Indian J. Anim. Res., **47** (6) : 527-532, 2013

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com / indianjournals.com

THE EMBRYONIC AND LARVAL DEVELOPMENT OF *CAPOETA TRUTTA* (HECKEL, 1843)

Z. Dogu*[1], F. Aral[2] and E. Sahinöz[1]

[1]Department of Fisheries and Aquaculture, Bozova Vocational High School,
Harran University 63850, Bozova, Sanliurfa, Turkey.

Received: 27-03-2012 Accepted: 19-11-2012

ABSTRACT

The embryonic and larval development of *Capoeta trutta* (Heckel, 1843) were observed after artificial fertilization. Eggs were obtained from females and milt was obtained from males matured by using abdominal massage naturally. Fertilized eggs were kept in lake water at 24–26°C. The perivitelline space formed 30 min after insemination. The diameter of the fertilized eggs ranged from 0.63 to 1.95 mm. The first cleavage occurred at 1.5-2 h, the morula began at 5 h, the blastula was observed at 9 h. An embryonic body formation was formed from the embryonic shield and also some somites were observed 10-12 h after insemination. The first hatching was occurred 60 h after insemination. Larval development of *C. trutta* was observed 96-240 h after insemination.

Key words: *Capoeta trutta*, Egg, Embryo, Larva.

INTRODUCTION

Cyprinidae is one of the largest fish family with around 2,100 species worldwide. As a family, *cyprinids* are classified based on having one dorsal fin, abdominal pelvic fins, cycloid scales, and a lateral line (Page and Burr, 1991). The *cyprinids* include fish commonly known as carps, shiners, chubs, daces, and pikeminnows. *Capoeta* genus (Heckel, 1843) is in the *Cyprinidae* and widely distributed from Afghanistan to Aegean coastal in Turkey. It generally lives on sediments having considerable muddy and sandy areas. There has been amateur fishing in the Euphrates and Tigris River systems and it has economic value in the region. There are five species and six subspecies of *Capoeta* in Turkey's waters (Geldiay and Balik, 2002) and also, there are 12 species of *cyprinids* known to Atatürk Dam Lake (Ersen, 2003). It may be 70 cm; shaped fusiform (Geldiay and Balik, 2002). Atatürk Dam Lake contains this fish that provide a large proportion of the protein need for the people living in the region. So, the various biological properties of *Capoeta trutta* were investigated by many researchers in this area (Polat, 1987; Dogu, 2002). However, there is almost no information about embryonic and larval growth of this fish species living in this reservoir. Information on early embryonic and larval development and organogeny is of critical importance in understanding the basic biology of a particular species and their dietary needs and environmental preferences (Koumoundouros *et al.* 2001, Borcato *et al.*, 2004).

Embryonic studies support phylogenetic development by presenting supportive proofs to determine an organism's ancestral forms. For example, it describes evolutionary development by explaining many issues like gill cleft in the lower vertebrates (fish) which is seen in almost all mammalian embryos in early developmental stages. In addition, this period of fish life is also used in various experimental studies; especially in aquaculture as well as toxicological studies (Aral *et al*, 2011).

The aim of this study is to describe the development of embryonic and early larval of *C. trutta* after artificial insemination and morphologic traits of embryo and larvae was discussed.

MATERIALS AND METHODS

During the study, *C. trutta* were caught with gill nets (22 x 22 mm), at Ataturk Dam Lake (37 ^{0} 24' 25''N,

*Corresponding author's e-mail: zaferdogu@harran.edu.tr, zafer_dogu@yahoo.com
[1]Department of Fisheries and Aquaculture, Bozova Vocational High School, Harran University 63850, Bozova, Sanliurfa, Turkey.

38 ^{0} 31' 35' 'E). Physicochemical parameters of the sampling areas were measured with YSI Environmental (YSI 85). Three mature female and three male *C. trutta* were transported to the laboratory under control and accommodated in small tanks. Then, the insemination was carried out at the Department of Fisheries of Harran University, Bozova Vocational High School.

Samples obtained were moved to the laboratory with the help of tanks containing lake water and for age determination, scales was examined under a stereomicroscope (Nikon SMZ 2 T stereo, Tokyo, Japan).

One hundred pieces of eggs taken from mature females were mixed with sperm. Later on, it was moved to a zuger like mechanism prepared beforehand (Sahinöz *et al*, 2006). The water temperature was adjusted to 24 – 26°C using thermostat heaters. Embryonic developments in fertilized eggs were examined on stereo-microscopes. Unfertilized eggs were taken away from the medium. Examination of the egg stages, measurements of diameters of eggs were performed with an ocular micrometer. Photos were taken with a stereo-microscope and an inverted photo-microscope (Nikon SMZ 2 T stereo).

RESULTS AND DISCUSSION

Mature *C. trutta* aged 4-6 years old were observed in the scale samples (Baker & Timmons 1991). The developmental stages of the embryos are shown in Fig1 (A-U).

Fertilized egg: The diameters of unfertilized eggs ranged between 1.52 and 1.65 mm, while the diameters of fertilized eggs ranged from 1.63 to 1.95 mm. The perivitelline space formed 0.5 h after insemination (A). No oil droplets in the eggs.

Cleavage: The first cleavage occurred at the animal pool 1.5-2 h after insemination (B).

Morula: The blastodisc consisted of many blastomers 5h after insemination (C).

Blastula and Gastrula: The blastocoel was formed inside blastodisc 9 h after insemination (D).

Embryonic body formation: The blastoderm covered half the egg 10-12 h after insemination and an embryonic body was formed from the embryonic shield (E-F). Some somites became discernible (G).

Optic vesicle and auditory vesicle formation: The head of the embryonic body started to swell 30-34 h after insemination Optic vesicles were formed in the head and auditory vesicles became recognizable behind the optic vesicles (H-I).

Notocord and Tail Formation: The notochord was recognized in the embryonic body 48 h after insemination (j). The tail bud began to separate from the yolk 51 h after insemination (J).

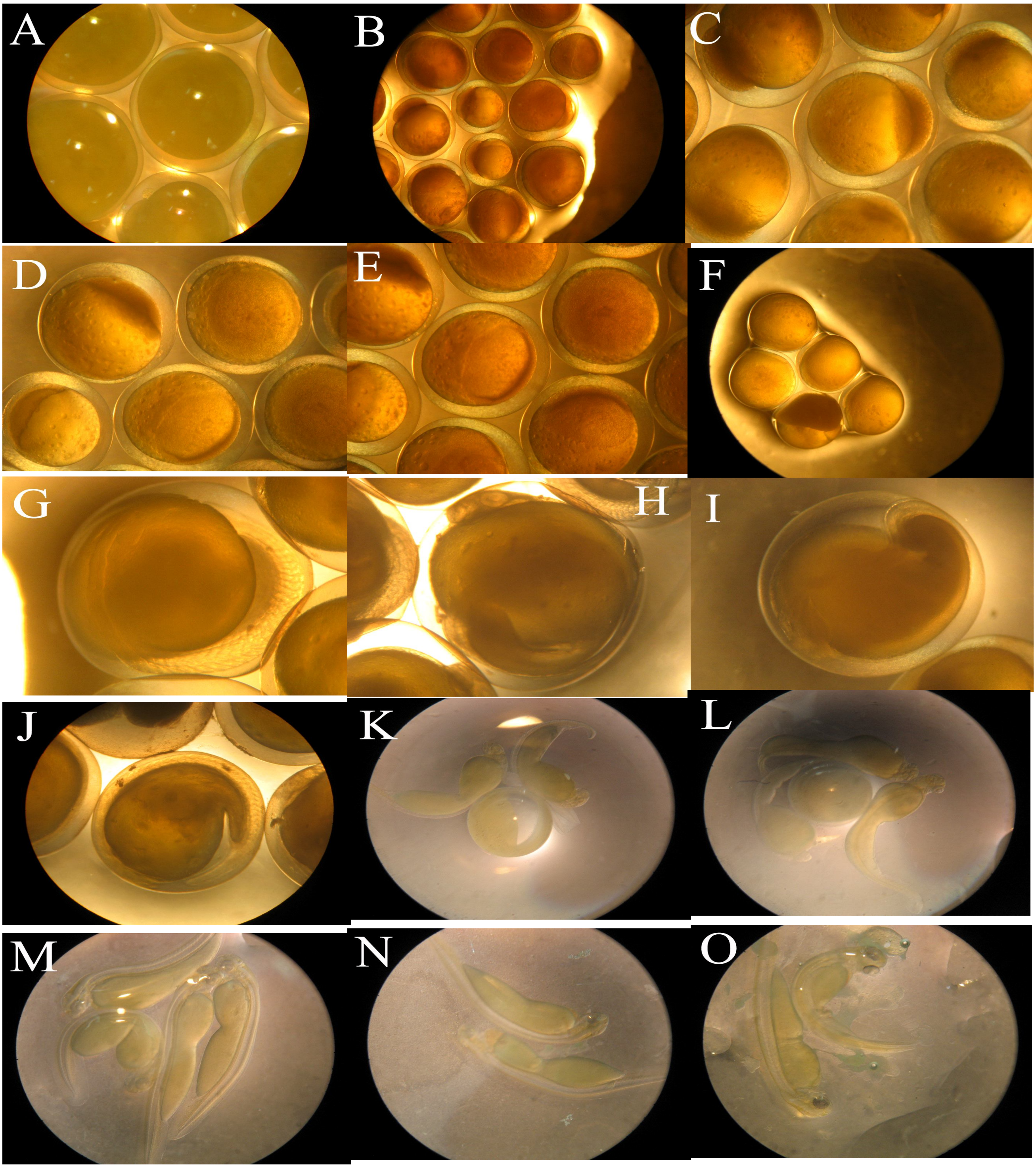
Hatching (newly hatched larvae): The body of a newly hatched larva remained curved for several hours after hatching in 60 h. (K). The mouth and anus were not yet open. No pigmentation was recognized.

Larval development: (L) shows the first external morphology of the larvae, 72 h after insemination. The body straightened slightly, 80 h after insemination (M). The eyes pigmentation were started at 96-120.h (N-O). Dorsal pigmentation was started and spread whole body, 144-168 h. after insemination (P-R). The eye pigmentation was finished and air bladder was appeared, 192 h. after insemination (S). Yolk sac was consumed, 216 h after insemination (T). The mouth and anus opened at the same time, 240 h after insemination (U).

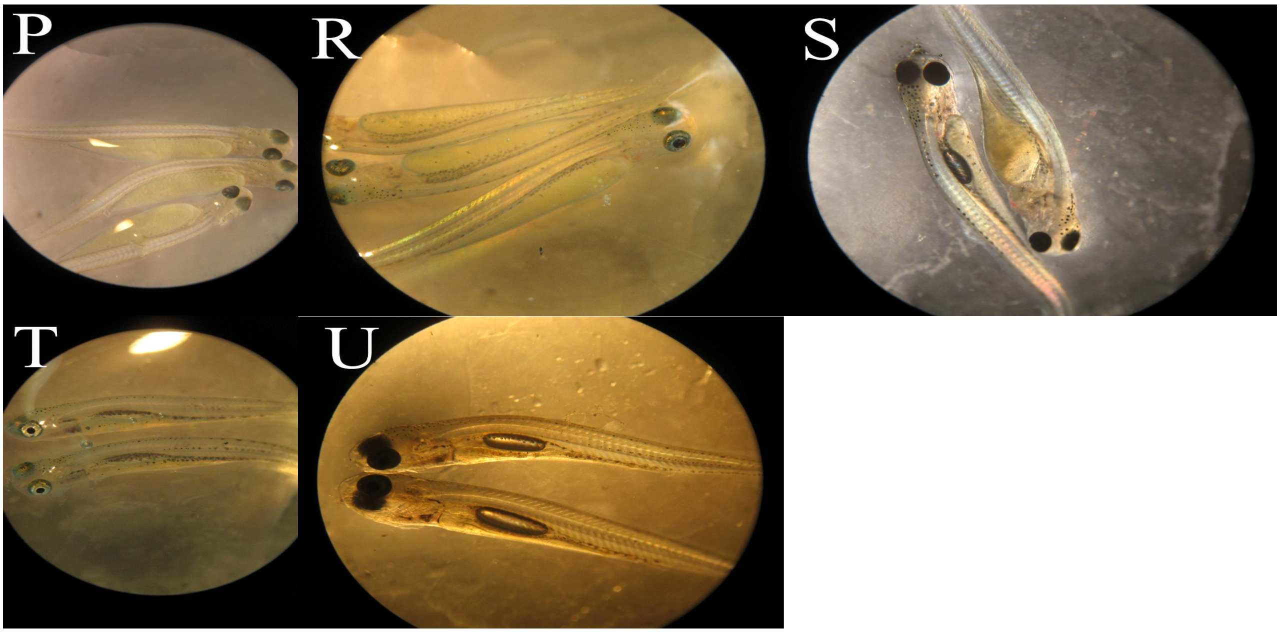
Egg size is a key feature in the early history of fish (Kamler, 2005). The diameters of the fertilized *C. trutta* eggs (0.63-1.95 mm) of our study were similar to those of the *cyprinids* (0.20-2.0 mm) (Ünal *et al.*, 2000; Çoban and Sen, 2006; Sahinöz *et al*, 2006). Perivitelline space (PVS) in *C. trutta* observed at 0.5 h after fertilization. It occurred 20-30 min after fertilization in *Chondrostoma regium* (Çoban and Sen, 2006), *Barbus sharpeyi and Barbus grypus* (shabout) (Pyka, 2001; Sahinöz *et al*, 2006). The perivitelline space formed was typical of most teleost fish species. This could be due to egg habitats. Because, the size of the perivitelline space can sometimes be used as an indication of egg habitat. For example, to avoid the turbulence of lotic habitats, perivitellin space of eggs could be occurred less than the lentic habitats (Cambray and Meyer, 1988). This may cause the formation of perivitellin space more quickly than usual.

In this study, the first cleavage occurred 1.5-2 h after fertilization. Similarly, other *cyprinid* species were reported between 1.15-4.5 h after insemination

FIG.1: The embryonic and larval development of *Capoeta trutta* (Heckel, 1843).



A.Fertilized egg, formation of perivitelline space, 0,5 h after insemination. B. The first cleavage, 1,5-2 h after insemination. C. The morula formation, 5h after insemination. D. The blastula and gastrula formation, 9 h after insemination. E-F-G. Embryonic body formation, 10-12 h after insemination. H-I. Optic vesicle and auditory vesicle formation, 30-34 h after insemination. J. The notochord and tail formation, 48-51 h after insemination. K. Hatching, 60 h after insemination. L. the first external morphology of the larvae, 72 h after insemination. M. The body straightened formation, 80 h after insemination. N-O: The eyes pigmentation formation, 96-120.h after insemination.



P-R.Body pigmentation formation, 144-168 h. after insemination. S. The eye pigmentation finishing and the starting air bladder formation, 192 h. after insemination. T Yolk sac consumption, 216 h after insemination. U. The mouth and anus opening, 240 h after insemination.

(Ünal *et al.*, 2000; [a]ahinöz *et al*, 2006; Mukhaysin and Jawad, 2012).

The morula phase of *C. trutta* was observed as 5 h after fertilization like *C. tarichi* (4-6 h.) (Ünal *et al.*, 2000). In contrast, the other *cyprinid* species were higher between 7.5-12.5 h. (Pyka, 2001; Sahinöz *et al*, 2006; Çoban and Sen, 2006; Mukhaysin and Jawad, 2012).

The blastula was formed 9 h after insemination. Similarly, *C. tarichi* and *B. sharpeyi* were reported between 6-12.5 h (Ünal *et al.*, 2000; Pyka, 2001). However, Mukhaysin and Jawad (2012) were observed in *B. sharpeyi as* 22 h. after fertilization. During these early stages, protection is a capability by the vitelline membrane (Finn, 2007). In the present study, an embryonic body formation was formed from the embryonic shield and also some somites were observed 10-12 h. after insemination. Sahinöz *et al* (2006) were found similar result for *B. grypus* (14 h.). However, Mukhaysin and Jawad (2012) were reported for *B. sharpeyi* as 23 h. after fertilization. The difference in hatching time might be due to environmental conditions like water, temperature, alkalinity, pH (Cussac *et al.*, 1985), and water flow. In addition, other environmental factors not detected in the water could have affected developmental period of the embryos (Pereira *et al.*, 2006).The cell–cell communication for specification and differentiation of cell lineages during these early stages are required; they occurred after the deep cell layer, gap junctions and cytoplasmics bridges. This structure and process are administered by an ion-dependent organization of the embryonic shield (D'Amico and Cooper, 1997). Similar to the results of Ünal *et al.* (2000), Sahinöz *et al* (2006) and Mukhaysin and Jawad (2012), the head of the embryonic body, the optic vesicles and the notochord and tail formation of *C. trutta* were recognized 30-34 h and 56 h after insemination, respectively.

In this study, the first hatching was occurred 60 h after insemination. On the other hand, the other researchers were reported between 72 and 96 h in the other cyprinids (Pyka, 2001; Sahinöz *et al.*, 2006; Mukhaysin and Jawad, 2012). Larval development of *C. trutta* was observed 96-120 h after insemination. This time was shorter than the former reported results of *B. grypus* (Pyka, 2001; Sahinöz *et al.*, 2006). In this period eyes and body pigmentation occurred and spreaded on whole body. The air bladder appeared, yolk sac consumed and also the mouth and anus opened. Pigmentation in fish is highly correlated with metabolism, specific hormones, and growth factors that accelerate metamorphosis, nutrition and food items (Bolker and Hill, 2000; Diler and Dilek, 2002), genes and genetic environmentally-sensitive factors (Parichy and Turner, 2003), as well as habitat (Urho, 2002). Absorption of the yolk sac, was faster than the other species under natural conditions (Penaz, 2001) possibly due to the ad libitum availability of bad quality food. Depletion of the yolk sac and opening mounth and anus may coincide with some significant improvements in the respiratory system, buoyancy ability, and swimming activity (Hazzaa and Huseyin, 2007).

CONCLUSION

The results presented in this work allowing comparisons of *C. trutta* with other studied *cyprinid* species living in the same environment. In the present study, we achieved in obtaining larvae of *C. trutta* by artificial insemination. Also, we clarified the characteristics of the embryonic development of *C. trutta* and add new information to the embryonic development of fish in order *Cyprinidae*.

REFERENCES

Aral F., Sahinöz E. and Dogu Z. (2011). Embryonic and Larval Development of Freshwater Fish, Recent Advances in Fish Farms, Dr. Faruk Aral (Ed.), ISBN: 978-953-307-759-8, InTech, http://www.intechopen.com/books/recent-advances-in-fish-farms/embryonic-and-larval-development-of-freshwater-fish.

Borcato F.L., Bazzoli N. and Sato Y. (2004). Embriogenesis and larval ontogeny of the Pirugordura, *Leporinus piau* (Fowler) (Pisces, Anostomidae) after induced spawning. Revista Brasileira de Zoologia. 21: 117-122.

Bolker J.A. and Hill, C.R. (2000). Pigmentation development in hatcery-reaered flatfishes. *J. Fish Biol.* 56: 1029-1052.

Cambray A.J. and Meyer K. (1988). Early ontogeny of an endangered, relict, cold-water cyprinid from Lesotho, *Oreodaimon quathlambae* (Barnard, 1938).*Rev. Hydrobiol. Trop.* 21 (4): 309-333.

Cussac V.E., Matkovic M. and Maggese M.C. (1985). Desarrollo embrionario de Rhamdia sapo (Valenciennes, 1840) Eigenmann y Eigenmann, 1888 (Pisces, *Pimelodidae*) II. Organogénesis media, organogénesis tardia y eclosión. *Rev. Bras. Biol., 45*(1-2): 149-160.

Çoban M.Z. and Sen D. (2006). Keban Baraj Gölü'nde Yasayan *Chondrostoma regium* (Heckel,1843)'da Büyüme Özellikleri, *Firat Üniversitesi Fen ve Mühendislik Bilimleri Dergisi*, 18(1): 41-48.

D'Amico L.A. and Cooper M.S. (1997). Spatially distinct domains of cell behaviour in the zebrafish organizer region. *Biochem. Cell. Biol.* 75, 563–577.

Diler I. and Dilek K. (2002). Significance of pigmentation and use in aquaculture. *Turkish J. Fish. Aquat. Sci.* 2: 97-99.

Dogu Z. (2002). Atatürk Baraj Gölü'ndeki *Capoeta trutta* (Heckel, 1843)'nýn Büyüme Özelliklerinin Incelenmesi, Yüksek Lisans Tezi, Ege Üniversitesi, Fen Bilimleri Enstitüsü, Izmir, 35s.

Epler R., Sokolowska-Mikolajczk M., Popek W., Bieniarz K., Bartel R. and J.A. Szczerbowski. (2001). Reproductive biology of selected fish species from Lakes Tharthar and Habbaniya in Iraq. *Arch. Fish. Pol.*, 9: 199-209.

Ersen S. (2003). Atatürk Baraj Gölü Balik Faunasinin Taksonomik Yönden Incelenmesi. Yüksek Lisans Tezi, Fýrat Üniversitesi, Fen Bilimleri Enstitüsü, Elazig, 6s.

Finn R.N. (2007). The physiology and toxicology of salmonid eggs and larvae in relation to water quality criteria. *Aquatic Toxicology. 81*: 337–354.

Hazzaa R.A. and Hussein A. (2007). Larval development of Himri, *Barbus luteus* (Cyprinidae: Cypriniformes) Reared in the Laboratory. *Turk J Zool.* 31: 27-33.

Kamler E. (2005). Parent–egg–progeny relationships in teleost fishes: an energetics perspective. *Rev. Fish Biol.* 15: 399-421.

Koumondoudours G., Divanach P., Kentouri M. (2001). Osteological development of *Dentex dentex* (*Osteichthyes: Sparidae*): dorsal, anal, paired fins and squamation. *Marine Biology*. 138: 399-406.

Mukhaysin A.A. and Jawad L.A. (2012). Larval Development of the *Cyprinid* Fish *Barbus sharpeyi* (Gunther, 1874). *J. of Fisheries and Aquatic Sci.* 7 (5): 307-319.

Nikolsky G.V. (1963). The Ecology of Fishes (Translated by L. Birkett). London Academic Press. 352. *F. U. Vet. Fak. Der.* 6 (35): 15-22.

Page L.M. and Burr B.M. (1991). A Field Guide to Freshwater Fishes – North America North of Mexico, Peterson Field Guide Series, Houghton Mifflin Company, Boston, Vol. 42, 432 pp.

Parichy D.M., Tumer J.M. (2003). Zebrafish puma mutant decouples pigment pattern and somatic metamorphosis. *Developmental Biology*. 256:242–257.

Penáz M. (2001). A general framework of fish ontogeny: a review of the ongoing debate. Folia Zool., 50: 241-256.

Polat N. (1987). Age Determination of *Capoeta trutta* (Heckel, 1843) in Keban Dam Lake. *Doga Turkish Journal of Zoology* 11(3):155-160.

Pereira C.R., Barcellos L.J.G., Kreutz L.C., Quevedo R.M., Ritter F. and Silva L.B. (2006). Embryonic and Larval Development of Jundiá (*Rhamdia quelen*, Quoy & Gaimard, 1824, Pisces, Teleostei), a South American Catfish. *Braz. J. Biol.*, 66(4): 1057-1063.

Pyka J., Bartel R., Szczerbowski J.A. and Epler P. (2001). Reproduction of gattan (*Barbus xanthopterus* Heckel), shabbout (*Barbus grypus* Heckel), and bunni (*Barbus sharpeyi* Gunther) and rearing stocking material of these species. *Arch. Pol. Fish.*, 9 (1): 235-246.

Sahinöz E, Dogu Z, Aral F (2006). Development of embryos in *Mastacembelus mastacembelus* (Bank& Solender, 1794) (Mesopotamian Spiny Eel) (Mastacembelidae). Aquac. Res., 37(16): 1611-1616.

Urho L. (2002). Characters of larvae What are they? *Folia Zool.* 51: 161-186.

Ünal, G., Çetinkaya, O. and Elp M. (2000). The embryonic and larval development of *Chalcalburnus tarichi* (*Cyprinidae*): An endemic fish species of the lake Van basin, Turkey. *Bull. of Pure and Appl. Sci.* 19A (1): 27-41.