駿河湾産ナンヨウホタルイカAbralia andamanicaに関する2,3の生物学的知見

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Tsukuba Business-Academia Cooperation Support Center, Agriculture, Forestry and Fisheries Research Council Secretariat
Some Biological Aspects of *Abralia andamanica* from Suruga Bay, Japan (Cephalopoda: Enoploteuthidae)*

Tadashi KUBOTA, Kenji IZUKA and Takashi OKUTANI**

Abstract

Some morphometrical variabilities and other biological characters were investigated on 207 specimens of an enoploteuthid squid, *Abralia andamanica*, caught by shrimp midwater trawl operated in Suruga Bay, Japan. The relations between dorsal mantle length (*L*) and body weight (*W*) is expressed as $W = 4.044 \times 10^{-4} L^{2.53}$, fin length (*FL*) as $FL = 0.570L + 0.073$, and fin width (*FW*) as $FW = 0.796L + 4.013$. Significant differences in relations between dorsal mantle length and fin length and width between the present specimens and published data by earlier workers may suggest an existence of geographical variabilities within the whole range of this species. The relative size of five photophores on optic vesicle is also variable. Some data on fecundity, ovarian eggs and stomach content analysis of this small squid are also given.

Introduction

An enoploteuthid squid, *Abralia andamanica* was originally described by Goodrich (1896) from the Andaman Sea. Since then, this squid has been recorded from various localities of temperate-tropical Indo-Pacific region, such as Mergui Archipelago (Massy, 1916), the Philippines (Voss, 1963), the East China Sea (Yamamoto and Okutani, 1975), Japan (Sasaki, 1916, 1929), the Hawaiian Islands (Grimpe, 1931) and the Tropical Eastern Pacific (Okutani, 1974). Voss (1963) stated that this species may be separable into several subspecies throughout its range.

Considerable numbers of this squid have been caught as an incidentatal catch of micronektonic shrimp (*Sergia lucens*) trawl operated in the northern and western coasts of Suruga Bay, Honshu, Japan. Using specimens thus collected, some measurements were taken as such data may be useful for identification of infra-specific variabilities in future study.

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* Contribution A No. 221 from the Faculty of Marine Science and Technology, Tokai University. Accepted September 25, 1981.
** Department of Zoology, Natural History Institute, National Science Museum, Tokyo.
Material and Method

Among 37 shrimp trawl catches sampled during 1978—1980, 207 squids were collected from 27 hauls (Fig. 1). This species seems to be more abundant in autumn season than in spring (Table 1). The shrimp trawls were operated in four major fishing grounds, namely from north to south, off Kambara near the mouth of Fuji River, off Miho Lighthouse, off Yaizu and off Yoshida (Fig. 2).

After general morphological observations, such as body shape, characters of arm and tentacular armatures, photophores on optic vesicule etc., four measurements, namely, dorsal mantle length, fin length, fin width and body weight were taken on all specimens fixed and preserved in a 10% formalin. Some biological characters such as size of ovarian eggs and weight and component of stomach contents were also observed.

Results

1. Size of specimens (dorsal mantle length and body weight)

Among 207 specimens under study, the males occupy 54,
### Table 1. Sampling data of the present specimens

<table>
<thead>
<tr>
<th>Sampling number</th>
<th>Date</th>
<th>Time</th>
<th>Fishing ground</th>
<th>Depth of tows</th>
<th>No. of specimens collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3-V-1978</td>
<td>2050-2140</td>
<td>A</td>
<td>70-90 m</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>8-XII-1978</td>
<td>1620-1800</td>
<td>D</td>
<td>50-100</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>19-III-1979</td>
<td>--</td>
<td>C</td>
<td>120</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>9/10-V-1979</td>
<td>1830-0245</td>
<td>A</td>
<td>50-70</td>
<td>--</td>
</tr>
<tr>
<td>5</td>
<td>21/22-V-1979</td>
<td>2015-0045</td>
<td>C</td>
<td>80-120</td>
<td>--</td>
</tr>
<tr>
<td>6</td>
<td>25/26-X-1979</td>
<td>1750-0015</td>
<td>B</td>
<td>40-60</td>
<td>39</td>
</tr>
<tr>
<td>7</td>
<td>26-X-1979</td>
<td>1730-1850</td>
<td>B</td>
<td>40-50</td>
<td>9</td>
</tr>
<tr>
<td>8</td>
<td>30-X-1979</td>
<td>1715-2010</td>
<td>B</td>
<td>20-80</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>31-X-1979</td>
<td>1710-2120</td>
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<td>36</td>
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<td>1700-1935</td>
<td>C</td>
<td>60-80</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>8-XI-1979</td>
<td>1735-1930</td>
<td>B</td>
<td>20-60</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
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<td>C</td>
<td>20-70</td>
<td>10</td>
</tr>
<tr>
<td>13</td>
<td>20-XI-1979</td>
<td>1635-1915</td>
<td>C</td>
<td>70-100</td>
<td>6</td>
</tr>
<tr>
<td>14</td>
<td>26-XI-1979</td>
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</tr>
<tr>
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<td>22-IV-1980</td>
<td>1750-1855</td>
<td>C</td>
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<td>2000-2055</td>
<td>C</td>
<td>80-100</td>
<td>--</td>
</tr>
<tr>
<td>28</td>
<td>7-V-1980</td>
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<td>A</td>
<td>80-110</td>
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</tr>
<tr>
<td>29</td>
<td>14-V-1980</td>
<td>1905-2020</td>
<td>A</td>
<td>110-130</td>
<td>--</td>
</tr>
<tr>
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<td>19-V-1980</td>
<td>2019-2125</td>
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<tr>
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<td>A</td>
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<tr>
<td>32</td>
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<td>A</td>
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<td>A</td>
<td>60-90</td>
<td>5</td>
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<tr>
<td>34</td>
<td>29/30-V-1980</td>
<td>1925-0400</td>
<td>A</td>
<td>20-90</td>
<td>4</td>
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<td>3/4-VI-1980</td>
<td>1930-0400</td>
<td>A</td>
<td>40-120</td>
<td>1</td>
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<td>36</td>
<td>4/5-VI-1980</td>
<td>1910-0245</td>
<td>A</td>
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<tr>
<td>37</td>
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<td>0000-0120</td>
<td>A</td>
<td>60-90</td>
<td>3</td>
</tr>
</tbody>
</table>

The dorsal mantle length ranged from 17.0 mm to 53.3 mm, both smallest and largest specimens were collected in December 1979. In classifying every 3 mm interval, the mode

The female, 124, and the unsexed, 29 specimens. The sex ratio (male: female) for sexed specimens is 1:2.3, and does not show a great fluctuation (with one exception) by monthly catch.

The dorsal mantle length ranged from 17.0 mm to 53.3 mm, both smallest and largest specimens were collected in December 1979. In classifying every 3 mm interval, the mode...
Fig. 3. Dorsal mantle length composition of the present material \((n=207)\). Blank: male, slashed: female, X's: unsexed.

Fig. 4. Body weight composition of the present material \((n=207)\). Blank: male, slashed: female, X's: unsexed.

Fig. 5. Relation between dorsal mantle length \((DML)\) and body weight \((BW)\). Circle: male, dot: female, crisscross: unsexed.
Some Biological Aspects of Abralia andamanica from Suruga Bay, Japan

1. Dorsal Mantle Length and Body Weight

For male is apparent at 32.0—37.9 mm classes in which 81.4% (44 specimens) falls. In contrast to this, the dorsal mantle length frequency for the female show a bimodal distribution. Some 40.5% of all females fall within 3 classes between 26.0 mm and 34.9 mm, while 34.7% within another 3 classes between 44.0 mm and 52.9 mm (Fig. 3).

The body weight range for the total specimens is from 0.58 g to 10.29 g. The minimum and maximum correspond to those for dorsal mantle length. The frequency distribution of body weight by 7 g-class indicates unimodal for male and bimodal for female. The mode for male is situated between 2.60 g and 3.99 g in which 81.5% fall. The modes for female exist at 1.20—3.29 g and 5.40—8.19 g classes (Fig. 4).

The relation between dorsal mantle length (L) and body weight (W) of the present material is given by the following equations (Fig. 5):

\[
\text{male : } W=18.998 \times 10^{-4}L^{2.668} \quad (r=0.8695)
\]
\[
\text{female : } W=3.901 \times 10^{-4}L^{2.543} \quad (r=0.9755)
\]
\[
\text{male + female : } W=4.044 \times 10^{-4}L^{2.534} \quad (r=0.9710)
\]

2. Fin Length and Width

Both fin length and width show linear relation with dorsal mantle length. The relation between fin length (FL) or fin width (FW) and dorsal mantle length (L) are (Figs. 6 and 7):

\[
\text{FL} = 0.570L + 0.073 \quad (r=0.9763, \ n=215)
\]
The difference by sex is very small in both cases.

3. Optic photophores
The number of photophores on the optic vesicule is consistently five. Two terminal ones are large, the central one is medium and remaining two are small in size. The relative size, shape and interval show a considerable variability among specimens. Four examples of variabilities in arrangement and size and eleven examples of shape of medial photophore are shown in Fig. 8.

4. Tentacular hooks
Count of tentacular hooks shows a considerable consistency with number of three. Very few specimens have an additional (4th) immature hook.

5. Ovarian eggs and fecundity
Shape of ovarian eggs is spherical with diameter range from 0.075 mm to 1.500 mm. Ripe eggs are transparent and yellow, mostly bigger than 0.775 mm. Total numbers of ovarian eggs were counted for three females. The result is shown in Table 2.
Those specimens with ripe eggs were all taken from the autumn catch. The general distribution pattern of the size frequency is not always very different from each other between the spring catch and autumn catch, but existence of small specimens and gravid female only in autumn catch suggests that this species may spawn in the late summer to the early winter (Fig. 9).

6. Stomach contents

Out of 65 specimens 34 specimens or 52.3% had empty stomach. Four major food items were found, namely, crustacean remains, cephalopod fragments, fish and unidentifiable substances. The occurrence of each item is tabulated in Table 3.

Stomach Content Weight Index (S. C. W./B. W. x 100) for filled stomachs (34) was mostly between 0.001 to 3.00 (24 stomachs) and only 7 stomachs exceeded 3.00. A single stomach was over 11.0.

Table 2. Fecundity of three females

<table>
<thead>
<tr>
<th>Diameter of ova</th>
<th>DML = 45.6 mm (26-X-1979)</th>
<th>DML = 56.3 mm (15-XI-1979)</th>
<th>DML = 45.9 mm (18-XII-1979)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0.300 mm</td>
<td>1266 (25.8%)</td>
<td>823 (18.3%)</td>
<td>1855 (23.3%)</td>
</tr>
<tr>
<td>-0.600 mm</td>
<td>2600 (42.4%)</td>
<td>1589 (35.1%)</td>
<td>3381 (42.5%)</td>
</tr>
<tr>
<td>-0.900 mm</td>
<td>1203 (19.6%)</td>
<td>849 (18.8%)</td>
<td>1224 (15.4%)</td>
</tr>
<tr>
<td>-1.200 mm</td>
<td>746 (12.2%)</td>
<td>1194 (26.4%)</td>
<td>1384 (17.4%)</td>
</tr>
<tr>
<td>&gt;1.200 mm</td>
<td>—</td>
<td>66 (1.5%)</td>
<td>120 (1.5%)</td>
</tr>
</tbody>
</table>

Total 6134 4521 7964

Fig. 8. Variabilities of photophores on optic vesicle (a-d) and shape of medial photophore (e-o).

a: DML 51.2 mm, b: DML 49.0 mm, c: DML 50.2 mm, d: DML 53.3 mm. Figures e to o were all drawn on the same scale.
Discussion

There is no previous study related to such aspects as body weight composition, fecundity, food relation etc. of this species. Some published morphological data by Goodrich (1896),
Table 3. Composition of food items in 65 specimens.

<table>
<thead>
<tr>
<th>Food</th>
<th>Frequency</th>
<th>(Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty</td>
<td>34</td>
<td>(52.3)</td>
</tr>
<tr>
<td>Crustacea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part</td>
<td>25</td>
<td>(38.5)</td>
</tr>
<tr>
<td>Cephalothorax</td>
<td>23</td>
<td>(35.4)</td>
</tr>
<tr>
<td>Antennae</td>
<td>20</td>
<td>(30.8)</td>
</tr>
<tr>
<td>Appendages</td>
<td>15</td>
<td>(23.1)</td>
</tr>
<tr>
<td>Eggs</td>
<td>1</td>
<td>(1.5)</td>
</tr>
<tr>
<td>Flesh</td>
<td>2</td>
<td>(3.1)</td>
</tr>
<tr>
<td>Mollusca</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part</td>
<td>12</td>
<td>(18.5)</td>
</tr>
<tr>
<td>Jaw plates</td>
<td>12</td>
<td>(18.5)</td>
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<tr>
<td>Fish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Part</td>
<td>15</td>
<td>(23.1)</td>
</tr>
<tr>
<td>Lens</td>
<td>10</td>
<td>(15.4)</td>
</tr>
<tr>
<td>Scales</td>
<td>8</td>
<td>(12.3)</td>
</tr>
<tr>
<td>Skin</td>
<td>12</td>
<td>(18.5)</td>
</tr>
<tr>
<td>Flesh</td>
<td>14</td>
<td>(21.5)</td>
</tr>
<tr>
<td>Vertebrae</td>
<td>6</td>
<td>(9.2)</td>
</tr>
<tr>
<td>Fins</td>
<td>2</td>
<td>(3.1)</td>
</tr>
<tr>
<td>Others</td>
<td>27</td>
<td>(41.5)</td>
</tr>
</tbody>
</table>

Sasaki (1916), Massy (1916) and Voss (1963) are available. Among the data common to the present study and the previous works, only fin length and width against dorsal mantle-length were compared (See Figs. 6 and 7).

It is interesting to note here that only this set of data is concerned, Goodrich's data well fits to the line applied for the present material (although but a single measurement was given in his original description). On the contrary, Voss's data on the Philippines specimens mostly biased from it: FW scattered below and FL did above the line. This may mean that specimens from the Philippines have a narrow and longer fin than those from Suruga Bay. The data by Sasaki (1916) and Massy (1916) were too few and scattered to draw any comment.

Grimpe (1931) claimed that the Japanese form could be separable from Goodrich's species giving a new name, Abralia robsoni. The Japanese population could be called A. andamanica robsoni for convenience' sake, but the essential morphological characters and geographical relationships with the adjoining populations have never been clarified yet. An existence of morphological variabilities is very clear between the Japanese (Suruga Bay) and the Philippines population, if one takes only FLI (fin length index) and FWI (fin width index), supporting Voss's view. But, it seems to be still premature to give subspecific names to geographical stocks before every local populations are worked out from biometrical and ecological points of view throughout the whole range of Abralia andamanica.
Acknowledgements

Our sincere gratitude is extended to Mr. Y. MATSUBARA, the Director of Yui Fishermen's Association, Mr. K. SANNO and Mr. J. MIYAHARA and the crew of Inari-Maru and Takayoshi-Maru for their cooperation in sampling. Cooperation in sampling by Messrs. M. KOSHIGA, H. UNNO, T. TAKAHASHI and Miss H. SUGIHARA is also appreciated. We like to thank Mr. T. SATO, Faculty of Marine Science and Technology, Tokai University, for his skill in taking a photographs of the specimens.

REFERENCES


駿河湾産ナンヨウホタルイカ Abralia andamanica に関する 2, 3 の生物学的知見

久保田正・飯塚堅司・奥谷喬司

要 旨

駿河湾で操業されているサクラエビ漁において混獲されるナンヨウホタルイカ Abralia andamanica（ホタルイカモドキ科）207 形本につき 2, 3 の形質について測定及び調査を行った。外套背長（L）と体重（W）の関係は \( W = 4.044 \times 10^{4}L^{2.534} \) で表わされ、殻長（FL）、殻幅（FW）
との関係はそれぞれ $FL=0.570L+0.073$, $FW=0.796L+4.013$ で表わされる。過去の文献における外套長と殻長、殻幅の関係を本研究に用いた材料を比較してみるとかなりの差を認め、種内に地理的変異型（亜種）の存在を示唆する。このほか、眼胞発光器の形態変異、卵巣内卵及び孕卵数、胃内容物の調査も行なった。