetic drugs and their cost. Treatment with herbal medicines now finds application in the livestock sector and is being used in such fields as treatment, increase of production, better quality and higher yield, preparation of feed rations [4].

The use of chemical medicines is prevalent in the fisheries sector, which is a major economic concern today, in order to prevent losses due to microbial diseases. However, the use of unconscious antibiotics and other medicines increases drug accumulation in fishes, as well as the resistance of microorganisms to antibiotics and their consumption has negative effects on the human immune system [5]. It is known that veterinary medicines have been widely used in aquaculture by participating in bathing, injection and eating for the prevention of economic losses and diseases due to various factors [6]. In Europe, amoxicillin, florfenicol, flumequine, oxolinic acid, oxytetracycline, sarafloxacin and sulfadiazineinethrimethoprim are antimicrobial agents permitted for use against external parasites and fungal diseases in aquaculture [7]. Unconscious drug use in this sector threatens the ecological balance as well as human health [8] and restrictions are imposed on veterinary drugs due to side effects [9].

Use of Plant Extracts in Fish Diseases

Aquaculture has become very common in the world and our country in recent years. Along with growth in this sector, the widespread use of many medicines has been associated with the health of people, environment and animals. The continuous and widespread use of synthetic antimicrobials adversely affects consumers. Herbal medicines are applied safely against bacterial diseases in organic agriculture, veterinary medicine and medicine. Since ancient ages, many plants have been used against infectious diseases because of their antibacterial properties and they have made the plants an alternative natural medicine with potential use in aquaculture [10]. Parts of many plants such as seeds, leaves, bark, fruits and roots contain bioactive phenolic compounds [11] and these compounds exhibit antimicrobial properties [12]. Plants have a variety of bioactivity due to components such as alkaloids, terpenoids, tannins, saponins, flavonoids and essential oils [13]. Natural chemicals containing plants have advantages such as environment friendly, low cost treatment, easy biodegradation in nature, less drug resistance, no toxicity and no carcinogenic effects. It has been reported that plants or extracts such as garlic, ginger, olive and nettles have antipathogenic and similar properties, particularly in fish, that enhance appetite and growth performance, warn the immune system [6].

In fish, the immune system is activated by using chemical immunostimulants and body resistance is increased against infections. Like chemicals, medical plants also stimulate the mechanism of specific and non-specific immune system in fish. Plants increase body resistance and increase the level of readiness of the body against viral, bacterial and parasitic diseases [14], [15]. Researches on the use of herbal extracts in the prevention and treatment of aquaculture diseases are available in the literature, with a limited number of studies. For example, significant changes in the immune system and the number of erythrocytes, leukocyte count, hematocrit level, NBT level, total protein and total Ig parameters of fish have been determined as a result of application of black seed oil to rainbow trout in the form of rubbing, grafting and feeding. At the end of the 21st day, it was reported that despite

the decrease of the effect of the black seed oil, it strengthens the immune system and keeps the immune system at a high level if it is used regularly and at certain rates [16]. The use of plant extracts instead of chemical drugs against pathogenic microorganisms in fish is also available in the literature.

Antibacterial activity of vegetable oils obtained from cantoron, turmeric and sesame seeds against the pathogens isolated from fishes were investigated. In vitro studies have shown that seed oil can be used in the treatment of vibriosis and lactococcosis, showing antibacterial activity on *Vibrio anguillarum* and *Lactococcus garveieae* pathogens [17]. One of the plants with medicinal properties, walnut fruits, leaves and crusts have antifungal, antimicrobial, antidiarrhetic, hypotensive, hypoglycemic and antihelmintic effects [18]. It has been reported that extracts from walnut leaf and walnut green shells obtained from different walnut species (Lara, Franquette, Mayette, Marbot, Mellanaise and Parisienne) have antimicrobial effects against gram-positive bacterium (*Bacillus cereus, Bacillus subtilis, Staphylococcus aureus*) [19], [20]. The walnut shell and leaf extracts obtained from *Junglans regia* (British walnut), *Junglans cinere* (white walnut) and *Junglans nigra* (black walnut) were applied to freshwater fish. It has been shown to be effective against the common external pathogenic bacteria (*Aeromanos hydrophilia, Pseudomonas floreescense, Bacillus, Salmonella*), fungus (*Ihthyophorus hoferi*) and protozoans (*Chilodonella ciprinii*) [21]. In addition, methanol-extracted walnut leaf oil showed antimicrobial effects against pathogens (*Pseudomonas aeruginosa, Pseudomonas fluorescens, Staphylococcus aureus, Escherichia coli, Salmonella typhi* and *Aspergillus niger*) isolated from skin, gill and digestive system tissues of fishes [5].

Nettle (*Urtica dioica L.*) and its Importance

Nettle is one of the plants used for the prevention of various diseases. This plant belongs to the family of *Urticaceae* [22] and is a perennial plant that grows spontaneously on rivers, roadsides and open forested areas of our country [23]. Nettle root, stem, leaves, flowers and seeds of nettle are used as herbal medicines. In the first century, Greek doctors Dioskorides and Galen reported that the nettle leaves were diuretic and laxative and they were used in the treatment of diseases such as asthma and lung inflammation. The nettle is used in folk medicine in almost every country [24]. It has been reported in the literature that nettle generally has antiinflammatory, antiallergic, antibacterial, antifungal, antiviral and anticarcinogenic effects [25]. Dry matter of stinging nettle leaf contains 18% protein, 14.5%-17% albuminous substances and 2.5% fatty substances. There are 8-10% fixed oil in the seeds and acetylcholine, histamine and formic acid in the burning hairs. Leaves contain K, vitamin B1, provitamin, urticin glycosides, cystosteine, xanthophylls, ash contains 6.3% ferrumtrioxide, silicon, potassium, calcium [26].

It contains a large number of bioactive compounds such as polysaccharides, lignans, flavonoids, coumarins, terpenoids, phenols and lectins [27], [28] and [29]. Because of its pharmacologically active metabolites, the leaves and seeds of the nettle (*Urtica dioica L.*) ise used in the traditional folk medicine for the treatment of the disease such as eczema, abscess, wound healing, liver failure, rheumatic pain, internal diseases, diabetes, skin infections, nose bleeds, prostate and cancer [22].

Use of Nettle *(Urtica dioica L.)* in Fish Diseases

Combating diseases and obtaining high quality products in aquaculture is one of the main objectives. In many fish farms, various antibiotics, chemicals and substances that stimulate the immune system are used to fight against viral, bacterial, fungal and parasitic diseases [30]. The immune system is important for fish to survive in a healthy way and resist infections. However, the chemicals used to develop the immune system are also responsible for the development of more resistant bacteria. In addition, the chemicals that accumulate in the tissues of fish also affect people who consume them. Commonly used antibiotics and sulphonamides are either destroyed early in the body or are less effective since they are not absorbed sufficiently. However, since plant extracts are organic molecules, their absorption in the body is easier and their activity is higher than the chemical ones [31]. There are few studies on the use of herbal medicines as a preventive or therapeutic agent in fish farming. However, interest in this area has increased in recent years due to the high cost of immune system stimulating chemicals used in aquaculture [31], [32].

There are studies in the literature on the positive effects of nettle (*Urtica dioica L.*) on immune system and growth performance on guinea pigs. Nettle (*Urtica dioica L.*) strengthens phagocytosis, cellular and humoral defense mechanisms against pathogens [13]. In 2015, a study conducted to investigate the haematological values of beluga fish (huso huso) fed with nettle-fortified fishmeal for 20-40-60 days. According to the control group, significant increases in lymphocyte, neutrophil and eosinophil counts were found on the 40th day (see Table-1). When the blood values of RBC, Hb, Hct, MCHC, MCH and MCV were also examined in the same study, it was found that the nettle increased these values at different feeding times according to the control group (see Table-2). [32].

Table 1. Differantial Leukocyte Counts of Huso huso Fish after 40 Day Feeding [32].

Leukocyte Counts (%)	Lym (%)	Neu (%)	Eos (%)
Nette	95.00±0.0	8.00±0.0	2.00±0.0
Control	90.2±0.2	7.00±0.1	1.80±0.1

Lym: Lymphocyte, **Neu**: Neutrophil, **Eos**: Eosinophil

Table 2. Some Hematological Factors of Beluga Fish (huso huso) [32].

Day/ Blood values	RBC	Hb	Htc	MCHC	MCH	MCV
20st day						
Nette	0.46	7.42	23.51	34.49	306.13	-
Control	0.42	3.8	20.53	19.09	186.26	-
40th day						
Nette	0.81	7.26	-	40.47	90.43	-
Control	0.68	5.47	-	25.83	83.59	-
60th day						
Nette	0.39	6.61	28.99	-	-	872.24
Control	0.36	5.81	17.57	-	-	753.69

RBC: Red Blood Cell, **Hb:** Hemoglobin, **Htc:** Hematocrit level., **MCHC:** Mean Corpuscular Hemoglobin Concentration, **MCH:** Mean Corpuscular Hemoglobin, **MCV:** Mean Corpuscular Volume

In 2013, another study conducted to determine the stimulating effects of different herbal extracts on immune system in fish. In the study, rainbow trout (*Oncorhynchus mykiss*) was fed with 1% and 0.1% nettle-fortified fish

meal for 3 weeks and the fish fed with nettle-fortified diet were found to have increased extracellular respiratory burst activity, intracellular activity, phagocytosis activity, blood leukocyte activity and plasma protein level compared to the control group (see Table-3). As a result, rainbow trout fed with bait containing nettle extracts reported that they stimulated the immune system against fish pathogens such as viruses, bacteria and fungi in the cellular and humoral defense mechanisms and could be used as an adjunct to the process of struggle against fish diseases of nettle [30].

Table 3. Non-specific Immune Activity of Rainbow Trouts [30].

Plant (%)	Extra-cellular Burst activity ($nmolO_2/10^{-5}$ leu)	Intracelullar activity (NBT), (OD at 650 nm)	Phago-cytosis (OD at 510 nm)	Plasma protein level (g/dl)
% 0.1 nettle	1.04	0.12	1.93	3.40
% 1 nettle	1.03	0.11	2.03	3.58
Control	1.02	0.10	1.88	2.48

Aeromonas hydrophlia is a pathogen that causes many diseases in the freshwater fishery, especially in the rainbow trout (*Oncorhynchus mykiss*) from blood poisoning to the ulcer. In 2009, *aeromonas hydrophlia* injected rainbow trout (*Oncorhynchus mykiss*) fed with fish meal containing of 1% (w /v) nettle for 14 days and the effect of nettle against this pathogen was investigated. Researchers found that nettle increased hematocrit and hemoglobin values, increased white blood cell (WBC) volume, monocyte, neutrophil counts and phagocytic activity compared to the control group. In addition, according to the control group, researchers reported that there was a decrease of 96% in pathogen-injected fish mortality and that the nettle also decreased the number of bacterial colonies according to the control group (see Table-4). [33].

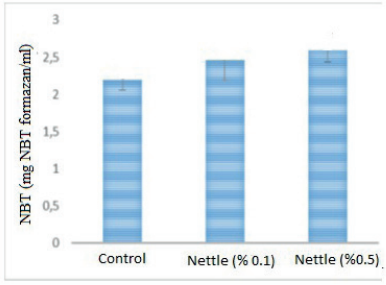
Table 4. Chaneges in RBC, WBC, Htc, Monocytes, Neutrophile values after feeding with nettle added fishmeal [33].

Plant (%)	RBCx10^6 μL^{-1}	WBC x10^4 μL^{-1}	Htc (%)	Mono-cytes	Neu
Control	1.09	3.5	31.8	4	3
%1 nettle	1.20	4.5	39.1	7	5

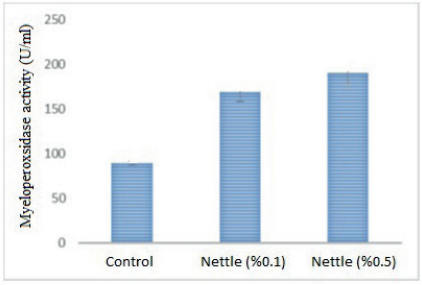
RBC: Red Blood Cell, WBC:White Blood Cell, **Htc:** Hematocrit level, **Neu**: Neutrophil.

The effects of the methanolic extract of the nettle on the immune system of Japanese fish (*Carassius auratus*) have also been examined. Two different concentrations of the nettle extract (0.1 and 0.5 g/kg bait) were incorporated into the fishmeal and the fishes were fed for 30 days. Superoxide radical release (NBT) is an important enzyme released in the inactivation of pathogens. Lysozyme activity is an immune response that disrupts the pathogen cell wall in viral, parasitic, and bacterial diseases. Myeloperoxidase (MPO) is an enzyme that is secreted by neutrophils and neutralizes foreign elements. Phagocytic activity indicates an increase in cell numbers that effect phagocytosis. For this reason, researchers used parameters such as superoxide anion production (NBT), lysozyme, myeloperoxidase and phagocytic activity in this study to determine changes in the immune system. At the end of the study, all immune responses were higher in both nettle groups than in the control group, and the highest immune response was found to be obtained with 0.5% nettle extract (see Table-5). Researchers have reported that nettle extracts are an effective immunostimulant for Japanese fish [34].

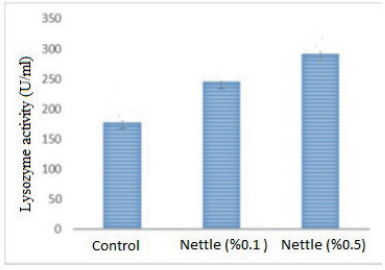
Table 5. Superoxide Anion Production (NBT), Lysozyme, Myeloperoxidase and Phagocytic Activity of Japanese Fish (*Carassius auratus*) [34].



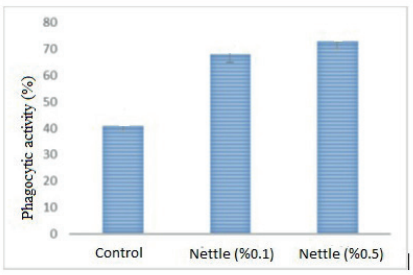
a) Changes in NBT activity



c) Changes in Myeloperoxsidase activity



b) Changes in lysozyme activity



d) Changes in phagocytic activity

Natural products containing rich antibacterial agents are important. Interest in natural antimicrobials with new and less toxic effects has increased. There are also studies in the literature investigating the use of nettle leaf extracts as an alternative to chemical drugs against fish pathogens. The most common fish pathogens such as *Aeromonas hydrophila* and *Yersinia ruckeri* which are gram-negative pathogenes and *Streptococcus agalactiae, Lactococcus garvieae* and *Enterococcus faecalis* which are gram-positive pathogenes, causeses infectious diseases. *A. hydrophila* causes tail problems (tail/fin rot) and haemorrhagic septicemia. *Y. Ruckeri* which is an enteric pathogen causes redmouth disease in fish. Pathogens such as *S. agalactiae, L. garvieae and E. Streptococcosis* cause lactococcosis, haemorrhagic septicemia and ulcerations in tails [10]. In 2012, nettle leaves extracted by using chloroform, n-hexane, methanol and ethyl acetate and their bioactive potential were investigated. Obtained extracts were applied in vitro to some common fish pathogens such as *Aeromonas hydrophila, Aeromonas salmonicidia, Flavobacterium columnare, Vibrio salmonicidia* and *Yersinia ruckeri*. In the study, it was determined that the highest inhibition zone (DIZ, mm) was in hexane-derived fractions. Gentamicin was used as standard and the antibacterial activities of the extracts were measured. Measured mean inhibition areas are given below (see Table-6). According to the results, researchers have been reported that the nettle leaf extract containing many bioactive components, so that it has potency as a natural drug in some infectious diseases seen in fish [35].

Table 6. Antibacterial Effect of Nettle Extracts Obtained Using Different Solvents on Some Fish Pathogens [35].

	DIZ (mm)				
Fish pathogene / Solvent	***Aeromonas hydrophila***	***Aeromonas salmonicidia***	***Flavobacterium columnare***	***Vibrio salmonicidia***	***Yersinia ruckeri***
Hexane	12±0.4	12±0.4	11±0.5	13±0.5	14.66±0.8
Chloroform	7±0.3	7±0.3	-	7±0.3	-
Ethyl acetate	-	-	-	-	-
Methanol	-	-	-	-	-
Standart (Gentamycin)	17.66±0.3	17.66±0.3	18.33±0.3	20.66±0.6	20.66±0.6

CONCLUSION

Fish are infected by pathogens and parasites such as viral infections, bacteria, fungi and protozoa. Medical plants have antimicrobial and immune system stimulating effects. When the literature is examined it is concluded that the extracts of many plant and plant parts such as canton, turmeric, garlic, sesame oil, blackcurrant, lemon, aloe vera, cinnamon, walnut and nettle are effective in prevention of pathogenic diseases encountered in aquaculture and especially fish farming, They have been used in the treatment and / or have potency of use. In this review, a study has been conducted on the use of nettle as an alternative to chemical medicines in the prevention and treatment of fish diseases. The presence of antimicrobial and antifungal properties of this plant has been associated with a terpene neoheptidene and fatty acid esters, heptadecyl ester, hexyl octyl ester, butyl tetradecyl ester and 1,2-benzenedicarboxylic acid [35]. It has been seen that the nettle leaves and root parts of the nettle are used in a limited number of antimicrobial applications in the literature. But if we summarize the work done, it is stated that nettle can be used as an alternative to veterinary medicines in the prevention and treatment of viral, bacterial and fungal diseases in fish studies. Nettle shows less toxicity because it is natural and provides an advantage in protecting the environment and human health. Nettle is a natural immunostimulant that enhances the immune system in fish and keeps defense mechanisms against pathogens ready. Due to the developing technology, increasing demand and decreasing natural resources have become a necessity of using drugs in the aquaculture. However, interest in organic products has increased due to possible side effects of chemicals. Nettle can also be used as an alternative to drugs used to increase yield in fish breeding. Unlike synthetic medicines that are used against possible infections, nettle can be preferred, which can be natural and easy to degrade. The use of herbal extracts in fish diseases makes the treatment cheap. Also, since herbal products and nettle contain many bioactive substances in the composition, pathogens have less resistance than synthetic drugs. Since it contributes to the prevention of the development of resistant microorganisms in this respect. Due to these advantages of the nettle, it is necessary to make use of it in the fishery sector and to carry out further researches.

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Fish Biomarkers, Suitable Tools For Water Quality Monitoring

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Abstract
A large number of biomarkers and indicator organisms have been suggested for the assessment of ecotoxicity of man-made compounds on aquatic environments. The physiological and biochemical indices in fishes are sensitive for detecting potential toxic effects, and also are obvious from the same reports that studies on the impact of pollutants on the physiological and biochemical status of aquatic organisms. In an attempt to define and measure the effect of pollutants on an ecosystem, biomarkers have attracted a lot of interest. The underlying principle of the biomarker approach is the analysis of an organism's physiological or biochemical response to pollutant exposure. The measurement of biochemical and physiological parameters is a diagnostic tool commonly used in aquatic toxicology and bio-monitoring, so Hematological and immunological parameters are suitable biomarkers in mercury studies. During stress, fish respond in a number of ways in order to regain homeostasis and two important physiological processes which are modulated when fish are exposed to stress, are hormonal status and immune function. In this paper, our previous research's on effects of different pollutants (heavy metals, pesticides, nano particles, organic pollutants and etc.) on many fish species (marine and freshwater) was studied to detect new biomarkers (enzymatic, hormonal, immunological, hematological, histopathological and etc.) for water quality monitoring. In this study we examined markers of hematology, enzyme, hormone and histopathology in different fishes. The aim of this study was to test a multi-trial biomarker approach for evaluating toxicological risk due to the major toxicant in the water, using fishes as bio-indicator organism. The main objectives of this researches were: to identify the tissues and biological materials useful for biomarker studies; to evaluate various biochemical biomarkers in different tissues; to identify the most suitable biomarkers for evaluating chemical stress due to the contaminants explored in this study.

Keywords: Biomarker, Fish, Pollutants, Water quality monitoring.

Origin of biomarkers

A much relied upon means to evaluate ecological risk has been through environmental monitoring in which chemical residues are assessed. This approach has provided useful information but with significant limitations, not the least of which are the time and costs associated with chemical residue analysis, inability to quantitatively evaluate the availability of a chemical from the environmental matrix to the aquatic organism, metabolism or limitations in available technology may render a chemical difficult, if not impossible, to detect in environmental or biological samples.

Application of biomarkers in environmental monitoring may resolve many of these challenges by providing a measure of availability of an environmental chemical to an aquatic organism by providing a direct measure of the response of an organism to chemical exposure. Regarding biological response to sublethal concentrations of environmental chemicals, Depledge (1993) noted that an essential criterion of the biomarker approach is the identification of early onset changes in otherwise healthy organisms that predict increased risk of development of chemically induced pathologies.

During the past two decades, attempts have been made to identify and characterize biomarkers in a range of organisms from bacteria to humans to predict disease or detrimental ecological effects (Adams, 2002; Depledge, 1993).

The term *biomarker* represents many endpoints, and several groups have challenged its original definition. Several definitions of biomarkers have been proposed since the first consensus definition proposed by the Committee on Biological Markers of the National Research Council (NRC) (1987). The NRC defined biomarkers as "indicators signaling events in biological systems or samples following chemical exposure" and proposed the use of biological markers to determine: (1) internal dose or biologically active concentration (exposure), (2) adverse effects, and (3) susceptible populations or individuals in an attempt to predict and possibly prevent clinical disease, specifically in humans. In fact, in the original definition and classification by the NRC (1987), the emphasis was placed on human health, specifically associated with reproductive toxicity. With fish specifically in mind, Adams (2002) modified the original NRC definition to include characteristics of organisms, populations, or communities that respond in measurable ways to changes in the environment. As the measurements have proceeded to include other organisms such as fish, debate has occurred as to their utility as a "marker" or as an "indicator" in ecological settings (McCarty and Munkittrick, 1996). It has been further argued that studies examining a biological response without a definitive purpose are essentially useless as "indicators" (Holdway, 1996). Peakall (1992) suggested the term *Biomarker* to indicate effects relating to individual organisms and *bioindicator* to indicate effects measured at the population or community levels of biological hierarchy. It is clear from the multiple definitions of the term *biomarker* that any study using this terminology must begin by defining the specific aims and purposes of the biological response that is measured or proposed as a biomarker.

The NRC proposed three types of biomarkers in an attempt to classify responses as markers of exposure, effect, and susceptibility. Each of these definitions has been addressed previously and discussed in terms of its potential use in ecological risk assessment paradigms (Schlenk, 2006). As more biomarkers have been increasingly proposed and characterized, significant overlap may occur when using this nomenclature, as some biomarkers can be in each of the three capacities. An effect resulting from stressor exposure may be defined as an early adaptive nonpathogenic event or as a more serious altered functional event, depending on the toxicokinetics and mechanism of action of the compound (Decaprio, 1997). Likewise, biomarkers of exposure and effect may often be combined into a single classification, with susceptibility occurring along any stage (Barrett et al.,

1997).

In recent decades, aquatic toxicology has moved from a descriptive approach, which was necessary to explore those concentrations of single toxicants within water that were not compatible with the life of individual fishes, to considerations of sublethal concentrations that do not cause death over the short term but do harm the individual, thus making it expend resources to survive in a state of altered equilibrium and these helped to cut across questions of bioavailability as the emphasis shifted to host response (Di Giulio and Hinton, 2008).

One of the benefits of the biomarker approach is the identification of early-onset changes, which predict increased risk of adverse effects following exposure to environmental chemicals. There are many definitions of biomarkers e.g.: "A biomarker is a xenobiotically induced variation in cellular or biochemical components or processes, structures, or functions that is measurable in a biological system or sample" (NRC, 1987).

Different type of biomarker

Toxic effects or responses can be divided into those that are "graded" and those that are "all or none". Graded effects are those such as the inhibition of an enzyme which can show some effect between zero and maximal. All-or-none responses are those that are only present or absent (on or off), such as death or the histopathologic abnormality (Timbrell, 2009).

The IPSC has three classes of biomarkers identified: biomarkers of exposure of the organism to the toxic substance, biomarkers of response of the organism to that exposure, and biomarkers of susceptibility of the organism to the chemical (WHO, 2005).

Biomarkers of Exposure: At its simplest, measurement of the dose is determination of the amount of chemical administered or the amount to which the animal is exposed. The level of a chemical in the blood approximates to the concentration in organs and a tissue is a true biomarker of exposure. Biomarkers of exposure are relatively transient and generally only detectable for about three months after exposure. However, a metabolic breakdown product may be responsible for the toxicity, and therefore, measuring the parent chemical may not always be an appropriate biomarker of exposure. Biomarkers of exposure are important in risk assessment, as an indication of the internal dose is necessary for the proper description of the dose-response relationship (Timbrell, 2009).

Biomarkers of Response: Living organisms can show many kinds of toxic or adverse response to a chemical exposure, ranging from biochemical or physiological to pathological. Consequently there are many biomarkers of response, which can be measured. These include markers such as enzymes, which appear in the blood when an organ is damaged and pathological changes. Indeed, a biomarker of response could be almost any indication of altered structure or function. However, although the new technologies (genomics or transcriptomics, proteomics and metabonomics) have an increasingly important role, interpretation of the often large amount of data generated is a significant task requiring bioinformatic techniques such as pattern recognition. Furthermore, all biomarkers of response must be validated in relation to certain criteria. It cannot be assumed, because a gene is switched on or off. Biomarkers of response are necessary for determination of the no observed adverse effect level (NOAEL) and the dose-response relationship (Timbrell, 2009).

Biomarkers of Susceptibility: these biomarkers cover a range of types from deficiency in metabolic enzymes to variation in repair systems. These would typically be measured in individual members of a population. An example could be a genetic deficiency in a particular enzyme involved in detoxication or xenobiotic metabolism. Biomarkers of susceptibility may be important for identifying especially sensitive groups to estimate an uncertainty factor (Timbrell, 2009).

Development of the Biomarker approach

The measurement of various contamination of sea water by classic chemical monitoring of few pollutants is possible, but also through examination for indicators of adverse effects of pollution on organisms is more effective. Selected biochemical parameters, so called biomarkers in an indicator fish, can be used for this purpose (Van der Oost et al, 2003).

Chemical monitoring of any persistent toxicant concentration in marine water as well in sediment may not provide accurate data on the stringency of contamination, especially in the case of natural condition, But biological monitoring using a series of assays having different endpoints in a key species could allow a sensitive approach to predict the potential risk of persistent contaminants like heavy metals.

In last decade, the use of biomarkers for many monitoring of marine environment has become wide spread. Biomarkers have been largely used for the assessment of effects induced by several classes of chemical contaminants on fishes, for example the assessment of alterations on some enzymatic activities of key species following exposure to natural and experimental contaminated waters has been one of the major uses of biomarkers in marine studies. Livingstone (2001) shows the main idea for the future evolution and purpose of the biomarkers and reports the role of biomarkers of oxidative stress in Ecotoxicology. Biomarkers have basic requirements for ecotoxicological study, such as: fast responsibility; low cost; simple procedures; applicability under varied testing conditions both in environment and labratory; and sensitivity to a high number of environmental contaminants include heavy metals.

In trying to define and measure the effect of pollutants on marine environment, biomarkers have been more interest. The doctrinaire principle of the biomarker approach is the assay of an organism's physiological or biochemical response to pollutant exposure, because toxic effect explicit itself at the sub cellular level before it becomes apparent at organ levels of biological organization. The measurement of biochemical responses to heavy metals will improve the assessment of biologically significant exposures to toxic metals and enhance the ability to evaluate the effects of xenobiotics on the health and survival of toxicant exposed fishes. With compare to direct monitoring method, biomarkers have the advantage of being more relevant biologically (Rees, 1993). Scientific studies for the identification of marine pollution biomarkers have been carried out extensively in animals in general and then fish in particular (Oikari and Jimenez, 1992).

A combination of physical, chemical and biological indicators is frequently used to evaluate water pollution (Karr, 1993). But in last decade, there has been a growing awareness of the need to detect and evaluate the effects of pollution in living organism (Schlenk, 2006). Heavy metal concentrations in aquatic organism are often more than aquatic environment in which the organisms resides. This suggests that organisms can be used as biological markers of metal pollution (Flessas et al., 2000).

Fish are largely being used for evaluate of water toxic metals and can serve as bioindicators of environmental pollution. The ability to accuracy predict of the

bioaccumulation of toxicant in fish has become an essential component in evaluation of the ecological and human risks in exposure to toxic pollutants, and also such estimates are needed to assess more accurately potential ecological risks to fish assemblages themselves. The long time exposure of fish to toxicants results primarily accumulation in their organs and tissues and secondly in sub cellular alterations due to their continuous deleterious action.

Although exposure-referenced toxicological benchmarks such as the LC_{50} and the EC_{50} have been widely used to make toxic evaluation, most harmful effects of chemical pollutants are because of accumulation of those compounds, more than their environmental concentrations per se (van Loon et al. 1997).

A range of different biomarkers have been used to indicate the biological effects of certain pollution on fish, both in natural environments and under experimental conditions (Ferrando et al., 2006).

The historical development of the biomarker approach can be seen to have close links with medicine and vertebrate biology (N.R.C, 1987). However, biomarker measurements are completely possible in invertebrate organisms (Depledge, 1993). There are several reasons why studies on fishes are better for ecological risk assessment. For example, fishes constitute more than 28000 species, they are major components of all ecosystems, and fish populations are often numerous, so that samples can be taken for analysis without significantly affecting population dynamics. Increasing knowledge of the physiology of fishes now permits reasonable interpretation of biomarker responses in terms of ecological risk assessment.

Application of Biomarkers

The release of different type of wastes generated by modern human activities into marine ecosystems potentially induces various combinations of stresses to fish. The evaluation of environmental xenobiotics requires explain of stress effects throughout the hierarchy of biological organization, from molecular and cellular levels up to organism and population levels (Moore, 2002). Therefore the assessment of different biomarkers to investigate the in vivo and in vitro effects of contaminants is a priority requirement to reveal the action mechanisms of xenobiotics. As marine ecosystems are the mostly final receptacles of industrial and urban waste discharges (Hoffman et al., 1995), a fundamental goal in ecotoxicology is to risk assessment of toxicant for aquatic organisms and human wildlife.

The investigation of the proper biomarkers for the best possible diagnoses is very important for researchers. Environmental experiments involving the use of biomarkers are recognized as one of the most powerful tools for the investigation of pollutants (Depledge, 1993).

Water pollutants cause toxic effects that range from biochemical alterations in single cell to the changes in organ and even whole population on aquatic organisms (Bernet et al., 1999). As the fish are considered as one of the bioindicator of the water contaminant, the extent and effect of pollution in them can be monitored by examining the sublethal indices or biomarkers.

Regarding to the biological effects of toxicant, the biomarker approach can offer more complete and relevant information regarding the potential impact of contamination on the health of an animal (Van der Oost et al., 2003). Exposure to environmental toxicants can launch the activation of defense mechanisms, the performance of which determines the toxic effect on the organism (Blaise et al., 2002).

The evaluation of physiological effects of chronic and sub chronic metals exposure using biomarkers of sublethal toxicity are necessary in order to assessment the impact of pollution under realistic conditions. These effects include genotoxic (Sanchez-Chardi and Nadal, 2007), enzymatic (Swiergosz- Kowalewska et al., 2006), haematological (Rogival et al., 2006), and histological alterations (Pereira et al., 2006) that in general only occur when substantial concentrations of metals are present in the tissues and blood. In fact, the combined use of biomarkers with bioaccumulation data provides a suitable measure of health status, physiological condition, and response of Fish populations to contaminant.

With complex environmental xenobiotics, it is ineffective to quantify all the contaminants. In this context, a strategy involving biomarkers has been demonstrated to be a suitable alternative for monitoring and management of whole aquatic ecosystems (Flammarion et al., 2002). Biomarkers enable the assessment of probable contaminent, in the environment, since chemicals may behave differently when acting individually or in mixtures. Besides, biomarkers reduce expensive cost of chemical analyses and the information provided may be used as an early warning system (Marin and Matozzo, 2004). Biochemical and physiological biomarkers, in particular, have been used in order to arrest irreversible damage in whole organisms, communities and ecosystems (López-Barea and Pueyo, 1998).

Biochemical biomarkers are frequently used for detecting or diagnosing sublethal effects in fish exposed to toxic substances. Choose of the suitable biological effect markers for the study of the chronic and sub chronic contaminant is frequently a controversial issue, when information on the mechanism of action of the contaminant is incomplete. But even very low exposure to contaminants may cause various biological effects (Toguyeni et al., 1997).

The application of biomarkers for mercury toxicity is of most interest to monitor not only the presence of mercury in the animal body, but also its bioavailability and capacity to find biological responses. Many biomarker studies examine the effects of toxicant exposure on whole soft tissue homogenate, but this approach may not always be suitable, as the partitioning of compounds among different tissues may largely influence toxicity and may be masked when measurements are restricted to whole body concentrations (Depledge and Rainbow, 1990). For example different body tissues have various abilities to accumulate metals (Gundacker, 1999), therefore using a suitable biomarkers from a blood that is current in whole body can produce more specific and relevant results to making an actual face of what is occurring in the ecosystem.

Biomarker approach measure directly the concentration of a toxin in an organism, not accounting for the biological effect, that it is one of the most important advantages of biomarkers (Depledge, 1993). For this reason a biomarker study was undertaken using in vivo and in vitro *A. latus* as a key species.

In the present study chemical analysis (of mercury) and three types of biomarker responses were investigated: (a) biomarkers of defense or early biological effect, (b) biomarkers of damage and (c) biomarkers of reproduction. The above mentioned biomarkers were selected because they have a definite role for the survival and performance of fish under heavy metals stress.

Correlation of biochemical and structural analyses in labratory, as well as *in vivo* exposures, led to the production and application of biomarkers of exposure and effect wild fishes. Resultant biomarkers were applied to heavily

contaminated and reference field sites as part of effects assessment and in investigations following large-scale disasters such as oil spills or industrial accidents.

Clearly, to avoid misinterpretation of biomarker responses, mechanistic links by which chemical effects at one level of organization give rise to detrimental effects at higher levels of biological organization must be established. As an example, alterations in steroid metabolism resulting in changes in hormone profiles which, in turn, alter sexual behavior might consider as chemical effect. So specific understanding of the normal homeostatic roles for these mechanisms should be achieved prior to their use as biomarker and also in the design of biomarker strategies, an integrated approach should be considered in which a hierarchy of responses are evaluated. The hierarchy can be constructed based on the level of biological organization that is being monitored or on different degrees of response sensitivity.

Development of the Biomarker approach

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Application of Biomarkers

The investigation of the proper biomarkers for the best possible diagnoses is very important for researchers. Environmental experiments involving the use of biomarkers are recognized as one of the most powerful tools for the investigation of pollutants (Depledge, 1993). In the biomarker approach it is either the activated defense mechanisms or the toxic effect that is measured in an organism, or both.

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Enzymatic Biomarkers

Chronic pollution induced heavy metals in the marine ecosystems is a major problem particularly in shallow water like creeks. Heavy metals may modify the structure of the cell membranes by stimulating the lipid peroxidation process concentration with consequent complex sequences of biochemical reactions (Viarengo, 1985), This process is generally known as oxidative Research deterioration of polyunsaturated fatty acids. In fishes generaly, peroxidation of lipids cause to the production of lipid radicals and in the formation of a complex mixture of lipid degradation products including malonyldialdehyde and other aldehydes such as alkanals, hydroxyalkenals and ketones hepatopancreas, (Viarengo, 1985).

Heavy metals accumulated in the fish tissues may catalyze reactions that generate reactive oxidative species (ROS) which result to environmental oxidative stress. These systems contain different antioxidant defenses. Defensive

mechanisms to discomfit the impact of ROS are found in many species including aquatic animals such as fish.

In spite of seriousness and longevity of heavy metals in the ecosystem, that they are non-degradable with significant oxidizing capacity and substantial affinity for electronegative nucleophilic species in proteins and enzymes.

Enzymes catalyse physiological reactions by decreasing the activation energy level that the reactants (substrates) must reach for the reaction to occur. The influense of pollutants on enzymatic activity of fish is one of the most important biochemical parameters which is affected under exposure of toxicants. In exposure to a toxicant, enzyme activity appears to be increased or it may be inhibited due to the active site being either denatured or distorted. Since some enzymes catalyse some steps in the metabolism of carbohydrates and protein, they are present in most tissues. The increase or decrease in enzyme level in a very accurate index for diagnostic of quantity and quality of toxicant. For example, such effects have been observed after chronic exposure to low doses or acute exposure to high doses of mercury.

Similar research on fish enzymes have demonstrated that antioxidant systems could provide relevant indices in explaining the sensitivity of some fish species to pollutions (Di Giulio et al., 1993). Antioxidants have a very sensitive role in maintaining cell homeostasis and, when these defenses are impaired or surmounted, oxidative stress products, namely reactive oxygen species (ROS), may induce DNA damage, enzymatic inactivation and peroxidation of cell constituents. Fish often increased the levels of protective antioidxants enzymes, as well as non-enzymatic free radical scavengers for prevent and cope again abnormality that cause by ROS. Thereupon, one of the suitable biomarker of exposure to heavy metals is the modulation of antioxidants enzymes for example mercury was recognized as a pro oxidant that induces oxidative stress (Stohs and Bagchi, 1995).

Induction of oxidative stress causes with mercury make an important contribution to molecular mechanism for liver injury. Recent studies confirm that mercury causes severe oxidative damages (Kim and Sharma, 2005) thus mercury is proved to be a potential oxidant in the category of environmental factors.

Hematology and Immunology Biomarkers

The finding of suitable biomarkers for the best possible diagnoses is very critical for ecotoxicological studies. Blood indices are considered pathophysiological parameters of the whole body and therefore are important in diagnosing the structural and functional status of fish exposed to xenobiotics (Adhikari et al., 2004).

Moreover, hematological indices provide quite frequently and routinely accepted methods in aquaculture to evaluate the interactions between dietary levels of nutrients (Lim et al., 2000). Although fish blood indices have been increasingly examined in ecosystem monitoring programs as valuable parameters of physiological changes in the presence of xenobiotics, the lack of basic knowledge about the blood response to stressors mainly from tropical species is the most important leakage to using these indices in environmental monitoring programs (Affonso et al., 2002).

The intensity and duration of these responses and/or effects are effected by several factors, including the concentration of the contaminant, duration of exposure, and the fish species (Heath et al., 1995)

The measurement of biochemical and physiological parameters is a diagnostic tool commonly used in aquatic toxicology and biomonitoring. Hematological parameters are more often used when clinical diagnoses of fish physiology are used to determine subchronic concentrations of pollutants.

Physiological changes induced by xenobiotics are also apparent at the biochemical and physiological level, such as in the carbohydrate and protein metabolism and in hematology. In cases where these alternations are adaptive they are referred to as stress responses, while they are considered effects when they have a negative cause on the physiological condition or even survival of the fish. The intensity and duration of these responses and/or effects are effected by several factors, including the concentration of the contaminant, duration of exposure, and the fish species (Heath et al., 1995). Other research have confirmed this found, for example, changes in hematocrit, hemoglobin, plasma glucose, and lactate levels in Cd-exposed fish (Gill and Epple, 1993). Although the immunotoxicity of mercury is well established, evaluation of their potential immunotoxicity in marine biota is complicated by variables that could modulate the immune response to contaminants under field conditions.

Hormones Biomarkers

Thyroid hormones (THs) have many physiological roles in fish like growth regulation, development, metabolism and hydromineral balance (Van Anholt et al., 2003). A little change in serum concentrations of these hormones, as well as in glucose levels reflects endocrine changes; thereupon, fish physiological competence to cope with ecosystem xenobiotics can be affected. Thus, the hormones biomarkers may also be useful tools in monitoring the impact of heavy metals stressors on fish. Also HPT alterations provide useful data about the health status of fish, being reliable candidates as biomarkers of ecosystem stressors (Teles et al., 2005).

During chemical exposure, for regaining safe homeostasis fish do much physiological processes and two important physiological processes which are modulated when fish are exposed to stress, are hormonal status and immune function (Wendelaar-Bonga, 1997). Whereas it is conspicuous that both of these processes are necessary for an animal survive, but there is few knowledge about role of hormone biomarkers during mercury exposure of marine fish, so in this study, a multi factorial approach, involving determining thyroid hormones as well as measurements of parameters of the non specific immune response like glucose, during the in vivo and in vitro exposure of mercury chloride was used. The information gained from this study may be useful for future strategies in monitoring and predicting the effects of mercury exposure and also in developing indices to measure stress during sea bream culture.

Endocrine Disruption Biomarkers

Environmental pollution by endocrine disruptors is presently a growing awareness concern. Such man made chemicals can mimic or block hormones interfering with the endocrine system and finally compromising crucial biological processes. The increasing hazardous of xenobiotics on biota and making potential endocrine disrupting is a serious threat to human and wildlife health. (Morgado, 2007).

The endocrine procedures have a specific role in fish stress mechanisms. Thus, we can use any changes in specific hormonal functions and consequent biochemical effects as important stress biomarkers.

Based on similar study related to freshwater fish, impacts of contaminants on sex steroid titers might be expected in marine fish, but few have been reported to date. In principle, sex steroids alternation in fish serum is because of intervention with the control of steroid synthesis via the pituitary-gonadal axis, or to effects on steroid metabolism

and excretion (Matthiessen, 2003).

In animals sex steroid hormones are produced by the endocrine system and control the life cycle stages of an organism including gametogenesis, fertilization, sexual development, and reproduction. Recent studies have established that a wide variety of man made chemicals in the ecosystems are capable of modulating and adversely affecting or disrupting endocrine function in animals (Tyler et al, 1998).

Histopathology Biomarkers

Histopathology is now recognized as useful index to assessment the effects of toxicants in vital processes such as growth and reproduction, detecting early effects of pollutant in cells, tissues and organs. Histopathological biomarkers have been widely used in fish for detection and assessment on chemical effects of exposure to toxicants. Also histopathological indices have been largely used as biomarkers in the monitoring of fish health status during exposure to toxicants, both in the laboratory and field studies (Thophon *et al.,* 2003).

Histopathological biomarkers allows examining specific target organs, including gills, gonad and liver, that are responsible for vital functions, such as respiration, reproduction and the accumulation and biotransformation of xenobiotics in the fish and this fact is very important advantage of these category of biomarkers in monitoring programs of marine ecosystems. Moreover, the changes detect in these organs are normally easier to identify than functional ones, and serve as warning signs of damage to animal health (Hinton & Laurén, 1990).

Fish tissues are sensitive indicators of marine toxicant and have a high mercury bioaccumulation capacity for both organic and inorganic forms solution in marine environment. Recent studies have confirmed links between exposure to pollutants and the development of hepatic lesions. For example toxicopathic liver lesions in fish species are suitable and sensitive signs of toxicant-induced injury and have been used as biomarkers of chemicals in environmental risk assessments. Hypertrophy of the liver is a common response of teleosts to pollutants and is linked to hepatic detoxication mechanisms (Lemaire et al., 1992).

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