Eggs and larvae of Callionymus flagris, C. richardsoni, and C. ornatipinnis were observed. The eggs of these species have the following characters in common, i.e., spherical shape with a diameter of about 0.7 mm, a partially segmented yolk, lack of oil globule, and egg-membrane with a hexagonal pattern. Eggs of C. flagris can be distinguished from eggs of other species by the size of its hexagonal pattern.

Processes of embryonic development are almost the same as known in common teleostean fishes.

Larva of each species is about 1 mm long just after hatching, and 2- to 4-days-old larva is about 2 mm long. Larva of each species has the following characters in common, i.e., spine-like patterns on dorsal and ventral fin folds, two layers of dorsal tissue, and longitudinal row of melanophores on the lateral body. The melanophores on dorsal and ventral edges near the top of the tail are useful to distinguish the species of larvae.

Callionymid eggs and larvae occur commonly and abundantly in plankton samples collected from the coastal waters of Japan. Of the members of the family, Callionymidae, the eggs and larvae of Callionymus richardsoni, C. beniteguri, and two unidentified fishes have been described, all on materials collected from the sea. More information is still needed for species identification of the eggs and larvae of callionymid fishes. Along the above mentioned purpose, mature parent fishes of three dragonets were reared in water-tanks to make them spawn in May, 1979, and those eggs and larvae thus obtained were observed.

C. ornatipinnis has been synonymized with C. beniteguri, but two different fishes of the genus were witnessed to inhabit the coastal areas of western Kyushu, one with typical characters of the former and another with those of the latter. The fish used in this examination with typical characters of the former was identified to C. ornatipinnis.
hexagonal pattern on egg-membrane. Those of
C. flagris and C. ornatipinnis are shown in Fig. 1
(A, F). These characteristic aspects are common
in eggs of the same genus known from Japanese
waters\textsuperscript{1,2,3} and ones from foreign waters\textsuperscript{7}. The
diameters of eggs in C. flagris, C. richardsoni, and
C. ornatipinnis were 0.63-0.75mm, 0.65-0.75mm,
and 0.69-0.73mm, respectively, and the hexagonal
patterns measured 0.017-0.029mm, 0.010-0.014
mm, and 0.012-0.018mm, respectively. These
eggs could not be distinguished from each other
by their sizes which closely resembled each other.
The size of the hexagonal pattern is useful to
distinguish C. flagris eggs from the eggs of the two
other species, but not for the discrimination of C.
richardsoni and C. ornatipinnis eggs.

Table 1. Embryonic development of C. ornatipinnis.

<table>
<thead>
<tr>
<th>Time elapsed from spawning*</th>
<th>Water * temp. (°C)</th>
<th>(Fig. 4)</th>
<th>Developmental stages observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>h min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>50</td>
<td>19.8</td>
<td>Two cells stage.</td>
</tr>
<tr>
<td>4</td>
<td>00</td>
<td>20.1</td>
<td>Morula stage.</td>
</tr>
<tr>
<td>7</td>
<td>30</td>
<td>20.7</td>
<td>Early gastrula stage.</td>
</tr>
<tr>
<td>10</td>
<td>30</td>
<td>20.8</td>
<td>Beginning of embryo formation. Germ ring had reached to half of the yolk diameter in lateral view.</td>
</tr>
<tr>
<td>13</td>
<td>45</td>
<td>20.8</td>
<td>Eye vesicle and myomere formation.</td>
</tr>
<tr>
<td>14</td>
<td>00</td>
<td>20.7</td>
<td>Kupffer’s vesicle formation.</td>
</tr>
<tr>
<td>14</td>
<td>30</td>
<td></td>
<td>Closure of blastopore.</td>
</tr>
<tr>
<td>15</td>
<td>30</td>
<td>20.7</td>
<td>Appearance of xanthophores on embryo and yolk sac.</td>
</tr>
<tr>
<td>16</td>
<td>00</td>
<td></td>
<td>Appearance of melanophores on embryo and yolk sac.</td>
</tr>
<tr>
<td>18</td>
<td>00</td>
<td>21.0</td>
<td>Differentiation of tail.</td>
</tr>
<tr>
<td>21</td>
<td>00</td>
<td></td>
<td>Just before hatching.</td>
</tr>
</tbody>
</table>

* The batch was regarded to be released at 1:30 p.m. on May 19, 1979.

Fig. 1. Photomicrographs of developing eggs of C. flagris (A-C) and C. ornatipinnis (D-F). All photographs are made to scale (0.2 mm).
Fig. 2. Developing eggs and larvae of *C. flagris*.
A, 8 cells stage, 1 h 55 min after spawning; B, 14 h 25 min; C, 23 h 5 min; D, eye lens formation, 24 h; E, 26 h 25 min; F, just hatched larva, 1.15 mm in total length; G, 1 day old, 1.70 mm; H, 2 days old, 1.91 mm; I, 4 days old, 1.95 mm.
Fig. 3. Developing eggs and larvae of *C. richardsoni*.
A, 3 h 40 min after spawning; B, embryo formation, 9 h 20 min; C, a little before the closure of blastopore, 12 h 30 min; D, Kupffer's vesicle and myomere formation, 14 h 30 min; E, 18 h 25 min; F, just hatched larva, 1.15 mm in total length; G, 1 day old, 1.97 mm; H, 2 days old, 1.98 mm; I, 3 days old, 2.00 mm.
Fig. 4. Developing eggs and larvae of *C. ornatipinnis*.  
A, 4 h after spawning; B, embryo formation, 10 h 30 min; C, a little before the closure of blastopore, 13 h 45 min; D, Kupffer’s vesicle formation, 18 h; E, 21 h; F, newly hatched larva, 1.33 mm in total length; G, 1 day old, 1.83 mm; H, 2 days old, 2.05 mm; I, 3 days old, 1.95 mm.
Embryonic development of *C. ornatipinnis* with time elapsed is shown in Table 1. Embryonic developments of three dragonets are drawn in Figs. 2-4. Processes of embryonic development were estimated to be almost the same for three dragonets, except the difference in developmental speeds due to the water-temperature. Hatching took place in 28 h 45 min at 19.2-20.5°C in *C. flagris*, in 21 h 30 min at 19.7-21.8°C in *C. richardsoni*, and in 23 h 30 min at 19.8-21.0°C in *C. ornatipinnis*.

In the eggs of these species, 1/3 or 1/4 of the yolk located near the embryo is segmented in the early developmental stages (Fig. 1, B, D). A little before and after the closure of the blastopore, the segmented yolk is located just beneath the yolk surface forming a thin layer (Fig. 1, C, F).

The melanophores which appear in the late stages are scattered dorsally on the embryo and on a part of the yolk sac near the embryo. The xanthophores are on the lateral part of embryo and on the yolk sac.

**Larvae**

The larvae were kept for three or four days after hatching without feeding in one-liter glass beakers, at a water-temperature of 19.0-20.0°C with *C. flagris*, 22.2-22.7°C with *C. richardsoni*, and 20.0-22.0°C with *C. ornatipinnis*.

Total length of just hatched larva was 1.15 mm both in *C. flagris* and in *C. richardsoni*, and the larva of *C. ornatipinnis* several hours after hatching was 1.33 mm long. They attained to 1.70-1.97 mm in 1 day. No big difference in size was seen between species in 2- to 4-day-old larvae, which were about 2 mm long.

The larvae of each species just after hatching possess large oval yolk, the long axis of which is approximately 70% of the total length. The yolk is indistinctly segmented peripherally, and was absorbed in 3 days.

Vertebral number of these species is common, and is mostly 21. Myomere numbers of the larvae were 19-22 in each species at any growth stage. Characteristically each larva has two layers of tissue dorsally in trunk and anterior part of tail.

Form and development of fins are common in these species. Pectoral fins start to appear in 1-day-old larva. Each larva except the one just after hatching has serrate patterns on edges of the dorsal and ventral fin folds. The serrations are more sharpened and ranged more irregularly than those in the sketch in Figs. 2-4. The density of the notches varies with the individual, and not with the species. A small vacuole is situated on the dorsal fin fold near the trunk in each 1- to 4-day-old larva.

One-day-old larvae of each species have some free neuromasts. The intestine convoluted in 2 or 3 days, the heart was formed in 1 or 2 days, the mouth was formed in 3 days, and the air-bladder was recognized in 2 or 3 days after hatching in larva of each species.

The xanthophores are scattered on the lateral body and the whole of the yolk sac, and crowd densely on the trunk ventrally in just hatched larva and 1-day-old larva of each species. The xanthophores increase dorsally and decrease ventrally in 2- to 4-day-old larvae.

No specific difference was found in distribution of melanophores on body and yolk sac except the posterior part of tail. For some time after hatching, thick melanophores are located on the back of the body and on the side of the central part of the tail, and some are also scattered on the whole side of the body and on the yolk sac near the body except the posterior part of the tail. In 1 or 2 days after hatching, the melanophores on the back of body shift in ventral direction, and most of them are situated laterally and ventrally in 2- to 4-day-old larvae. It is characteristic in 2- to 4-day-old larvae that the melanophores range on a longitudinal line on the side of the body, and crowd forming a band on the central side of the tail, and that they are thick dorsally on the intestine. Either melanophores or xanthophores are absent or scarce on posterior half of the tail in each larva. Near the end of the tail, *C. flagris* larva has several melanophores on both dorsal and ventral edges, *C. richardsoni* larva on only ventral edge, and *C. ornatipinnis* has none either dorsally or ventrally, although some individual variations have been found. The melanophores and xanthophores are also situated forming some clusters on the dorsal and ventral fin folds, sometimes together and sometimes separately.

The serrate pattern of the fin folds and the typical location of the melanophores on the central side of the tail have also been described in fishes of the same genus. The longitudinal row of the melanophores on the side of body has been observed in the postlarvae of unidentified species, *C. reticulatus*, and *C. beniteguri*. These seem to be the generic characters which are common in many species.

The larvae for some time after hatching stayed
upside down, just beneath the surface of the water, then they floated at random in various depth with the head directed to the bottom. The larvae 2- to 4-day-old swam normally.

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References


