

Resource management of a small-sized cyprinid population in an isolated small stream based on its ecological characteristics

The indigenous cyprinid *Rasbora rubrodorsalis* is widely distributed in agricultural water masses (e.g., irrigation canals) of various Indochinese countries including Laos. This species is small-sized (max. ca. 30 mm), occurs abundantly in remote rural areas of hilly/mountainous regions, and is an important food resource in the area. In recent years, however, settlements and habitat expansion of invasive alien fishes as well as agricultural exploitation / urbanization in such areas are becoming a concern, possibly causing the decline in species diversity/stock level of indigenous fishes. This situation necessitates the acquisition of ecological information conducive to the species' resource management.

The following ecological features and relevant findings were obtained in the present study.

- 1) The sex ratio of *Rasbora rubrodorsalis* is remarkably biased towards females (male : female = 0.43 : 1), and the females grow larger than males in size (figure omitted).
- 2) Mature female occurrence ratio increases with seasonal day-length extension (figure omitted), and breeding is more active during high-temperature period (March to October). However, mature females also occur even during low-temperature period (November to February), indicating that the species breed throughout the year (Fig. 2). Maturation sizes of females are > 20 mm SL and > 23 mm SL during high- and low-temperature periods, respectively (Fig. 2), and the maturation ages (in days) were estimated to be 50 and 80 days during high- and low-temperature periods, respectively (Fig. 3).
- 3) Longevities were estimated to be 150 days in females and 100 days in males (Fig. 3); therefore, plural generation alternations are considered to occur within a year.
- 4) Seasonal fishing control is considered not efficient for stock management of the species due to its short longevity. Although the upward migration of the species over the small waterfall located at the mid-stream is considered impossible because of limited swimming ability, stock provision from upstream to downstream areas is highly possible insofar as upstream breeding population is well conserved. Hence, continuous fishing in the downstream area concurrent with fishing prohibition in the upstream area is strongly recommended for the conservation of the breeding population and is contributory to both sustainable fisheries and species conservation (Fig. 4).

In addition to the above, environmental conservation is also indispensable for realizing the above-mentioned method for species conservation. Furthermore, considering the deterioration of genetic diversity as observed in the sympatric cyprinid *Esomus metallicus* and the ambassid *Parambassis siamensis* probably due to the geographical isolation, such deterioration may also be occurring in the *Rasbora rubrodorsalis* population. Genetic soundness, therefore, needs to be examined by micro-satellite DNA marker analysis.

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Fig. 1. Laotian indigenous cyprinid *Rasbora rubrodorsalis* (adult, 24.3 mm SL)

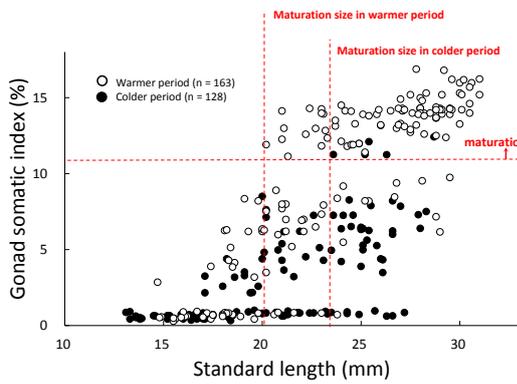


Fig. 2. Relationship between standard length and gonad somatic index in female *Rasbora rubrodorsalis* both in warmer and colder periods

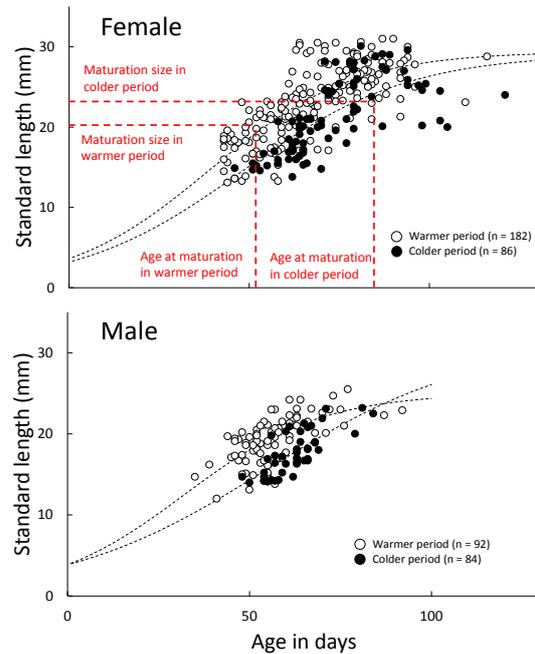


Fig. 3. Growth models of female and male *Rasbora rubrodorsalis* (fitted by Gompertz growth curves)

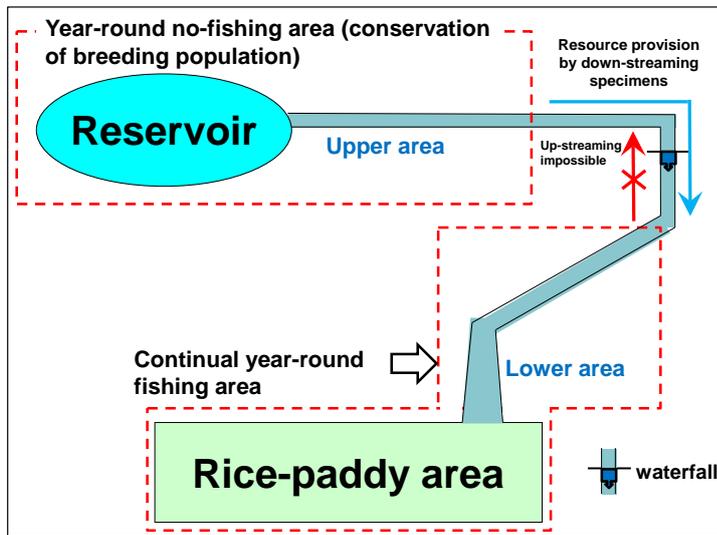


Fig. 4. Schematic drawing of the stream investigated in this study and the suggested year-round no-fishing area and continual fishing area for *Rasbora rubrodorsalis*