Age Composition of Anadromous Wakasagi, *Hypomesus nipponensis*, Upstream in the Hei River in Iwate

Tsuyoshi SASAKI¹, Toshiro SARUWATARI² and Seiichi WATANABE³

**Abstract:** Otoliths were examined from 581 fish specimens that were collected from August 1997 to April 1998 in the mouth of the Hei River, and 300 fish specimens were collected from April to June in 1998 in spawning site of the Hei River. Results of those examinations revealed the age composition of anadromous wakasagi, *Hypomesus nipponensis*. The opaque zone and translucent zone are formed sequentially: the first translucent zone (T1) is formed in August - November and the first opaque zone (O1) is formed in October - April; the second translucent zone (T2) is formed in May - September and the second opaque zone (O2) is formed in August - April. This study found that a 0+ year-old fish forms a first opaque zone (O1), whereas a 1+ year-old fish forms a second opaque zone (O2) in their respective otoliths. Based on those findings, 609 fish specimens were collected at the spawning site of the Hei River from April to June in 2001. They were examined to determine their age composition. Both 0+ and 1+ year-old fish were found in the spawning site of the river.

**Key words:** *Hypomesus nipponensis*; Anadromous; Otolith; Age composition

Anadromous wakasagi, *Hypomesus nipponensis* (McAllister), comes under of Osmeridae, Salmonidae (Saruwatari et al. 1997). The biology of *H. nipponensis* has been investigated widely in many lakes (Sato 1954; Shiraishi 1961; Kasebayashi and Nakano 1961; Torisawa 1999), but its life history has scarcely been revealed in rivers. Furthermore, their age composition remains uninvestigated. Observation of translucent and opaque zones of otolith has been more effective for age determination than scale annuli (Katayama and Kawasaki 1994). Nevertheless, that method has not been adopted for all populations (Torisawa 1999). This study examined seasonal formation patterns of otolith annuli and demonstrated the way in which this provides information about fish age at the Hei River spawning site.

**Materials and Methods**

*H. nipponensis* swim upstream from sea areas to spawn. Spawning sites are typically situated 3.0 km upstream from the river mouth (Sasaki et al. 2003). We captured 581 fish specimens from August 1997 to April 1998 using round haul nets and angling at the river mouth; 300 fish specimens were collected from April to June in 1998 at the Hei River spawning site. Immediately after catching, their standard body lengths (SL) were measured to 1/10 mm using vernier calipers. Twenty sagittal otoliths that were resampled from each sample were cleaned with water and then immersed them in glycerin (Sulisutiono et al. 1999) for more than 24 hours. Subsequently, they were examined under an optical microscope using reflected
light. Thereupon, opaque and translucent zones were observed (Fig. 1). The lower right portion of otolith margins in Fig. 1 was investigated in cases where whole otolith margins were unclear.

Results

Figure 2A shows seasonal changes in the zones at otolith margins without the second translucent zone (T2). Although fish specimens were not sampled from April to July in Fig. 2A and July in Fig. 2B, we estimated the zones at otolith margins by consulting data of the subsequent or preceding month. The first translucent zone (T1) is formed in August-November, whereas the first opaque zone (O1) is formed in October-April. Figure 2B shows the seasonal change in the composition of rings having a second translucent zone (T2). The translucent zone (T2) is formed in May-September. T2 is formed three months earlier than T1. T2 may be formed as a result of the influence of the spawning period. The opaque zone (O2) is formed in August-April. Fish age was expressed as if July 1 were their birthday in the Hei River. Thereupon, we found that a 0+ year-old fish forms a first opaque zone (O1), whereas a 1+ year-old fish forms a second opaque zone (O2) in their respective otoliths.

Figure 2 shows the standard body length distribution of fish captured in the river mouth. Based on evidence shown in Fig. 2, black bars and white bars indicate the existence of T2. Black bars represent 1+ year-old fish; white bars are 0+ year-old fish.

To reveal age compositions in the spawning site, 609 specimens were captured from April to June in 2001 with cast nets at the spawning sites situated 3.0 km upstream from the river mouth. After the standard body lengths were measured, 609 sagittal otoliths were examined under an optical microscope using reflected light. Thereby, we observed opaque and translucent zones. The standard body length distribution of the individuals creates a mixed result regarding the existence of O2 in the otoliths. Black bars show 1+ year-old fish data; white bars show 0+ year old fish data (Fig. 4).
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**Discussion**

We estimated the age of *H. nipponensis* in the spawning site to be 0+ year-old fish in many lakes in Japan. Commercial fishing claimed a high proportion of 1+ year-old fish before their upstream migration to spawn (Kasebayashi and Nakano 1961; Torisawa 1999). In Lake Kasumigaura, many 0+ year-old spawning fish reportedly cannot live beyond their spawning period (personal communication, Tanimura, 2002).

However, anadromous *H. nipponensis* have shown two peaks of body length distribution at spawning sites such as the Ishikari River (Tanaka 1972). In the Hei River, there are also two peaks of 75 mm and 100 mm in the body length distribution in the spawning period in 2001 (Fig. 4). We considered that the two peaks occurred as a result of different types of life history *i.e.*; whether *H. nipponensis* inhabited fresh or sea water in Ishikari River (Tanaka 1972). Nevertheless, such is not the case in the Hei River population; the annual rings in the otolith demonstrated that the smaller fish were 0+ year-old and the larger ones were 1+ year-old. As a result of this report, we understand that not only 0+ year-old fish, but also 1+ year-old fish, swim upstream to the Hei River spawning site.

In addition to the findings in this study, we also discovered that, although the first translucent zone is formed when growth is stagnant in many fish, such was not the case with *H. nipponensis*: their first translucent zone was formed from August to December when growth was strong. This is an additional area of study for which biotic or abiotic factors must be investigated.

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References


岩手県閉伊川に遡上する遡河回遊型ワカサギの年齢構成

佐々木剛・猿渡敏郎・渡邊精一

河川に生息する遡河回遊型ワカサギの年齢構成を明らかにするため、閉伊川で採集した個体の耳石の輪紋を観察した。サンプルは、1997年8月から1998年4月にかけて河口付近において採集した581個体と、1998年の4月から6月に産卵場において採集した300個体を用いた。閉伊川では第1透明帯は8月〜11月に、第1不透明帯は10月〜4月に、さらに第2透明帯は5月〜9月に、第2不透明帯は8月〜4月に形成されていた。したがって、0+年魚の時に第一不透明帯が形成され、1+年魚の時に第2不透明帯が形成されたことが分かった。この方法を使って、2001年に閉伊川の産卵場で採集したワカサギ609個体を用い、産卵遡上時の年齢構成を調査した。その結果、体長の小さい群は0+年魚、大きい群は1+年魚であることが確認された。