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# Morphological Variation of Medusa of the Northern Form of *Eutima japonica* Uchida

By

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(With 2 Text-figures and 5 Tables)

*Eutima japonica* Uchida from Hachinohe, Aomori Pref. was at first described by Kakinuma in 1964 under the name of *Eugymnanthea cirrifera* based on the newly liberated medusa and the polyp associated with *Mytilus edulis* (Kakinuma 1964, Kubota 1983). However, the mature medusa of this population has been unknown. Therefore it is possible that the taxonomic treatment is not right. This comes into question by the occurrence of *Eucheilota intermedia* Kubota in central Japan (see Kubota 1984, 1985b), because the polyp and young medusa of this species are very similar to those of the present species. Therefore, the present research was conducted to decide the taxonomic status of the hydroids at this locality. The bivalve-inhabiting hydroids were collected from Kabushima Is. near Hachinohe and its adjacent waters from Kikonai, Hokkaido to Otsuchi, Iwate Pref., northern Japan. Moreover, hydroids from Enoshima Is., Kanagawa Pref. and hydroids from Atami, Shizuoka Pref., both in central Japan, were also examined (cf. Kubota 1985a) to know the morphological variation and the distribution of the northern form of *Eutima japonica*.

## Materials

The hydroids associated with three species of Mytilidae such as *Mytilus edulis*, *M. coruscus*, and *Septifer virgatus* from six localities from northern to central Japan were used in the present study (Table 1). Most of the bivalve specimens were collected from the intertidal region, while larger specimens of *M. coruscus* from Otsuchi were collected by skin diving within several meters in depth and *Atrina pectinata* and *M. edulis* from Kikonai were collected by fishermen's diving at the depth of 15-24 m. All the specimens of *M. edulis* from Enoshima Is. and Atami were attached to a raft, *M. edulis* from Kikonai was attached to the

Table 1. Host bivalves examined, association rate, and the host size harboring polyps of *E. japonica*. The localities are arranged from north to south.

Locality and bivalve species	Collecting date	No. of bivalves examined	Association rate (%)	Antero-posterior axes of host harboring polyps, in mm
Kikonai				
<i>Mytilus edulis</i>	23-V-'82; 19-IV, 16-V-'84	39	7.7	69-116
<i>Septifer virgatus</i>	24-V-'82	18	0	—
<i>Atrina pectinata</i>	23-V-'82	100<	0	—
Kabushima Is.				
<i>Mytilus edulis</i>	12-VI-'83	57	19.3	35- 51
Kitayamasaki				
<i>Mytilus edulis</i>	12-VI-'83	56	16.1	30- 48
Otsuchi				
<i>Mytilus edulis</i>	13-VI-'83	190	70.5	23- 70
<i>Mytilus coruscus</i>	(13-17)-VI-'83	45	2.2	55
<i>Septifer virgatus</i>	13, 14-VI-'83	104	21.2	28- 47
Enoshima Is.				
<i>Mytilus edulis</i>	15-X-'83	159	34.6	15- 79
Atami				
<i>Mytilus edulis</i>	14-X-'83	86	3.5	34- 60

shell of *A. pectinata*, and all the other bivalves except for *A. pectinata* were attached to rock.

From the Table 1 together with additional observations, the followings are noticeable (cf. Kubota 1983): (1) A small number of polyp was attached to the right mantle of one small specimen of *M. coruscus* from Otsuchi. Therefore the present species has so far been found within only two small specimens of this bivalve examined by the author. This forms a marked contrast to the relationship of the association rate of the present species and the size of *M. edulis*. Although the shell size was not described, the present species was found within *M. coruscus* from Hachinohe by Uchida (1964); (2) The association rate of the hydroid with *Septifer virgatus* at Otsuchi is higher than that at other localities so far been examined; while the number of polyp per this host is not many in every host; (3) In the bivalve specimens whose total number of polyps per host is small, all or most of the polyps were found on the mantle just beneath the labial palp; (4) Among the specimens of *M. edulis* harboring the present species so far been examined, the specimen from Kikonai is the largest, measuring up to 116 mm in antero-posterior axis and the depth of the habitat of this host is the deepest.

Only from *Mytilus edulis* the mature medusae could be obtained by rearing in laboratory in Sapporo. The methods as to rearing the material and the observation were described before (Kubota 1983). All the measurements in text are shown in the form of mean  $\pm$  SD (range). Only the difference is that several specimens from Kabushima Is., Kitayamasaki, and Otsuchi were reared in seawater from Akkeshi Bay for a week.

It is noteworthy that the smallest host specimen from Enoshima Is. is 15 mm in antero-posterior axis, the smallest host for the present species, within which a total of 376 polyps were attached to all of the soft body portions, and 23.1% of the polyps bore the medusa-bud and only 0.3% bore the daughter polyp (cf. Kubota 1983).

### Results and Discussion

Only 17 specimens of the youngest medusa within one day old originated from *Mytilus edulis* from Otsuchi were examined in detail. They have an umbilical canal, eight statocysts, and eight marginal swellings, while in the largest specimen two small adradial marginal warts were produced besides them. They have four tentacles except for one specimen which had three tentacles (cf. Table 2). The umbrella is  $2.2 \pm 0.8$  mm (1.0-3.6 mm) in diameter and  $1.4 \pm 0.4$  mm (0.8-2.0 mm) in height. There are many statoliths,  $26 \pm 5$  (17-41) per specimen. In one statocyst up to seven statoliths are contained, consisting of several (up to five) larger ones and some (up to four) smaller or undeveloped ones. One abaxial cirrus is found on every interradial marginal wart except for one wart. There are many lateral cirri and some cirri are found on the free marginal portion of the umbrella, not far from the base of marginal swelling, and the total number of cirri per specimen is  $33 \pm 7$  (24-43). The number of cirri per perradial marginal swelling is  $4 \pm 1$  (3-8,  $4 \times 17$ ), and the total number of lateral and abaxial cirri per interradial one is  $4 \pm 1$  (2-6,  $4 \times 17$ ), being the same number with each other.

The present material shows the maximum value of the measurements in three characters in the youngest medusa of the present species (cf. Kubota 1983, Table 13): 3.6 mm in umbrellar diameter, 41 in the total number of statoliths, and 10 in the total number of marginal swellings.

One of the characteristics of the youngest medusa of the northern form of *Eutima japonica* is the possession of four tentacles (Kubota 1983). The number of tentacles of the youngest medusae was examined in 788 specimens originated from 68 specimens of *Mytilus edulis* collected from six localities (Table 2). In each locality most of the specimens or all the specimens have four tentacles, while some have three or two tentacles. It is noteworthy that the percentage ratio of the specimens with four tentacles is the lowest in the southernmost population (Atami population).

The laboratory-reared youngest medusae grow rapidly and begin to produce

Table 2. Frequency distribution of the number of tentacles of the youngest medusa of *E. japonica* associated with *Mytilus edulis* from six localities.

Locality	No. of host bivalves examined	No. of specimens examined	Number of tentacles		
			2	3	4
Kikonai	2	28	3.6	3.6	92.9
Kabushima Is.	5	13	7.7	0	92.3
Kitayamasaki	4	13	0	0	100
Otsuchi	12	321	0.6	0.6	98.8
Enoshima Is.	42	373	6.7	2.7	90.6
Atami	3	40	17.5	10.0	72.5

the peduncle and four interradial tentacles soon. In 15 specimens from Otsuchi, Enoshima Is., and Atami eight tentacles are produced on the  $9 \pm 2$ th day (6th to 12th day). At this developmental stage, the umbrella is  $5.5 \pm 0.6$  mm (4.7-6.6 mm) in diameter, and there is a short peduncle which was already produced in younger stage than the present stage, many exumbrellar nematocysts, and more than 24 marginal swellings. Most of the cirri disappear (only in five specimens one or two cirri remained) and the gonads are immature (though one specimen is nearly mature).

The morphological variation of the laboratory-reared mature medusa from Kikonai, Kabushima Is., Kitayamasaki, and Otsuchi in northern Japan is shown in Fig. 1, B, and that from Enoshima Is. and Atami in central Japan is in Fig. 1, A. To draw this figure a total of more than 110 specimens 9-97 days old were examined, and some of which were examined repeatedly several times. In the present material, the umbrellar diameter attains to 11.9 mm and the total number of marginal swellings including tentacular bulbs (up to 15 in number) attains to 85. Most of the specimens have eight tentacles, while some have less than eight, 4-7 in number despite of their large body size (5.2-8.4 mm in diameter) and presence of many marginal swellings (24-72 in number) (Fig. 1). In eight specimens with 4-6 tentacles on about 25th day, the successive development of marginal tentacles was examined in most of their life-span (Fig. 2). Three specimens had eight tentacles afterwards (Nos. 1, E, F), whereas the other five specimens (specimens A-D, G) had six or seven tentacles despite of the increase of the number of tentacles (though in specimen A two perradial tentacles were degenerated afterwards). It is noteworthy that the former three specimens had six tentacles on about 25th day, whereas the latter five specimens had four or five tentacles on that day. Although possession of more than eight tentacles is a diagnostic character of the mature medusa of the present species, specimens with less than eight tentacles are rarely found.

One of the other characteristics of the northern form of *Eutima japonica* is the

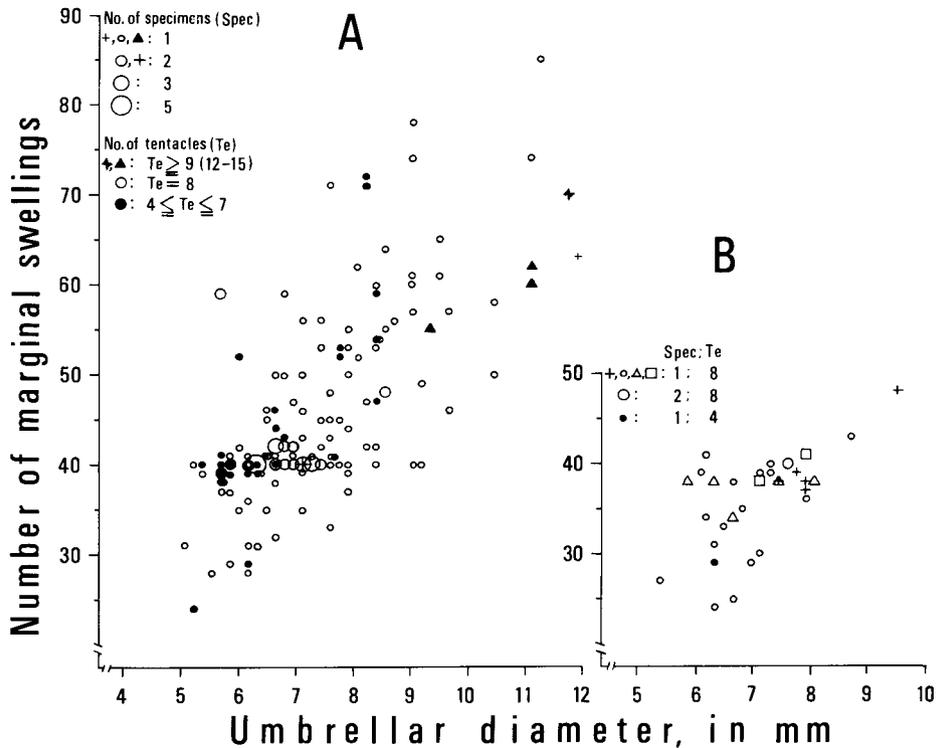


Fig. 1. Relationship between the umbrellar diameter and the total number of marginal swellings of the mature and spent medusae of both sexes. A: In specimens from Atami 22-65 days old (cross) and those from Enoshima Is. 18-97 days old (other symbols). B: In specimens from Otsuchi 9-26 days old (circles), those from Kitayamasaki 18-26 days old (triangles), those from Kabushima Is. 11-26 days old (quadrangles), and those from Kikonai 17-34 days old (cross).

disappearance of cirri in a well-developed but immature medusa described above as well as in the mature medusa. This is also confirmed in the present mature to spent medusa, examining more than 100 specimens from Enoshima Is. and a small number of specimens (a total of 29 ones) from the other localities (Table 3). Many cirri do not reappear afterwards in these specimens and no cirri are found in most of the specimens of different ages.

The development of marginal warts of the second to the fifth or the sixth sets was clarified, in many specimens from Enoshima Is. As a result the developmental pattern is the same as that described before (see Kubota 1983, Figs. 13, 18). Most of the marginal swellings of the fourth set are produced at the following portions of the umbrellar margin: at the portions between the marginal warts of the third sets and the perradial marginal swellings, other portions between the

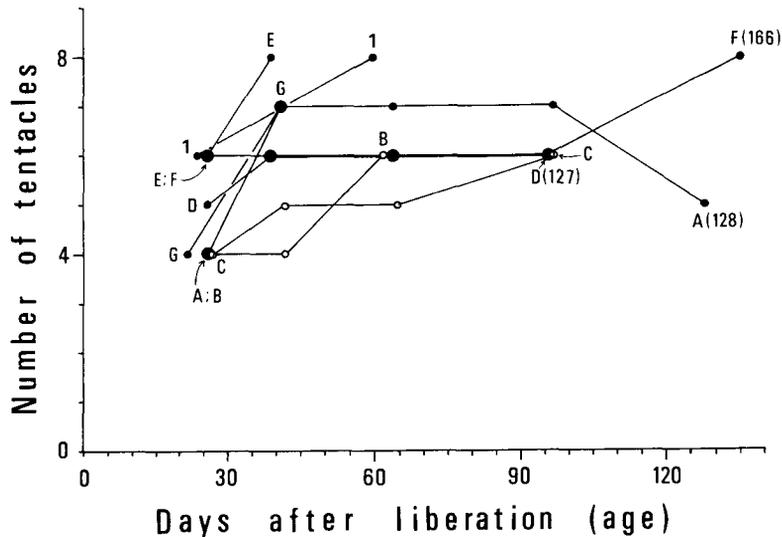


Fig. 2. Successive development of marginal tentacles in seven specimens (abbr. 1, A-F) originated from two specimens of *Mytilus edulis* from Enoshima Is. The numbers in parentheses indicate their life-span.

interradial marginal swellings and the marginal warts of the third sets, and the other portions between the statocysts and the marginal warts of the second sets. Most of the marginal warts of the fifth or sixth sets are produced at the following portions of the umbrellar margin: at the portions between the marginal warts of the second sets and the marginal warts of the third sets and rarely at the other portion between statocysts and the marginal warts of the second sets.

The measurements of various body portions of nearly earliest developmental stage of the mature medusa and a well-grown medusa older than this stage from three localities are shown in Table 4.

Together with somewhat abnormal specimens the morphological variation of the northern form of *Eutima japonica* in the present material is summarized as follows: there are 3-8 oral lips, 3-6 radial canals, and up to nine statocysts; with the manubrium found within the subumbrellar cavity or reached the umbrellar aperture (in only one specimen from Enoshima Is. whose umbrella was 11.3 mm in diameter and with 85 marginal swellings (the maximum value of the northern form of the present species), the manubrium was protruded from the umbrellar aperture, see Fig. 1, A).

It was observed that (1) the largest statolith is 28  $\mu$ m in diameter, (2) the manubrium is up to 2.6 mm in length, (3) the number of statoliths per statocyst is up to 20, the maximum value of the northern form of the present species, being the same number as that in the southern form, (4) the development of peduncle is

Table 3. Frequency distribution of the number of cirri per specimen of different ages, represented by the number of specimens of both sexes. Number of cirri is arbitrarily divided into five classes.

Locality	Age in days*	No. of cirri/specimen					Total no. of specimens examined
		0	1-9	10-19	20-29	30-39	
Kikonai	17-19	4	0	0	0	0	4
	60*	1	0	0	0	0	1
Kabushima Is.	11-26*	2	0	0	0	0	2
Kitayamasaki	18-26*	5	0	0	0	0	5
Otsuchi	9-26*	21	1	0	0	0	22
Enoshima Is.	18-47	83	15	8	2	0	108
	37-48*	18	1	1	1	0	21
	51-63	11	0	0	0	1	12
	63-65*	6	0	0	0	0	6
	96-97*	1	2	0	0	0	3
Atami	22-23	2	0	0	0	0	2
	63-65	3	0	0	0	0	3
All the data combined	9-97*	157	19	9	3	1	189

\*Some or all of the specimens were examined twice or several times.

not well in the specimens with indistinct oral lips (Table 5, upper column), and in these specimens the number of tentacles and marginal swellings is not many (with usually four tentacles and about 24 marginal swellings), whereas in the specimens whose oral lips are distinct but their number is abnormal (more than five) the peduncle as well as the number of tentacles, the number of marginal swellings, and umbrellar diameter are normally developed (Table 5, lower column); all the specimens shown in Table 5 were not used to draw Fig. 1, A), (5) the degree of pigmentation on marginal swelling and manubrium is variable, from distinctly pigmented to completely absent, (6) the egg diameter discharged from five specimens 9-12 days old from Otsuchi is  $60 \pm 6 \mu\text{m}$  ( $44-72 \mu\text{m}$ ) in 36 eggs, (7) one specimen from Enoshima Is. was survived for 166 days (cf. Fig. 2), which is the longest life-span of the present species.

In conclusion, the range of variation of the taxonomic characters of the present species overlaps with that of *Eucheilota intermedia* Kubota (cf. Kubota 1985b). However, an individual specimen could be easily separated into two species by the combination of some characters even if the abnormally developed individuals of the present species described above are included.

Table 4. Measurements of various body portions of mature medusa of *E. japonica* from three localities, northern Japan, in mm.

Locality	Kabushima Is.		Kitayamasaki			Otsuchi	
	Age in days	11	26	18	19	26	9-12
No. of specimens examined	1 ♂*	1 ♂*	1 ♂**	1 ♂	1 ♂**	6 ♂♂ + 8 ♀♀	1 ♀
Umbrellar diameter	7.1	7.9	7.5	6.7	8.1	6.6 ± 0.5 ( 5.4 - 7.3 )	7.6
Breadth of stomach	0.3	0.3	0.4	0.5	0.5	0.4 ± 0.1 ( 0.2 - 0.6 )	0.4
Position of gonads <sup>1)</sup>	0.8	—	1.3	1.7	2.2	1.1 ± 0.2 ( 0.8 - 1.4 )	1.4
Length of gonads	2.4	—	1.7	1.9	1.6	1.5 ± 0.1 ( 1.3 - 1.7 )	1.7
Maximum width of gonads	0.11	—	0.19	0.19	0.19	0.21 ± 0.04 ( 0.14 - 0.31 )	0.16
Umbrellar height	4.6	5.9	5.6	4.9	5.7	4.0 ± 0.6 ( 2.7 - 5.1 )	5.9
Thickness of jelly above the stomach	2.1	2.7	2.7	2.5	3.2	2.0 ± 0.3 ( 1.3 - 2.5 )	3.0
Length of peduncle	1.0	1.3	1.6	2.1	3.2	0.6 ± 0.1 ( 0.5 - 1.0 )	2.1
Length of manubrium	1.6	1.6	1.7	1.7	1.7	1.7 ± 0.2 ( 1.3 - 2.1 )	1.7
Breadth of velum	0.8	0.6	0.8	0.7	—	0.7 ± 0.1 ( 0.5 - 1.0 ) <sup>2)</sup>	0.8
Total number of marginal swellings	38	41	38	34	38	34 ± 5 ( 24 - 41 )	40
Number of statoliths	67	87	65	70	77	52 ± 9 ( 40 - 71 )	76
Number of statoliths per statocyst	6-11	8-14	6-10	8-10	9-11	4-10	8-12
No. of cirri	0	0	0	0	0	0-2	0

\*\*\*: The same specimen of different ages.

1) Length from center of stomach to proximal portion of gonads.

2) Examined in 13 specimens.

Table 5. Relationship between the development of oral lips and the development of peduncle in 23 immature specimens from Enoshima Is., with measurements of some characters.

Age in days	Oral lips (No. of oral lips) <sup>1)</sup>	Peduncle <sup>2)</sup>	Umbrellar diameter in mm	No. of tentacles	No. of marginal swellings	No. of cirri	No. of statoliths	No. of statoliths/statocyst
20	I	A	4.6	6	26	0	71	8-10
22	I	A	2.9	4	19	1	44	5- 7
22	I	A	3.1	4	24	0	52	6- 8
22	I	A	3.5	4	24	0	53	5- 8
22*	I	R	4.5	4	27	0	61	7- 9
23	I (3)	A	3.5	4	11	0	60	6- 8
23	I	A	4.3	7	29	0	70	8-10
23	I	R	4.4	4	25	0	62	5- 9
24	I	R	3.8	4	26	0	66	7-10
25	I	A	3.5	4	21	0	56	6- 8
25	I	A	3.6	4	23	0	69	7-10
25	I	A	3.7	4	24	0	54	6- 8
25**	I	R	4.4	6	25	0	65	6-10
25	I	A	4.9	4	25	0	71	7-10
26	I	A	3.7	4	24	0	68	7-11
32	I	R	4.3	4	34	0	66	8- 9
38*	I	R	6.0	8	29	0	71	7-10
41**	I	R	6.5	6	25	0	74	8-10
26	D (5)	W	6.3	8	28	0	72	8-10
27	D (5)	W	6.2	8	44	1	65	7- 9
27	D (6)	W	6.8	8	41	0	68	7-10
27	D (6)	W	7.1	8	48	0	64	7- 9
29	D (8)	W	6.3	8	47	6	82	10-11
29	D (7)	W	6.7	8	41	0	75	9-10
29	D (6)	W	6.8	8	42	0	64	7- 9

\*\*\*: The same specimen of different ages.

1) I: indistinct, D: distinct.

2) A: absent, R: rudimental, W: well-developed but within subumbrellar cavity.

### Summary

Through the laboratory-rearing of the bivalve-inhabiting hydroids from six localities from Kikonai, Hokkaido, northern Japan to Atami, Kanagawa Pref., central Japan, they are determined to be the northern form of *Eutima japonica* Uchida, 1925, with which *Eugymnanthea cirrifera* Kakinuma, 1964 is certainly synonymous. Some morphological characters of this form are confirmed to be stable: (1) The youngest medusa has usually four tentacles; (2) The maturation is rapid, and it occurred on the 9th day after liberation in the specimen matured earliest; (3) Most of the cirri disappear in the developmental stages of the medusa from a well-grown but immature one to a spent stage; (4) The mature to spent medusa has usually eight or more tentacles. Some newly described character states of the mature to spent medusa are: (1) The number of tentacles is rarely four to seven; (2) Many exumbrellar nematocysts remains in some specimens 9-24 days old; (3) In the specimens whose oral lips are indistinct, the peduncle is absent or only slightly developed. Despite of the wide morphological variation of the present species, it can be clearly distinguished from the most closely related hydroid *Eucheilota intermedia* Kubota, 1984.

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