Maturation and Growth in the Wild Population of Hemigrammocypris rasborella

Norio ONIKURA¹,*; Jun NAKAJIMA²; Hiromi KOUNO¹; Yoshiko SUGIMOTO¹ and Jun KANETO¹

Abstract: Maturation and growth in the wild population of Hemigrammocypris rasborella were investigated from January 2007 to January 2008 by analyzing specimens fixed in formalin. Monthly changes in the gonadosomatic index (GSI) in female and male and oocyte diameter in females were estimated. From the GSI and oocyte diameter measurements, the spawning period of wild H. rasborella was determined to be from June to August. The von Bertalanffy growth curves (VBGCs) indicated that females had higher growth rates than males.

Key words: Cyprinidae; GSI; Oocyte diameter; Von Bertalanffy growth curve

The golden venus chub Hemigrammocypris rasborella Fowler, inhabits lowland aquatic habitats such as irrigation ditches and ponds (Onikura et al. 2009) on the Honshu, Shikoku, and Kyushu Islands (Kawanabe et al. 2005). There have been a few field studies on this species (Akada and Yodo 2006; Aoyama et al. 2008; Onikura et al. 2009).

Hemigrammocypris rasborella are known to have short life span of about 1 year (Onikura et al. 2009), but no clear information has been published about the maturation of individuals of the wild population. The sexual dimorphism of H. rasborella was examined on the basis of its growth curve in this study.

Specimens were collected from an irrigation ditch (33°15’48”N, 130°10’20”E) along the Ushizu River, Kyushu Island, Japan, between January 2007 and January 2008. The sampling sites and methods have been described in detail in our previous report (Onikura et al. 2009). The total number of individuals captured every month by Onikura et al. (2009) was 40-320. The wild population of H. rasborella is small, and their habitat is limited; therefore, we designed a collection method that only had a small impact on the wild population.

Approximately 20 randomly selected individuals, totals of 178 females and 101 males, were fixed in 10% buffered formalin each month. In the laboratory, the gonads were removed and weighed (Wg; mg). Body weight (Wb; mg) and body length (BL; mm) were measured, and the gonadosomatic index (GSI = Wg × 100/Wb) was calculated. In females, oocyte diameters (>0.10 mm) were measured to the nearest 0.01 mm with a Nikon profile projector (6C-2; Nippon Kogaku, Tokyo). The females and males were divided into 2 groups on the basis of BL data into age class 0 and 1, according to the classification of Onikura et al. (2009). The average BLs were calculated for each month and each age class. The age and length data were used to calculate the parameters of the VBGC by analyzing length-at-age data (Gayanilo et al. 2005), using the FAO-ICLARM fish stock assessment tools (FISAT) software package. July 1 was chosen as the date of birth.

The average values of GSI were high from May to August in males and from June to August in females (Fig. 1). The peak oocyte diameters were < 0.2 mm on April 19 and May 23, and > 0.7 mm on June 25 and August 29 (Fig. 2). The fertilized egg diameter of this species is approximately 1 mm in aquaria (Nakamura 1969); oocytes with a diameter of > 0.7 mm were observed from June to August and estimated to be mature. On September 28, oocytes of diameters < 0.2 mm (Fig. 2) indicated that the post-spawning season was in progress. These seasonal changes in the GSI and oocyte diameter imply that the spawning season of the wild population is from June to August.

The BLs in females (n = 33) were greater than those in males (n = 15) in the spawning season (Mann Whitney U test, Ucal = 204.0, P < 0.01). Therefore, the VBGC of females and males are shown separately in Fig. 3. Females grew faster than males, suggesting sexual dimorphism in the wild population. Although Aoyama et
The ecological traits of the *Danioninae* species such as *Hemigrammocypris rasborella* (Hr), *Aphyocypris chinensis* (Ac), *Zacco platypus* (Zp), *Niphonocorys temminckii* (Nt) and *Opsariichthys uncirostris uncirostris* (Ouu) in Japan.

<table>
<thead>
<tr>
<th>Traits</th>
<th>Species</th>
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<tbody>
<tr>
<td>General body size (total length, cm)</td>
<td>3-6   4.7  5.1  15  30</td>
</tr>
<tr>
<td>Life span (y)</td>
<td>1-2  1-2  3   -  5</td>
</tr>
<tr>
<td>Maturation age (y)</td>
<td>1    1    2   3   3</td>
</tr>
<tr>
<td>Main habitat (river, ditch, or lake: R, D, or L)</td>
<td>D    D    R   R   L</td>
</tr>
</tbody>
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Sexual dimorphism (presence or absence: P or A)
1. larger body size in females P - A A A
2. larger body size in males A - P P P
3. anal fin elongation in males A A P P P
4. pearl organs in males A A P P P

The ecological traits were summarized by referring to several published works (Tanaka 1964; Mizuguchi and Hiyama 1969; Nakamura 1969; Kawanabe et al. 2005; Aoyama et al. 2008; Onikura et al. 2009; Nakajima and Onikura 2009).

- No data.

al. (2008) reported the size differences between females and males during the spawning season, this was not shown in their growth curves. Between the ages from 0.6 to 0.9, average *BL* of both females and males plotted irregularly. The ages from 0.6 to 0.9 corresponded to winter and spring, and this species is known to show no growth in winter and rapid growth in spring (Onikura et al. 2009). We estimated the irregular plots from 0.6 to 0.9 ages due to the period with changing growth pattern.

The ecological traits of the *Danioninae* species inhabiting Japan are summarized in Table 1. They may be classified into two types: small size and short life span (SS type) and large size and long life span (LL type) based on the data in Table 1. *Hemigrammocypris rasborella* belongs to the SS types with small size, short life span, early maturity, and larger body size in female than males (Table 1). In *r/K* selected traits (Pianka 1970), the SS types might acquire the *r* selected trait. This trait is characterized by adaptation to high environmental risks (Pianka 1970). We reported that agricultural ditches posed higher environmental risks than did rivers because the water levels in ditches often change considerably with agricultural calendars (Onikura et al. 2009). Before the artificial conversion into paddy fields, we imagined that this species inhabited water routes in lowlands and floodplains that were very risky during the dry season. Therefore, the females of *r* selected *Danioninae* species including *H. rasborella*, which inhabit ditches may develop larger body sizes than the males to facilitate prolific reproduction. In contrast, 3 *Danioninae* species belong to the LL type with large body size, long life span, late maturity, and exhibition of secondary sexual traits in males (Table 1); these species thus acquired the ‘*K* selected traits’. The *K* selected traits are adaptations to not only intra- but also inter-species competitions in low-risk habitats (Pianka 1970). Males of *K* selected *Danioninae* species, such as *Zacco platypus*, which inhabit rivers with low risks, may develop secondary sexual characteristics to attract females.

**References**


