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Reproductive biology of *Capoeta tinca* in Gelingüllü Reservoir, Turkey

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A b s t r a c t . The breeding and sexual maturation properties of a cyprinid fish *Capoeta tinca* were studied in Gelingüllü Reservoir, a recently impounded dam in Central Anatolia. Ripening of gonads commenced in early spring, whereas spawning occurred between May and June. Sexual maturity age was 2^+ for males and 3^+ for females. The results obtained from this study were compared with those of other populations of *C. tinca* in Turkey.

Key words: Central Anatolia, spawning, sexual maturity age, gonadosomatic index

Introduction

The Cyprinid fish, *Capoeta tinca,* has a wide distribution in Anatolia, including the Sakarya, Kızılırmak and Çoruh river basins as well as some streams in the Marmara region that are hydrologically connected to the Black Sea. But it is not present in the Mediterranean Basin and in Thrace, the European part of Turkey (E r k ' a k a n 1983). *Capoeta tinca* can adapt very easily to changes in water regime, it occurs both in lotic and lentic habitats so this species has economic value as a commercial fish from natural and man-made lakes. In the meantime, *C. tinca* has tolerance to salinity and pollution, and lives in streams with salinity of 10.5 $g.l^{-1}$ and conductivity of 22000 $\mu S.cm^{-1}$ (E k m e k ç i 2002). As an herbivorous fish, it is not a high value food like *Esox lucius*, *Sander lucioperca* and *Silurus glanis*. However, owing to its wide distribution and tolerance to different habitats, and its size (max. standard length=43cm, max weight=1178g; Y ı l m a z & G ü l 1999a), this species is consumed as food by people.

We examined the breeding and sexual maturation properties up on which minimum fishing size is to be based for the sustainable management of Gelingüllü Reservoir, a recently impounded dam in Central Anatolia. There have been a few studies of *C. tinca* reproduction (A k g ü l 1986, 1988, Y ı l m a z & G ü l 1996, Y ı l m a z & G ü l 1999b), though only one in a reservoir (E k m e k ç i 1996). Whereas its growth properties are well-documented (e.g. S o l a k 1982, E r k ' a k a n & A k g ü l 1985, A k g ü l 1986,1988, C e n g i z l e r & E r d e m 1994, Y ı l m a z et al. 1996, E k m e k ç i 1996, 2002, Y ı l m a z & G ü l 1999a).

Study Area, Material and Methods

The Gelingüllü Reservoir is located to the southeast of the city of Yozgat, in the region of Central Anatolia (39°36'30''N, 35°03'20''E). The reservoir has an area of 2.4 km^2 at the maximum water level. The dam was constructed on the Delice stream, a tributary of Kızılırmak River (Fig.1). The altitude of the reservoir is 1000 m. above sea level. Typical continental climate prevails in the study area, maximum and minimum air temperatures were

recorded as 37.1 °C (in July) and -23.7 °C (in January) respectively. Surface water temperature ranges between 22 °C (July) and 2 °C (December), whereas the dissolved oxygen content varies between 8.9 $mg.l^{-1}$ (June) and 11.8 $mg.l^{-1}$ (April). Water pH ranges between 7.47 and 9.39, and the conductivity ranges between 310 and 430 $\mu S.cm^{-1}$. Secchi disc transparency is 1.11 m in May 1996 and 4.42 m in November 1996.

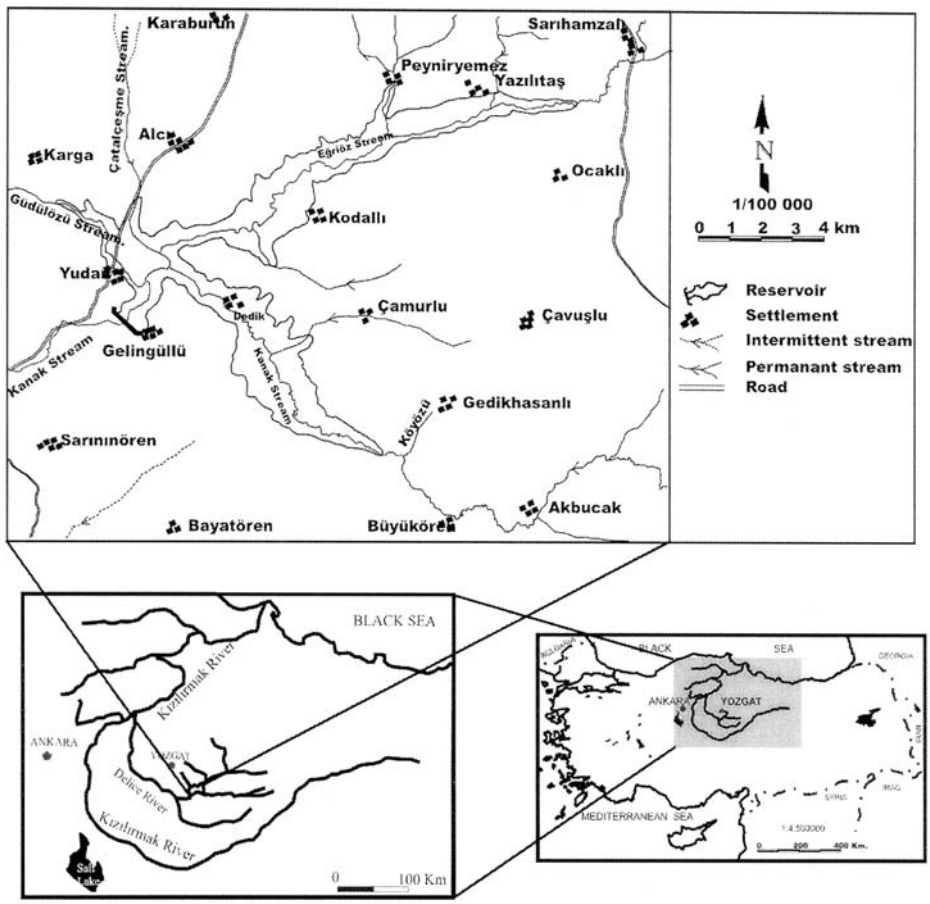

Fig. 1. Map of the study area.

Beside *C. tinca,* native fish species such as *Capoeta capoeta sieboldi,* chub (*Leuciscus cephalus*), nase (*Chondrostoma regium*), bleak (*Alburnus orontis),* barbel (*Barbus tauricus*), *loach* (*Orthrias* sp.) and introduced species such as goldfish (*Carassius auratus*), topmouth gudgeon (*Pseudoraspora parva*) and common carp (*Cyprinus carpio*) live in the Gelingüllü Reservoir.

A total of 220 fish were sampled on a monthly basis between December 1995 to December 1996, except in January and February 1996, when the lake was frozen. In the second week of every month samples were collected with the aid of fishermen, using gill nets of 25 to 110 mm mesh size. During our field studies in Gelingüllü Reservoir, we had some doubts about the hybrids among *C. tinca* and *C. capoeta*. In this study, specimens suspected of being hybrids were excluded.

Fork length (FL) were measured with an accuracy of 1 cm and weighed to nearest 1 g in the field. Scales were used for age determination. They were firstly cleaned by 4% NaOH and dry mounts held between microscope slides as given in L a g l e r (1966). Males differ from females morphologically by the presence of breeding tubercules formed on the head during the spawning period. The sex of immature fish was confirmed by observation of gonads with the aid of a binocular. For sex determination of mature specimens, the gonads of fresh samples were observed macroscopically, and then the ovaries were removed and weighed. Body weights were determined to the nearest gram, where as the gonads of females were weighed with an accuracy of 0.1 g. and preserved in 4% formaldehyde for subsequent assignment of gonad development, 29 ovaries could not be weighed as they were less than 0.1g. Gonadosomatic index (GSI) was calculated as:

GSI = Gonad weight x 100 / total body weight.

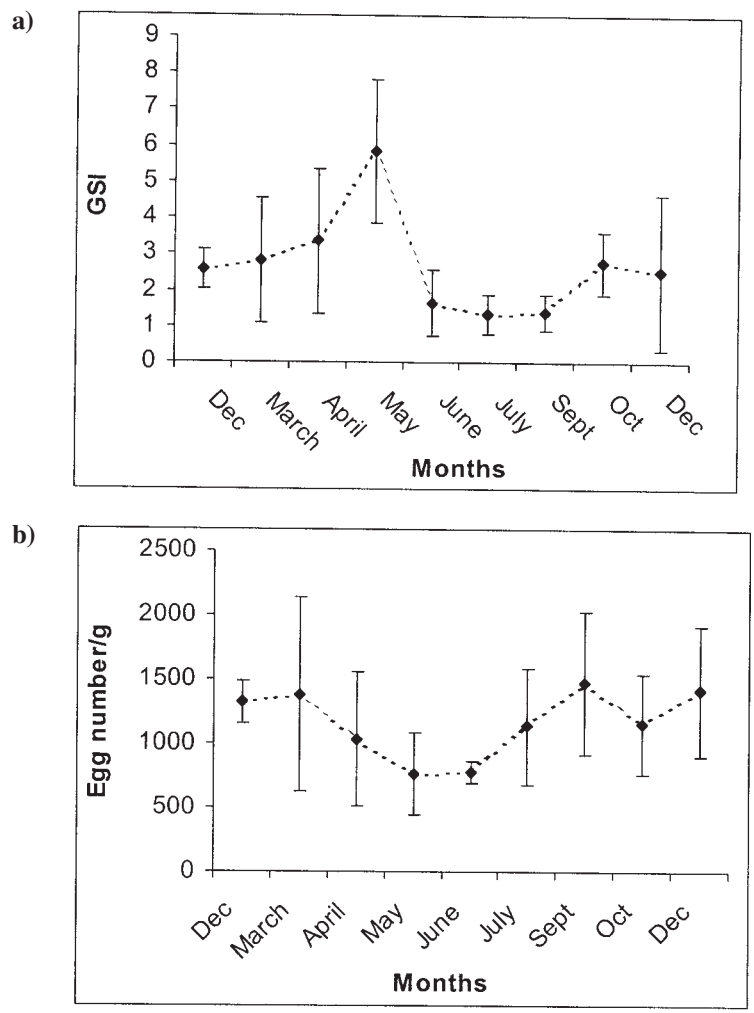

Fig. 2 (a). Monthly variation of gonadosomatic index and **(b)** relative fecundity (eggs.g^{-1}) for female *Capoeta tinca*.

Seasonal changes in GSI, egg diameter and number of eggs per 1 gram of ovary were used to elucidate the reproductive biology of this species. Egg diameter and number of eggs could be counted from 50 females whose ovaries contain visible eggs. Age at maturity was determined from fish collected in April and June based on gonad development.

Fecundity was estimated from counts of yolky eggs in 1 g samples from three different parts (proximal, middle and distal) of a preserved ovary and multiplying the mean value by the total weight of both ovaries (B a g e n a l & B r a u m 1971). Mean egg diameter was calculated from the average of a total of 30 eggs, 10 from the proximal, middle and distal parts of the ovary, which were measured to the nearest 0.01 mm. The students' t-test was used to test for the differences in egg number and diameter between different parts of ovary.

Results and Discussion

Age at maturity in *Capoeta tinca* of Gelingüllü Reservoir is at age 3. Only 7 % of females <3 years were immature, whereas the remaining females of ≥ 3 years were all mature. It is apparent that the females became mature at the age of 3. The males, on the other hand, become mature at age 2. Although age at maturity of both males and females in C. *tinca* populations of other river basins differs from those reported here, the one-year difference between males and females is characteristic of all populations (A k g ü l 1986, 1988, E k m e k ç i 1996, Y ı l m a z & G ü l 1996, Y ı l m a z & G ü l 1999b).

The females were dominant in the population to the males by a ratio of 1:4.23 during the sampling period. In other populations of *Capoeta tinca* in Turkey, the ratio of males to females fluctuates between 0.64–1.15:1 (A k g ü l 1986, 1988, E k m e k ç i 1996, Y ı l m a z & G ü l 1996, Y ı l m a z & G ü l 1999b).

Gonad weight and GSI in females peaked in May (Fig.2a) as did egg diameter (Fig.3), suggesting that eggs were laid between May and July. In July, all the ovaries were empty and only a few remaining eggs were observed. However, GSI values from *C. tinca* populations in

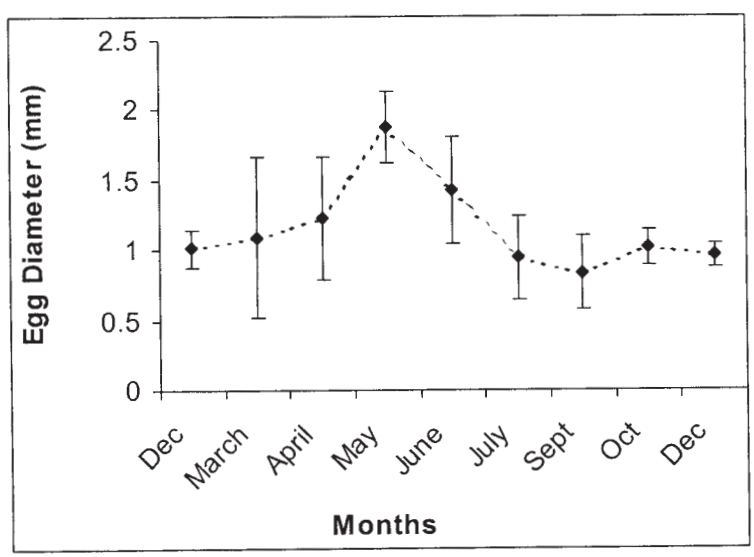

Fig 3. Monthly variation of egg diameter for *Capoeta tinca*.

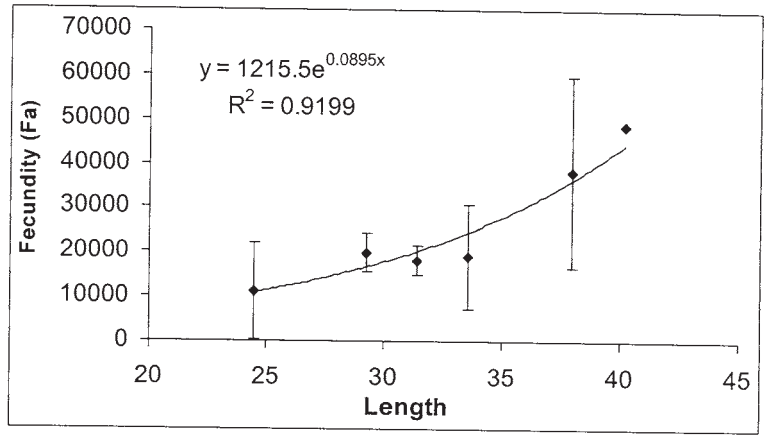

Fig. 4. Length-fecundity (Fa) relation for *Capoeta tinca*.

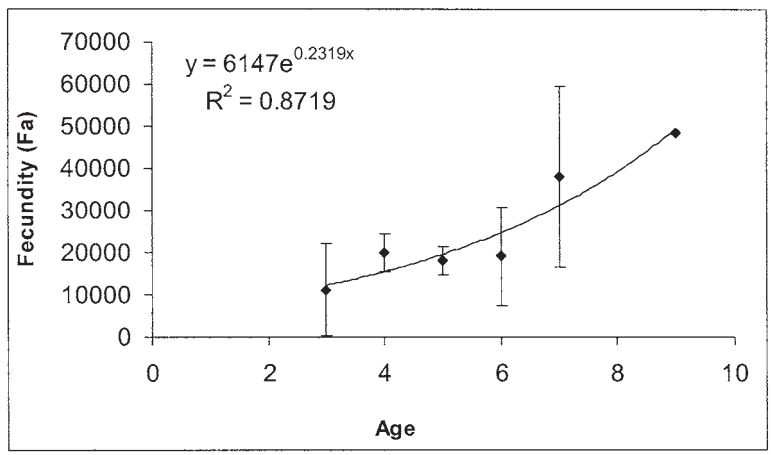

Fig. 5. Relation between age and fecundity (Fa) for *Capoeta tinca*.

other regions of Turkey indicate that reproduction starts in April and lasts until September, depending on the water temperature and altitude, with spawning periods in Anatolia such as, May to June (Solak 1982, Yılmaz 1994), May–July (Ekmekçi 1996, Yılmaz & Gül 1996), July to September (Erk'akan & Akgül 1985), and June–July (Akgül 1988). Altitude, climate and the ecological differences of stagnant and running water have great effects on the spawning period as stated by Nikolskii (1963) and Bennett (1970). The water temperature in the Gelingüllü Reservoir during the spawning period was about 19 °C. The recorded water temperatures during the spawning period of *C. tinca* vary between 21–22.5 °C (Solak 1982; Erk'akan & Akgül 1985, Akgül 1988, Yılmaz 1994, Ekmekçi 1996, Yılmaz & Gül 1996, Yılmaz & Gül 1999b).

Relative fecundity can be used to identify the start of the breeding season, because the number of eggs in a constant weight decreases when they become ripe. This occurred in May and June (Fig. 2b). There were no significant differences in means of the number of

eggs per g. and egg diameter between the parts of ovary (student's t-test). The maximum mean egg diameter (1.88 mm) was measured in June. Y ı l m a z & G ü l (1996, 1999b) stated the maximum of mean egg diameter as 1.8 mm and 1.62 mm respectively.

The mean number of eggs (absolute fecundity) in ovaries was significantly related to the mean fork length with (Fig. 4) ($F=45.93$ $df=1,4$ $p<0.05$). A significant relation ($F=27.23$, $df=1,4$ and $p<0.05$) was also established between age and the mean number of eggs in ovaries (Fig. 5). The maximum absolute fecundity was found as 58 896 eggs for a 7 year old female with a weight of 720g and 39.9cm total length (36.6cm fork length) caught in December 1995.

A c k n o w l e d g e m e n t s

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