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Water Quality from Koçkale and Pertek Regions of Keban Dam Lake (Elazığ/TURKEY) on Ovarium Tissue of Capoeta trutta (Heckel,1843) Histopathological Effect

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Abstract: In this study the changes of physical and chemical characteristics of water obtained from pointed stations of Koçkale and Pertek regions of Keban Dam Lake and for this purpose, water temperature, dissolved oxygen, pH, nitrate, nitrite, ammonia, free CO_2, phosphate, calcium hardness, magnesium hardness, free chloride and total hardness have been monthly analysed. At the same time, a total number of 367 *Capoeta trutta* (Heckel, 1843) have been caught and macroscopic and microscopic features of ovarium of 182 female from Koçkale region and 185 female from Pertek region have been examined. Macroscopically; it was observed that the ovariums of fish from Pertek region showed better development than those from Koçkale region. Microscopically; it was also observed that the atretic folicula (development uncompleted, but oocyte stage unable to reach ovulation because of environmental factors) numbers in the ovariums of fish from Koçkale region showed an obvious increase compared with that from Pertek region. It was concluded that ovarium development of the fish was negatively affected as a result of the changes in chemical parameters of ammonia, nitrate and phosphate in Lake water with discharging of sewage from Elazığ city into Keban Dam lake at Koçkale region.

Key words: Keban Dam Lake, Capoeta Trutta, Water Quality, Ovarium Tissue.

INTRODUCTİON

Rapidly increasing world population, ever-increasing industrialization, urban sprawl, unconscious and over-exploitation of herbicides, pesticides and insecticides, artificial fertilizers, detergents etc. pollute the environment and pose a threat to living beings. Waste waters as a result of these activities both change the physico-chemical structure of the medium water in receptive areas they are discharged in such as lakes, rivers, coves and bays and cause significant changes in the bottom structure (Dave and Nilsson, 1999, Haitzer *et al*.,1988). Aquatic environments which are polluted intensively due to these activities turn into confined spaces for living beings. The effect of water pollution on aquatic organisms depend on the physical, chemical and bacteriological structures of pollutants and whether waters of the discharge site are stagnant or flowing. Living beings should not have any defects in their reproductive organs and the conditions of their habitats should be hospitable for the continuation of their posterities. Fishes and other aquatic animals are effected considerably by the physical and chemical changes in water and this is reflected in their metabolical and physiological activities (Scott and Sloman,2004).

Capoeta trutta (Heckel,1843) is an economically important species living only in the Dicle and Fırat aquatic systems and is consumed extensively by the people living in the area. Although there are many researches on the distribution and taxonomy of the species in Dicle and Fırat and their branches made by the researchers both from our country and abroad, there are barely any researches on especially the effects of the changes in water quality on the histological structure of *Capoeta trutta* (Heckel,1843) ovariums. He reported, in a study he carried out on the biological characteristics of the same species in the Dicle River, that spawning in females began from May onwards and egg-bearing females were non-existant at the end of June (Ünlü,1991).

No histopathological researches on the effect of existing water conditions in both areas on the reproductive organs of fish were found. The researches done in the study areas are those on gill histopathology Özdemir (1992) and water quality (Duman and Özdemir,1991, Harlıoğlu,1989, Özdemir,1989).

Materials and Methods:

Research Area:

The Keban Dam is situated 45 km. North-west of Elazığ city centrum in the vicinity of Keban County. The Dam Lake basin has got an average width of 125 km, a length of 425 km and an area of 64100 hectares and a water volume of 30.6×10^9 m^3 (Anonymus,1994). The study was conducted in Koçkale region 20 km south of

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Elazığ city center and at which point the sewage from the city is discharged into the Dam Lake and Pertek region where no discharging takes place and regarded as a clean region.

Selecting Research Stations And Research Period:

Water and fish samples were taken from three stations; one from the Lake's receptive zone where sewage is discharged at Koçkale (Station I) and two from an area of 1 to 5 km wide where there is no pollution (Station II and Station III) and three stations from Pertek region. (Figure I).

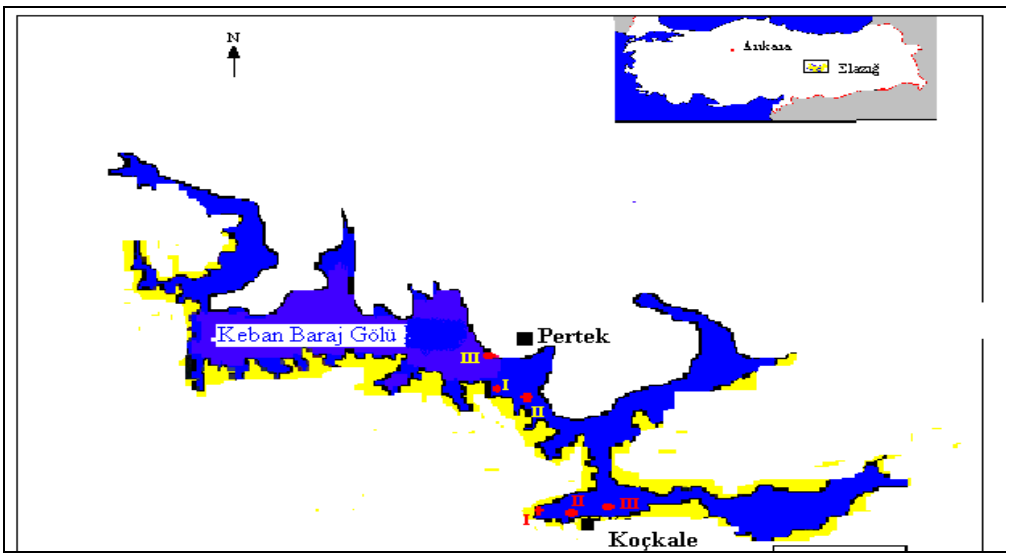

Fig. I.General appear of the stations in this study regions. 1/10000 000

Taking Water Samples:

Water samples were taken from station I at Koçkale region where the sewage from the city is directly discharged into the Dam Lake by dipping 2-liter polyethylen bottles into the lake's surface and from station II-III by dipping Nansen bottles into the lake's surface.

The same steps were repeated at stations at Pertek and the following analyses were done for water samples in 2-liter polyethylen bottles using a Hanna C-200 field photometer and a DR-2010 field spectro-photometer. Carbondioxide and chlorine analyses were done in the field (Apha, 1985).

Taking Fish Samples:

Fish were caught with help from local fishermen using trammel nets with 18x18, 24x24 and 50x50 mm mesh size. Fish were put into three 15-20 liter polyethylen plastic cans and were brought to laboratories at Fisheries Faculty of Fırat University. Then, their body weights were measured using ±0.1 g sensitive digital scales and their total lengths were measured on ± milimetrical measuring board. The abdominal parts of the fish were incised longitudinally and examined macroscopically to determine where their ovariums were placed. Ovarium weights were measured on a ±0.001g sensitive and their lengths were measured on a milimetrical measuring board and the obtained values for each month were shown in tables. Dorsal fin beams were used for age determining since the most accurate annual rings for this species are determined with dorsal fin beams (Öztürk *et al*., 1997; Polat, 1987).

Preparation Of Histological Preparates:

Ovarium pieces taken from the fish were fixed in 4% Formaline solution. Paraffine blocks were prepared for histological examination according to the routine preparate preparation technique Luna (1968) and cut in a microtome tuned to 5µm. In the cross-sections, hematoxylin and eosin was used in order for the nucleui and cytoplasms of the egg cells to be seen, triple staining ligaments and their cells and P.A.S for the zona pellucida and glycogen cells were used and examined with a light microscope (Linaes *et al.,* 2002; Luna, 1968; Ural and Özdemir, 2000). Findings were evaluated and the pictures of those thought to be significant were taken.

RESULTS AND DİSCUSSİON

Physical And Chemical Properties Of The Dam Water İn Koçkale And Pertek Regions:

Water quality parameters at the stations of both regions were measured monthly and given in tables below (Tables I-VI).

Macroscopic Findings İn The Ovariums Of Capoeta Trutta Caught From Koçkale And Pertek Regions:

Macroscopically, while it was found that the ovariums of the 2-4 age group fish caught in the period from October to February in Koçkale region were cord-like and had an off-white colour and a slight veining, it was observed that the ovariums of the fish of age group 4 in Pertek region were taut and had a yellowish colour and veining increased gradually towards the end of February.

Table-I: Physical and chemical analyses of water in the Koçkale region of 1'th station.

5Koçkale region of 1'th Station.

Monts	Temperature (°C)	pH	Dissolved O_2 mg/L	Free CO_2 mg/L	Nitrite mg/L	Nitrate mg/L	Amonia mg/L	Phosphate mg/L	Free Clor mg/L	Total Hardness mg/L	Calcium mg/L	Magnesium mg/L
August	21	8,7	7,7	8,1	0,051	20	2	4,12	0,02	72,6	152	84
September	18	8,7	7,8	7,5	0,048	15	1,8	3,16	0,02	69,2	148	78
October	12	8,2	8,7	7,3	0,026	13,7	0,91	2,15	0,02	67	143	76
November	10	8,4	9,2	6,9	0,025	14,2	0,78	2,13	0,01	71,6	153	81
December	8	8,4	9,8	6,7	0,023	14,7	0,5	1,47	0,02	71,3	123	69
January	7	8,5	9,9	6,7	0,020	14,5	0,51	1,35	0,01	70,8	121	68
February	7,4	8,4	9,8	6,7	0,020	15,6	0,67	3,01	0,02	73,7	140	94
March	7,4	8,5	9,6	6,5	0,030	16,1	0,75	3,25	0,01	75,1	144	96
Aprıl	8,1	8,4	9,2	6,8	0,040	17,3	0,83	3,51	0,01	73,7	148	89
May	13,1	8,1	9	7,2	0,051	17,9	0,9	3,55	0,01	73,1	151	86
June	15,2	8	8,6	7,2	0,050	17,7	0,91	3,5	0,01	73,3	150	85
July	21	8,2	7,8	8,3	0,052	17,8	1,1	3,4	0,02	73,6	153	91

Table-II: Physical and chemical analyses of water in the Koçkale region of 2'th station.

Koçkale region of 2'th Station

Monts	Temperature (°C)	pH	Dissolved O_2 mg/L	Free CO_2 mg/L	Nitrite mg/L	Nitrate mg/L	Amonia mg/L	Phosphate mg/L	Free Clor mg/L	Total Hardness mg/L	Calcium mg/L	Magnesium mg/L
August	20	8,6	7,7	7,8	0,048	18	1,5	3,78	0,01	62,5	131	72
September	18	8,7	7,8	7,5	0,045	15	1,5	3,15	0,01	67,7	142	78
October	12	8,2	8,7	7,3	0,024	13,2	0,89	2,1	0,01	66,2	143	74
November	10	8,4	9,2	6,8	0,023	14,2	0,78	2,1	0,02	71,6	153	81
December	8	8,4	9,8	6,7	0,023	14,7	0,51	1,45	0,01	71,3	123	69
January	7	8,5	9,8	6,8	0,021	14,4	0,52	1,32	0,02	70,9	120	60
February	7,3	8,5	9,8	6,8	0,020	15,3	0,65	2,19	0,02	74,5	138	97
March	7,3	8,3	9,7	6,6	0,033	15,9	0,73	3,2	0,02	73,8	142	93
Aprıl	8,5	8,3	9,3	7	0,038	17,6	0,85	3,48	0,02	73,3	145	90
May	13,3	8,2	8,9	7,2	0,049	18,2	0,92	3,52	0,02	72,5	150	85
June	15,3	8,1	8,4	7,3	0,051	18,1	0,93	3,48	0,02	72,7	148	84
July	22	8,2	7,7	7,4	0,050	18,4	0,91	3,55	0,01	71,4	150	83

Table-III: Physical and chemical analyses of water in the Koçkale region of 3'th station.

Koçkale region of 3'th station.

Monts	Temperature (°C)	pH	Dissolved O_2 mg/L	Free CO_2 mg/L	Nitrite mg/L	Nitrate mg/L	Amonia mg/L	Phosphate mg/L	Free Clor mg/L	Total Hardness mg/L	Calcium mg/L	Magnesium mg/L
August	20	8,6	7,8	7,7	0,043	15	1,3	3,27	0,02	58,5	122	68
September	17	8,6	8,1	7,2	0,046	13	1,1	3,12	0,01	56,9	125	62
October	11	8,1	8,9	7	0,022	12,8	0,83	2,1	0,02	61,1	132	71
November	11	8,3	9,1	6,8	0,023	14,4	0,76	2,12	0,01	70,5	150	80
December	7	8,5	9,8	6,8	0,022	14,3	0,52	1,4	0,02	71,2	121	60

Table-III: Continue

January	7	8,4	9,9	6,8	0,020	14,4	0,51	1,32	0,01	72,6	123	62
February	7,5	8,4	9,8	6,6	0,020	15,3	0,6	2,76	0,02	73,2	136	95
March	7,4	8,5	9,8	6,3	0,033	16,1	0,74	3,12	0,01	73,6	146	90
Aprıl	8,6	8,4	9,5	7,1	0,014	18,1	0,88	3,45	0,01	74,8	150	91
May	13,5	8,1	8,9	7,4	0,051	18,6	0,91	3,47	0,02	71,2	148	83
June	15,5	8,2	8,4	7,6	0,050	18,3	0,92	3,5	0,01	71,4	150	84
July	21	8,2	7,6	7,5	0,045	18,5	0,93	3,3	0,01	68,9	138	70

Table-IV: Physical and chemical analyses of water in the Pertek region of 1'th station.

Pertek region of 1'th Station.

Monts	Temperature (°C)	pH	Dissolved O_2 mg/L	Free CO_2 mg/L	Nitrite mg/L	Nitrate mg/L	Amonia mg/L	Phosphate mg/L	Free Clor mg/L	Total Hardness mg/L	Calcium mg/L	Magnesium mg/L
August	22	8.7	7.7	7.8	0.013	7.1	0.01	0.02	0.02	48.5	24	103
September	19	8.7	7.8	7.5	0.012	6.6	0.01	0.02	0.02	47.8	21	103
October	12	8.2	8.7	6.2	0.012	5.8	0.01	0.01	0.02	48.4	22	104
November	10.8	8.4	9.2	6.1	0.01	5.2	0.01	0.02	0.01	45.9	17	101
December	8	8.4	9.8	5.8	0.01	5.1	0	0.01	0.02	48.5	26	102
January	7	8.5	9.9	5.7	0.009	4.8	0	0.01	0.01	49.1	26	103
February	7.4	8.4	9.8	6.1	0.011	5.2	0	0.01	0.02	53.1	31	110
March	7.4	8.5	9.6	6.3	0.01	5.1	0	0.02	0.01	54.2	32	112
Aprıl	8.2	8.4	9.2	6.4	0.012	5.3	0.01	0.03	0.01	54.3	30	113
May	13.2	8.1	9	6.8	0.01	5.3	0.01	0.02	0.01	54.1	30	113
June	15.1	8.1	8.8	7.1	0.01	5.5	0.01	0.02	0.02	54.4	31	113
July	20	8.1	7.8	7.9	0.009	6.4	0.01	0.01	0.01	48.7	23	108

Table-V. Physical and chemical analyses of water in the Pertek region of 2'th station.

Pertek region of 2'th Station

Monts	Temperature (°C)	pH	Dissolved O_2 mg/L	Free CO_2 mg/L	Nitrite mg/L	Nitrate mg/L	Amonia mg/L	Phosphate mg/L	Free Clor mg/L	Total Hardness mg/L	Calcium mg/L	Magnesium mg/L
August	21	8.6	7.7	7.8	0.011	6.8	0.01	0.01	0.01	47.8	23	102
September	19	8.7	7.8	7.5	0.011	6.4	0.01	0.01	0.01	46.6	20	101
October	12.2	8.2	8.7	6.3	0.011	5.7	0.01	0.01	0.01	47.8	21	103
November	11	8.4	9.2	6.2	0.009	5.2	0.01	0.01	0.02	42.9	15	96
December	8	8.4	9.8	5.7	0.01	5.1	0	0.01	0.01	48.9	29	105
January	7	8.5	9.9	5.6	0.01	4.8	0	0.01	0.01	50.3	28	104
February	7.3	8.5	9.8	6.2	0.012	5.3	0	0.02	0.01	52.1	30	108
March	7.3	8.3	9.7	6.3	0.013	5.2	0	0.02	0.02	52.8	30	110
Aprıl	8.5	8.3	9.3	6.3	0.011	5.2	0.01	0.02	0.02	53.5	29	105
May	13.3	8.2	8.9	6.8	0.011	5.2	0.01	0.02	0.01	55.6	32	115
June	15.2	8	8.6	7.2	0.01	5.5	0.01	0.01	0.01	52.1	31	110
July	21	8.1	7.7	7.9	0.015	5.8	0.01	0.02	0.01	51.4	27	104

Table-VI. Physical and chemical analyses of water in the Pertek region of 3'th station.

Pertek region of 3'th station.

Monts	Temperature (°C)	pH	Dissolved O_2 mg/L	Free CO_2 mg/L	Nitrite mg/L	Nitrate mg/L	Amonia mg/L	Phosphate mg/L	Free Clor mg/L	Total Hardness mg/L	Calcium mg/L	Magnesium mg/L
August	20	8.6	7.7	7.8	0.01	6.7	0.01	0.01	0.02	47.8	23	102
September	18	8.6	7.8	7.2	0.011	6.1	0.01	0.02	0.01	46.1	18	101
October	12.3	8.1	8.8	6.5	0.013	5.7	0.01	0.01	0.01	48.1	24	102
November	11	8.2	9.1	6.2	0.011	5.3	0.01	0.02	0.01	47.1	18	96
December	7	8.4	9.5	5.7	0.011	5.2	0	0.01	0.01	49.5	28	104
January	7	8.3	9.7	5.5	0.009	5.1	0	0.02	0.01	51.8	29	106
February	7.3	8.4	9.8	6.2	0.013	5.4	0	0.02	0.01	53.7	32	110

Table-VI: Continue

March	7.3	8.2	9.7	6.1	0.012	5.5	0	0.01	0.01	54.1	31	108
Aprıl	8.6	8.4	9.5	6.5	0.012	5.3	0.01	0.02	0.01	54.5	33	112
May	13.5	8	8.7	6.9	0.013	5.5	0.01	0.02	0.01	54.9	28	102
June	15.1	8.1	8.5	7.3	0.015	5.2	0.01	0.01	0.01	55.8	25	105
July	20	8.1	7.6	7.9	0.017	6.5	0.01	0.02	0.01	50.8	25	104

The ovariums of the fish at age group 5-7, especially those in Pertek region were observed to swell towards the period of growth and gained a mixture of orangish-yelowish colour and increased in weight. However, it was found that these changes in the ovariums of the fish in Koçkale region began towards the end of March. It was observed that the ovariums of the fish at age group 8-10 in both regions took up the abdominal cavity completely and there was a significant increase in both weight and length. It was also determined that ovariums of the fish of all age groups took a shape of a quite long cord and suffered a considerable weight loss. No macroscopical lesions were seen in the fish ovariums which were examined depending on seasonal changes in water quality properties.

Microscopic Findings İn The Ovariums Of Capoeta Trutta Caught From Koçkale And Pertek Regions:

In the microscopic examinations of the fish obtained from the research zones, a considerable increase was observed in the number of atretic follicles and primordial follicles in the ovariums of the fish in Koçkale zone in the period from January to February compared to those in Pertek zone. (Figures II, III*)*.

Fig. II: Ovarium tissue of *C.trutta* between january and february in the Koçkale region. pf:primordial folicules. **O:**oosits. **Numbers;**different growth stages of ovarium. **B;** connective tissue. Hematoxylin and eosin x33

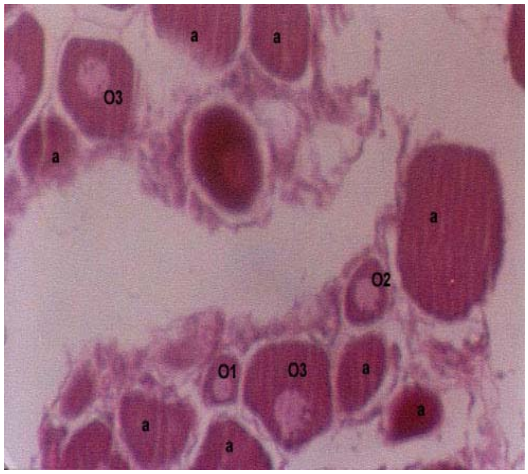

Fig. III: Ovarium tissue of *C.trutta* between january and february in the Pertek region. **O:**oosits, **Numbers 1,2,3;** different growth stages of ovarium. **a;** atretic folicules. Hematoxylin and eozin x330

Although it was observed that there was an abundance of primordial oocytes in the female ovariums of the age group 2-4 and that the growing oocytes were at the growth phases 2,3 and 4 (Figure IV) depending on the increase in the amounts of nitrite, nitrate, ammoniac and phosphate in the dam lake water in Koçkale zone in March and April, it was observed that the thickness of zona pellucida increased, diameters of nucleus and nucleolus increased and the majority of oocytes were in the growth phases 4,5 and 6 in the ovarium tissues of the fish at age group 4 in Pertek zone in the same periods (Figure V).

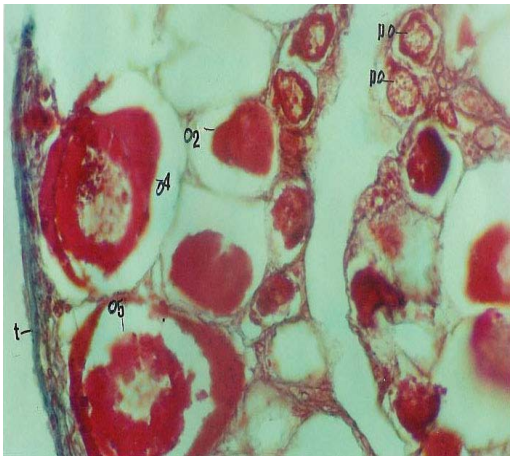

Fig. IV. Ovarium tissue of *C.trutta* between march and april in the Koçkale region of 1'th station. **O:** oosits, **Numbers;** different growth stages of ovarium. **po;** primordial folicules, **t;** tunica albuginea. Hematoxylin and eozin x330

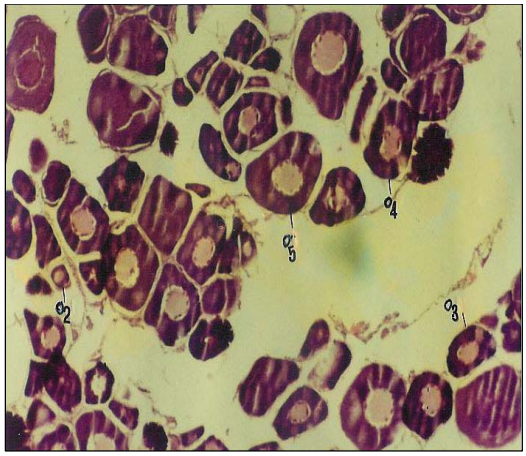

Fig. V. Ovarium tissue of *C.trutta* between march and april in the Pertek region. **O:** oosits, **Numbers;** different growth stages of ovarium. Hematoxylin and eozin x33

While it was observed that there was an abundance of atretic follicles in the ovarium tissues of the age group 5-7 fish in Koçkale region and that the existing oocytes were at the growth phases 4,5 and 6 (Figure VI) depending on the changes in water quality criteria such as ammoniac, nitrite, nitrate and phosphate, it was determined that the majority of the oocytes in the ovariums of the fish in Pertek zone were at the growth phases 6 and 7 and were comprised of mature follicles (Figure VII).

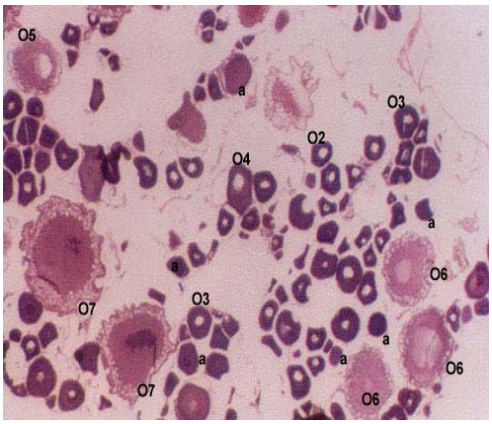

Fig. VI. Ovarium tissue of *C.trutta* in May in the Koçkale region of 1'th station. **O:** oosits, **Numbers 1,2,3;** different growth stages of ovarium. **a:**atretic folicules. Hematoxylin and eozin x33

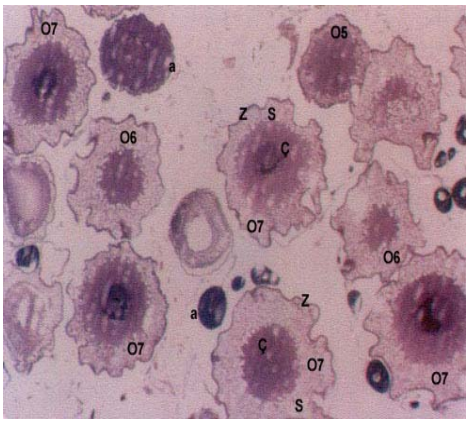

Fig. VII. Ovarium tissue of *C.trutta* in May in the Pertek region. **O:**oosits, **Numbers 5,6,7;** different growth stages of ovarium. **a;** atretic folicules, **z:** zona pellucidae, **s:**stoplazma of ovaria, **ç:** focus of ovaria. Hematoxylin and eozin x33

While the egg cells obtained from the ovarium tissues of the 8-10 age group fish in Koçkale and Pertek zones tended to show a growth similar to the growth in other months, significant changes in the microscopic and macroscopic structures of the ovarium tissues of the fish were observed in especially the period from June to

August (spawning time). The abundance of the egg-bearing female fish in Pertek zone was remarkable while there were few egg-bearing females in Koçkale zone. Besides, microscopically, few atretic follicles were observed in *Capoeta trutta* (the objects of the study) ovariums in Pertek zone. However, a remarkable rise in the number of atretic follicles (oocytes not ovulated due to the changes in water quality criteria (ammoniac, nitrite, nitrate and phosphate) (Figures VIII,IX). It was also observed that, depending on the changes in water quality criteria (ammoniac, nitrite, nitrate and phosphate) the effect on the egg cells in ovariums increased as their ages increased in Koçkale zone as opposed to Pertek zone.

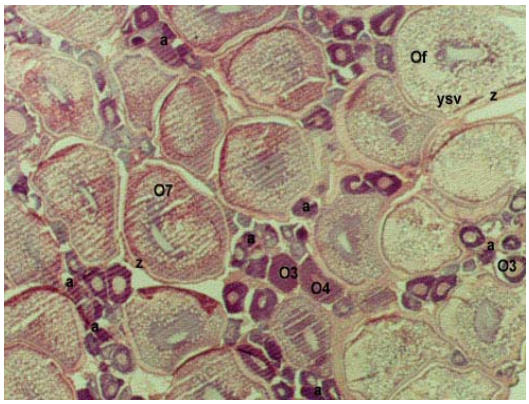

Fig. VIII: *C.trutta* of ovarian tissue between June and July in the Koçkale region. Of: mature follicules. O: oosit numbers; different growth stages of ovarium. a:atretic follicules. z: zona pellucidae. ysv: vesicules of egg yellow. Trichorome Stained x 300.

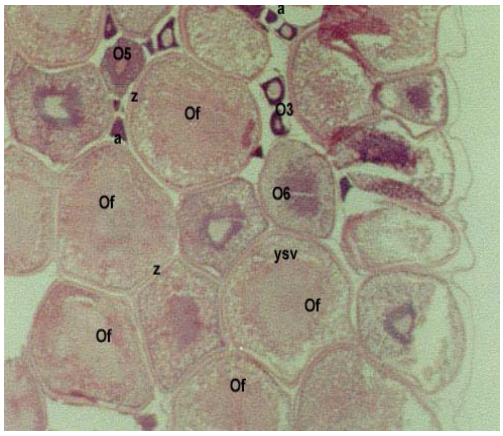

Fig. IX: *C.trutta* of ovarian tissue between June and July in the Pertek region. Of: mature follicules. O: ovosit numbers; different growth stages of ovarium. a:atretic follicules. z: zona pellucidae. ysv: vesicules of egg yellow. Trichorome Stained x 300.

Discussion:

Although significant differences in temperature values between the stations in Koçkale zone were not recorded, high temperatures (15-22°C) in summer months and low temperatures(7-8°C) in winter months were recorded. The pH values of the dam lake water at the stations of both research zones (Koçkale–Pertek) varied between 8.0 and 8.7 and this shows that there is a homogenous composition between the research zones.

Although the amounts of dissolved oxygen at the stations of both zones were not very different (average 7-9 mg/l), it was observed that oxygen was low at the station I in Koçkale, where the sewage from the city discharged into the dam lake, compared to other stations. The oxygen level was measured to be low (7.7 mg/L at station I in Koçkale) in summer months and high (10 mg/L at station III in Koçkale and Pertek zones) in winter months.

Although carbondioxide levels were recorded to be 6.3 mg/L at station III in March and 8.3 mg/L at station I in July in Koçkale, a significant difference on a monthly basis was not seen between the stations. Of the stations in Pertek zone, the lowest carbondioxide value was measured to be 5.5 mg/L at station I in January and the highest value was 7.9 mg/L at all of the three stations in July.

Our findings in this study show a similarity with those of Duman and Özdemir (1991), Harlıoğlu (1989), Özdemir (1989). Although nitrate, nitrite, ammoniac and phosphate values at station I in Koçkale zone, where a direct discharge into the Keban Dam water occurs, tend to increase especially in summer months compared to other seasons and reach their peaks in August (nitrate 20 mg/L, nitrite 0.51 mg/L, ammoniac 2 mg/L and orthophosphate 4.12 mg/L), it was found that they pose no threat to the living things in the environment. The values in Pertek zone, another study area where the same parameter values are measured, were determined to be lower than those in Koçkale zone (nitrate 5 mg/L, nitrite 0.01 mg/L, ammoniac 0.01 mg/L and ortophosphate 0.01 mg/L).

Macroscopically, while it was found that the ovariums of the 2-4 age group fish caught in the period from October to February in Koçkale region were cord-like and had an off-white colour and a slight veining, it was observed that the ovariums of the fish of age group 4 in Pertek region were taut and had a yellowish colour and veining increased gradually towards the end of February.

In the macroscopic examinations of the ovariums of *Capoete trutta*, the objects of our study, it was seen that the ovariums of the fish caught in January in Koçkale region were cord-like, had an off-white colour and showed a slight veining, it was observed that they took on a yellowish colour, became swollen and taut and their weights increased towards the growth period (March-April). As to the ovarium growth of the fish in Pertek zone, despite the fact that the ovariums are tauter than those in Koçkale zone, had a remarkably yellowish colour and an ever-increasing veining at the beginning of January, it was determined that there was a significant increase in their weights and lengths and the developed ovariums completely covered abdominal cavities.

The macroscopic findings from our study show a similarity with those of Bara (1960), Dixit and Agrawala (1974), Elorduy (1994), Ural and Özdemir (2000), they obtained from their research on the ovarium growth of various fish species. In the microscopic study of ovariums of the same fish, it was observed that the oocyte and nucleus diameter increased in parallel with ovarium growth in Koçkale in the period between March and April, the ovariums took a round or polygonal shape, the nucleus and the cytoplasm were stained with hematoxylin and eosin, the rate of connective tissue decreased steadily, the zona pellucida got thicker, egg yolk vesicles intensified towards the periphery, and the number of glycogen and lipid globules increased. The ovariums of *C.trutta* in Pertek zone were found to show growth earlier (January-March). In the microscopic studies of ovarium structure, the findings relating to the microscopic studies on ovarial growth are in parallel with the findings of our study despite the fact that environmental conditions and fish species were different (Anderson and Douglas, 1974; Dixit and Agrawala, 1974; Elorduy, 1994; Msiska and Pierce, 1999; Palmer *et al.,* 1995, Park and Yoon, 1992; Scott and Sumpter, 1983; Tomkiewica *et al.,* 2003; Ural and Özdemir, 2000; Van Der *et al.,* 1988; Van Oordt, 1987; Yasute and Wales, 1983).

In our study, it was found out that the changes in the chemical parameters (ammoniac, nitrite, nitrate and phosphate values) of the lake water in Koçkale zone had a retarding effect on the growth of *C. trutta* ovariums and hence caused a greater rise in the number of atretic follicles than it did in Pertek zone. They reported that atretic follicles would form in the ovarium due to long-term changes in environmental factors acting upon ovarium growth (Al Daham and Bhatti, 1979; Bardakcı *et al.,* 2000; De Vlaming, 1972; Nagahama, 1983; Wootton, 1982). They reported that the unusual rise in the number of atretic follicles caused a stress on fish and effected ovarium growth as a result of the changes in environmental factors such as water temperature, the amount of oxygen, nitrite, nitrate, phosphate especially during ovarium growth. In the ovariums examined before spawning (June-July), İt was observed that the number of atretic follicles increased substantially in Koçkale zone compared with that in Pertek zone due to the changes that took place especially in these months in ammoniac, nitrite, nitrate and phosphate values of the dam water measured at the point in Koçkale zone where the sewage from the city of Elazığ is discharged into Keban Dam Lake.

In different studies done on the factors which have an effect on ovarium growth, it was reported by many researchers that the changes in environmental factors such as water temperature, photoperiod, the amount of dissolved oxygen, salt concentration in marine environment and feeding etc. usually caused the formation of atretic follicles and because they fail to mature completely, these follicles are absorbed by fagocytes (Debarah *et al.,* 2004; Kamanga *et al.,* 2004; Layl, 1998; Okuzawa *et al.,* 1989, Wootton, 1982). Although the medium conditions in these studies were different, the fact that the number of atretic follicles increased in the ovarium tissues which were effected by environmental factors in the period of egg growth is in parallel with our findings in the present study.

When the ovarium growth of *C. trutta* in both regions were compared, it was seen that while the ovarium growth in Pertek zone began at mid-January, they began maturing at a later date (late March) in Koçkale zone due to the changes in chemical parameters of the lake water such as ammoniac, nitrite, nitrate and phosphate at Keban Dam Lake in Koçkale zone.

It was also determined that there was a bigger rise in the numbers of oocytes I, II, III found in ovarium structure and atretic oocytes compared to that in Pertek zone. It was concluded that these parameters which pollute the water (ammoniac, nitrite, nitrate and phosphate) influenced the ovarium growth of the *C. trutta* in Koçkale zone negatively. For this reason, it is possible, based on the findings of the present study and other

studies by other researchers, to speak of a pollution spreading more and more each year in Koçkale zone, the flat part of the Keban Dam Lake.

The discharge of the sewage from the city of Elazığ into Koçkale zone pollutes the dam water both qualitatively and quantitatively and so, indirectly pose a threat to the survival and continuation of the fish and other aquatic living things.

Therefore, it is of outmost importance to treat the sewage from the city in a treatment unit physically, chemically and biologically before releasing it into the dam lake. This would prove beneficial also for the people who live in the neighbourhood and rely on fishing for their livelihoods.

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