Karyotypes of *Capoeta antalyensis* (Battalgil, 1944) and *Capoeta baliki* Turan, Kottelat, Ekmekçi & İmamoğlu, 2006 (Actinopterygii, Cyprinidae)

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**ABSTRACT**

Chromosome numbers and morphologies of *Capoeta antalyensis* (Battalgil, 1944) originating from Boğa Creek and *Capoeta baliki* Turan, Kottelat, Ekmekçi & İmamoğlu, 2006 originating from Kızılırmak River were investigated. Four females and two males specimens of *C. antalyensis* and three females and five males specimens of *C. baliki* were analyzed. Metaphase chromosomes were obtained from kidney cells. The diploid chromosome number of *C. antalyensis* was found 2n=150, of which 42 pairs were meta-submetacentric chromosome and 33 pairs were subtelo-acrocentric chromosome, and fundamental arm number (NF) was found 234. The diploid chromosome number of *C. baliki* was 2n=150, consisting of 44 meta-submetacentric chromosome pairs and 31 subtelo-acrocentric chromosome pairs, and the number of arms was 238. Neither species showed any sex chromosome differentiation.

**Keywords:** *Capoeta antalyensis*, *Capoeta baliki*, karyotype, Anatolia

**ÖZET**


**Anahtar Kelimeler:** *Capoeta antalyensis*, *Capoeta baliki*, karyotip, Anadolu
INTRODUCTION

It is known that 19 species of the genus *Capoeta* Cuvier-Valenciennes 1842, belonging to Cyprinidae family live in the inland waters of Turkey. *Capoeta antalyensis* is an endemic species that prevails in the rivers in the vicinity of Antalya Province. *C. baliki*, previously was named as *Capoeta tinca*, is another endemic species that pervades in Sakarya and Kızılırmak Rivers (Geldiay and Bahk, 2007; Kuru *et al*., 2014).

Polyploidy as one of the most striking aspects of fish genetics can also be analyzed with chromosome counts (Thorgaard and Disney, 1990). In a study about the karyology of five *Barbus* species in South Africa, Oellerman and Skelton (1990) found that chromosome counts ranged between 2n=148 and 2n=150 with a majority of the species in the Cyprinidae family having 2n=50 chromosomes, and argued that the latter species were of hexaploid origin. Rab and Collares-Pereira (1995), on the other hand, stated that *Barbus* species were cyprinids of tetraploid origin and were characterized by 2n=100 diploid count. According to these authors, polyploidy in cyprinid fish is an extremely complicated event resulting from various origins and the chromosome number in polyploid species increases in integral multiples of the most common chromosome value (2n=50). It was noted that *Barbus bynni* (Syn: *Barbus bynni occidentalis*) and *B. wurtzi* had a chromosome number of 2n=148 and *B. petitjeani* had a chromosome number of 2n=150 and that all three species were hexaploid (Guegan *et al*., 1995).

Chromosome number and morphology can vary intra and interspecifically. Analysis of this variation within and among species is currently a popular approach which is widely used by fish systematists. While intraspecific variations can be used for analysis of population structure and dynamics, interspecific variations are useful sources to apply for analyzing an array of evolutionary and genetic hypotheses. For this purposes the research of fish chromosomes has become an important area (Thorgaard and Disney, 1990). Although many cytogenetic studies have been carried out on Anatolian fishes (Gaffaroğlu *et al*., 2006; Gaffaroglu *et al*., 2012) no cytogenetic study about *C. antalyensis* and *C. baliki* has been found. The present study is the first to examine the karyotype characteristics of *C. antalyensis* and *C. baliki*.

MATERIALS AND METHODS

Specimens of *C. antalyensis* (four females and two males) originating from Boga Creek, Antalya, Türkiye (36°51' N, 30°37' E) and *C. baliki* (three females and five males) originating from Kızılırmak River, Kırşehir, Türkiye (38°57' N, 34°12' E) were analyzed (Figure 1). They were transported alive to the laboratory and kept in well-aerated aquaria until analysis. Mitotic chromosome slides were prepared according to Collares-Pereira (1992) from kidney cells. The specimens were injected intraperitoneally with 0.1% colchicine solution and head kidneys of specimens were removed and placed in KCl solution. The cell suspension was centrifuged and supernatant was discarded. The cell suspensions were dropped onto cleaned slides. The slides were stained with 10% Giemsa. At least 10 metaphases were counted per specimen. Chromosomes were classified using the nomenclatures proposed by Levan *et al*. (1964).
Meta-submetacentric (M-SM) chromosomes were taken as biarmed while subtelo-acrocentric (ST-A) chromosomes were taken as uniarmed. Classification of chromosomes was made according to ratio of long and short arm. Metacentric (M) means a chromosome with equal-sized arms, Submetacentric (SM) means a chromosome with the ratio of long arm more than the ratio of short arm. ST-A means a chromosome with the short arm at the end of centromere and/or centromere is non-terminal (uniarmed). The preparations were observed and photographed digitally at a Leica DMLB 3000 research microscope.

RESULTS

Diploid chromosome numbers of C. antalyensis and C. baliki were determined to be 2n=150. Chromosome morphology of C. antalyensis consisted of 42 pairs of M-SM and 33 pairs of subtelo-acrocentric ST-A chromosomes with NF 234 (Figure 2) and C. baliki had 44 pairs of M-SM and 31 pairs of ST-A chromosomes with NF 238 (Figure 3). There was no sex chromosome differentiation in these two species.

DISCUSSION

A review of literature has shown that there is no previous cytogenetic study about C. antalyensis and C. baliki. The present study is the first to determine the chromosome number and morphology of C. antalyensis and C. baliki and to characterize their karyotype.

Diploid chromosome numbers of C. antalyensis and C. baliki have been found identical. However, there are differences in their chromosome morphologies. Two pairs of chromosomes identified as ST-A in C. antalyensis were determined to be M-SM in C. baliki. Due to the differences in their chromosome morphologies, NF of C. antalyensis and C. baliki were also found different.

Results obtained from C. antalyensis and C. baliki are similar to those found in other Anatolian Capoeta species (Table 1). Capoeta trutta and Capoeta umbla (Syn: Capoeta capoeta umbla) originating from Tigris River system (Kılıç-Demirok and Ünlü, 2001), Capoeta capoeta gracilis originating from Sefidroud and Shahroud Rivers (Pourali et al. 2006), Capoeta damascina originating from Ceyhan and Seyhan River system (Ünal, 2015) carry the same number of chromosomes with C. antalyensis and C. baliki. Besides, C. umbla bears significant similarities to C. antalyensis and C. baliki in terms of chromosome morphology. The only difference between them is that a chromosome pair identified as ST-A in C. antalyensis is M-SM in C. umbla and a chromosome pair identified as M-SM in C. baliki is ST-A in C. umbla. Also C. damascina is similar to C. baliki in terms of the number of M-SM and ST-A chromosome pairs whereas is different from C. antalyensis in terms of the number of chromosome pairs classification as M-SM and/or ST-A. However, there are occasional differences between the chromosome morphologies of C. trutta on one hand and C. antalyensis and C. baliki on the other. C. antalyensis and C. baliki have a higher number of M-SM chromosome pairs and a lower number of ST-A chromosome pairs than C. trutta. Furthermore, number of arms of C.
antalyensis and C. baliki is higher than C. trutta and C. umbla. Moreover C. baliki has the same number of arms with C. damascina but number of arms of C. antalyensis is lower than C. damascina.

On the other hand, diploid chromosome number of C. antalyensis and C. baliki is the same with Capoeta capoeta (Safar et al., 2000) and Capoeta sevangi (Syn: Varicorhinus capoeta) (Krysanov, 1999) but it is different from C. damascina (Gorshkova et al., 2002). In terms of chromosome morphology C. antalyensis and C. baliki are very different from C. sevangi but they are very similar with the others. Moreover, number of arms of C. antalyensis is the same with C. capoeta. Otherwise number of arms of C. antalyensis and C. baliki is higher than C. sevangi but it is lower than C. damascina.

Kılıç-Demirok and Ünlü (2001) reported that C. trutta and C. umbla could also be hexaploid species. Apart from cyprinids, Misgurnus anguillicaudatus of the Cobitidae family was noted to be a hexaploid species having 6n=150 chromosomes (Abbas et al., 2009). Chromosome number of the hexaploid Carassius gibelio (Syn: Carassius auratus gibelio) was found 2n=160 (Mayr et al., 1986). These studies suggest that C. antalyensis and C. baliki may also be hexaploid species.

Just like C. sevangi (Krysanov, 1999), C. trutta, C. umbla (Kılıç-Demirok and Ünlü, 2001) and C. damascina (Ünal, 2015) and as well as many other species in the same family (Rab and Collares-Pereira, 1995), C. antalyensis and C. baliki were also found to lack sex chromosome differentiation.

Fishes show more extensive chromosomal diversity. Determination of numerical and structural chromosome differences are essential for genetic data of species. It is believed that the results we have obtained will contribute to the cytogenetics of C. antalyensis and C. baliki.

REFERENCES


Table 1. Karyotype characteristics of *Capoeta* species that prevail in the inland waters of Turkey.

<table>
<thead>
<tr>
<th>Species</th>
<th>2n</th>
<th>Chromosome morphology</th>
<th>NF</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>C. trutta</em></td>
<td>150</td>
<td>70M-SM+80ST-A</td>
<td>220</td>
<td>Kılıç-Demirok and Ünlü, 2001</td>
</tr>
<tr>
<td><em>C. umbla</em></td>
<td>150</td>
<td>86M-SM+64ST-A</td>
<td>236</td>
<td>Kılıç-Demirok and Ünlü, 2001</td>
</tr>
<tr>
<td><em>C. damascina</em></td>
<td>150</td>
<td>46M+42SM+62ST-A</td>
<td>238</td>
<td>Ünal, 2015</td>
</tr>
<tr>
<td><em>C. antalyensis</em></td>
<td>150</td>
<td>84M-SM+66ST-A</td>
<td>234</td>
<td>In this study</td>
</tr>
<tr>
<td><em>C. baliki</em></td>
<td>150</td>
<td>88M-SM+62ST-A</td>
<td>238</td>
<td>In this study</td>
</tr>
</tbody>
</table>
Figure 1. Map shows the sampling sites.
Figure 2. (a) Metaphase and (b) karyotype of *Capoeta antalyensis*. Bar represents 3 µm.
Figure 3. (a) Metaphase and (b) karyotype of Capoeta baliki. Bar represents 3 µm.