館山湾におけるシロギス,Sillago japonicaの食性

<table>
<thead>
<tr>
<th>項目</th>
<th>内容</th>
</tr>
</thead>
<tbody>
<tr>
<td>誌名</td>
<td>水産増殖 = The aquiculture</td>
</tr>
<tr>
<td>ISSN</td>
<td>03714217</td>
</tr>
<tr>
<td>著者</td>
<td>渡邊, 精一</td>
</tr>
<tr>
<td></td>
<td>横田, 賢史</td>
</tr>
<tr>
<td></td>
<td>Sulistiono,</td>
</tr>
<tr>
<td>巻/号</td>
<td>47巻3号</td>
</tr>
<tr>
<td>掲載ページ</td>
<td>p. 331-336</td>
</tr>
<tr>
<td>発行年月</td>
<td>1999年9月</td>
</tr>
</tbody>
</table>
Food and Feeding Habits of the Japanese Whiting, 
*Sillago japonica*, in Tateyama Bay

SUZUKI**1**, Seiichi WATANABE**1**, and Masashi YOKOTA**1**

(Accepted May 19, 1999)

**Abstract:** The study on food and feeding habit of the Japanese whiting, *Sillago japonica*, were conducted. Stomach contents were examined from 442 fish (varied from 115 mm to 245 mm total body length) collected using encircling trammel net from October 1993 to January 1995 in Tateyama Bay.

All samples were distinguished to be male (n=227) and female (n=215). Monthly changes on the index of stomach contents (ISC) indicated that feeding became active from April (0.39) to September (0.45) and decreased during October to March. Four phyla of organisms were found in the stomach of the samples, which were Arthropoda, Mollusca, Annelida and Chordata. Major diets of fish were Natantia (shrimps) and Polychaeta which constituted of 44% and 33% in female and 40% and 34% in male, respectively. Stomach contents of male and female were similar. They varied according to the sampling month and season. The feeding incidence on Natantia increased corresponding to size in both female and male.

**Key words:** *Sillago japonica*, Food and feeding habits; Tateyama Bay

One of the most popular fish in Japan, the Japanese whiting, *Sillago japonica*, is commonly consumed, and also a target for game fishing in sandy coastal areas, especially during the summer season. It is distributed along the coast from Hokkaido to Kagoshima in Japan, China, Korea, Taiwan and probably also Philippines. Overfishing and the habitat degradation may have caused a decline in some populations.

Although several studies on ecology, fishing methods and a number of experimental observations have been conducted on *S. japonica*, little information on food and feeding habits of this species has been available. Observations on the food and feeding habits of *Sillago japonica* in Hiroshima, Japan revealed that it mainly feeds on crustaceans and polychaetes.

To understand of the interaction between members of a community and prey selection which enables mapping of energy, nutrient, and occasionally pollutant flow and management of natural populations and aquaculture, we investigated food and feeding habits of *S. japonica* in Tateyama Bay.

**Materials and Methods**

Samples were taken monthly by encircling trammel net in Tateyama Bay (139°49'-139°51'E and 34°59'-35°01') from October 1993 to January 1995. A total number of 442 fish were collected. Total length-TL (nearest 1 mm), total body weight-BW and stomach content weight-SCW (nearest 0.01 g) were measured. After the stomach was dissected out, its contents were preserved in 10% formalin. These stomach contents were later removed into a petri dish and observed under a stereo microscope and identified.

Index of stomach contents was computed using \( ISC = 10^2 \frac{SCW}{BW} \). Frequency of occurrence in stomach contents was determined. Similarity index analyses were carried out on the prey to compare differences between female and male and among seasons; the equation used

---

**1** Tokyo University of Fisheries, Department of Aquatic Biosciences, 4-5-7 Konan, Minato, Tokyo 108-8477, Japan.
was, similarity index \( S = 2C/(A+B) \), where \( A \), \( B \) = number of different prey items in groups \( A \) and \( B \), \( C \) = number of joint prey items shared by groups \( A \) and \( B \).²⁰

Results

Fish Length Composition

Samples of 442 individual of fish were distinguished to be female and male. The total length distribution of both sexes are presented in Fig. 1. All samples were adult, ranged from 135 to 245 mm in females and from 115 to 245 mm in males. This figure also shows that there exists more than one modes, 165 mm and 195 mm in female and 155 mm, 185 mm and 215 mm in male.

Feeding Activity

Feeding activity of *S. japonica* collected in Tateyama Bay from April to September using analysis of index of stomach content (ISC) is presented in Fig. 2. In April the value was around 0.39, increased to 0.57 in June and 0.59 in August, but it decreased in October to March, when the ISC values were 0.30 (October), 0.04 (December) and 0.12 (March).

Stomach Contents-prey

Prey types in the stomach contents were represented by at least 9 orders in 4 phyla: Arthropoda (Crustacea); Mysidacea, Tanaedacea, Isopoda, Amphipoda, Decapoda (Natantia, Brachyura), Stomatopoda; Mollusca (Gastropoda); Annelida (Polychaeta); Chordata (Osteichthyes). Major ones were Crustacea (33%, 34%), and Polychaeta (44%, 40%), for female and male respectively (Fig. 3). The figure shows that prey types of female and male Japanese whiting were similar. A similarity index of 85% (with 11 organisms was found in both female and male; 11 in female and 15 in male) showed that the diet was basically the same between sexes. However, prey types in male seemed more varied as Mycidacea, Tanaedacea and Stomatopoda were not found in female. Unidentified flora (debris), fauna, and inert matter (silt) were also found in the stomach contents.

Relationship between Stomach Contents and Season

Monthly observation on the stomach contents of both female and male fish is presented in Fig. 4. From these results, it can be stated that the diet of both sexes were similar. As shrimps (Natantia)
Fig. 3. Diet composition of the stomach contents of the Japanese whiting, *Sillago japonica*, collected from Tateyama Bay. C-Crustacea: A-Amphipoda, B-Brachyura, I-Isopoda, M-Mysidacea, N-Natantia, S-Stomatopoda, T-Taenadacea; Mollusca: G-Gastropoda; Annelida: P-Polychaeta; Chordates: O-Osteichthyes; D-Debris; S-Silt; U-Identified animals.

Fig. 4. Monthly stomach contents of the Japanese whiting, *Sillago japonica* (with number of samples), collected in Tateyama Bay. C-Crustacea: A-Amphipoda, B-Brachyura, I-Isopoda, M-Mysidacea, N-Natantia, S-Stomatopoda, T-Taenadacea; G-Gastropoda; O-Osteichthyes; P-Polychaeta; D-Debris; S-Silt; U-Identified animals.
and polychaetes were always present in the stomach contents of at least one sex, these prey were always present in both feeding ground. Generally consumption of crustaceans exceeded that of polychaetes with no significant correlation to season in either sex. However, in October 1993 only around 20% of the diet was polychaetes, and none in January 1994, but from June to August 1994, it was the major diet in female. In male, it appeared that no polychaetes were consumed in November 1993, but in January 1995 it occupied around 60% of the diet.

As shown in Table 1, when similarity index analysis was employed for diets among seasons by sex, the values were smallest between winter and autumn in female (0.59), and between summer and spring (0.63) in male. But highest in female (0.80) between winter and summer, and in male (0.84) between autumn and spring.

Table 1. Similarity index of the diet of the *Sillago japonica* in Tateyama Bay among seasons

<table>
<thead>
<tr>
<th>Sex</th>
<th>Season</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Summer</td>
<td>0.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Autumn</td>
<td>0.62</td>
<td>0.67</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>0.76</td>
<td>0.80</td>
<td>0.59</td>
</tr>
<tr>
<td>Male</td>
<td>Summer</td>
<td>0.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Autumn</td>
<td>0.84</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Winter</td>
<td>0.71</td>
<td>0.71</td>
<td>0.71</td>
</tr>
</tbody>
</table>

Relationship between Stomach Contents and Total Body Length

Figure 5 shows the relationship between the stomach contents and total body length. Analysis of samples from a minimum size of 150 mm to 210 mm maximum (at 10 mm intervals) showed that in both sexes, fish consumed more Natantia and less Polychaeta as they grew. This figure shows the change in the food preference at around 160-175 mm in TL.

Discussion

Feeding activity of the Japanese whiting in Tateyama Bay appeared to be most active from April to October. This correlated both to the May-October spawning season and the increasing water temperature. It was also close to the period of feeding activity of April to September reported for the same fish in Hiroshima.

Based on the examination, main foods of *S. japonica* collected in Tateyama, Crustacea (mainly Natantia) and Annelida (Polychaeta) were by far the principle prey. In total, 49.5% of stomach contents were crustaceans and 33% polychaetes in female and 43% and 34%, respectively in male. The crustacean diet of female was more varied including crabs, mysids, and amphipods (not found in male). Male included Taenadacea in their diet (not found in female), and also had more plant matter (2% debris) than female (0.4%). From these observations, *S. japonica* collected in this area was predominantly carnivorous. This condition is similar to that in whiting from the Seto Inland Sea (Hiroshima). Although it can be stated that crustaceans and polychaetes were the preferred prey of *S. japonica* in Tateyama Bay, the percentage of each consumed probably was most dependent on the prey availability in the feeding ground as can be seen in Kakuda's report.
(ibid.) where Macrura was the dominant crustacea.

On the monthly basis as shown in Fig. 4, generally crustaceans were dominant, polychaetes second, but in several months the reverse was found. Why no polychaetes were consumed by male in November 1993 and female in January 1994 can not be explained as they were present in the feeding ground, consumed in great number by the opposite sex. No significant trends or correlation between prey and seasons could be found.

Although the stomach contents among seasons were similar, when analyzed by similarity index (Table 1), it was found that it was closest in female (0.59) between winter and autumn, and in male (0.63) between summer and spring. This relationship may have been caused more by physiological (e.g. maturity-immaturity) and the environmental (e.g. prey availability) conditions than on seasonal food preference.

From analysis of the change in preference as reflected in stomach contents (Fig. 5), in both sexes, at around 170 mm TL, prey preference switched from polychaetes to shrimps. As the fish grew, shrimps represented a larger percentage of the diet, reaching around 80% at 210 mm TL. This was probably in part caused by the environmental factors such as availability and distribution of foods, but the change in prey preference was mainly related with maturity of the fish. The previous study found that 90%-100% of the large-sized fish collected during spawning season (June-October) were mature fish. However, a more detailed study on diet and the maturity is needed to provide a more definite explanation.

References

館山湾におけるシロギス，Sillago japonica の食性

Sulistiono・渡邉精一・横田賢史

館山湾において1993年10月から1995年1月にかけて瀬戸内海により採取したシロギス442個体（全長115－245 mm）の食性を調査した。標本は雄227個体、雌215個体であった。胃内容物指数（ISC）は4月から9月までは高く、10月から3月までは低い値を示した。標本中には節足動物、軟体動物、環形動物、背索動物が餌生物として見られた。同湾においては遊泳類と多毛類が本種の主要な餌であり、雌ではそれぞれ44%，33%，雄ではそれぞれ40%，34%を占めていた。雌雄とも胃内容物は類似しており、餌生物の存在比率は季節的変化が見られた。サイズの増加とともに遊泳類を利用する割合が高くなった。