

A New Hydromedusa of the Genus *Eirene* (Leptomedusae; Eirenidae) from Toba, Japan

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ABSTRACT—A new hydromedusa *Eirene lacteoides* (Leptomedusae; Eirenidae) from Toba, Mie Prefecture, Japan is described based on the laboratory-reared 18 male medusae and 33 immature ones. The new species resembles *Eirene lactea* (Mayer, 1900) in having distal projections of peduncle, but can be distinguished by the presence of an adaxial papilla on every well-developed tentacular bulb and even on some small tentacular bulbs bearing very short tentacles. The development of medusa, the nematocyst equipment, and the distributional records of *E. lacteoides* are also described.

INTRODUCTION

Many mature and immature medusae of an undescribed form of the family Eirenidae were obtained by culture. They were at first found in seawater tanks of the Toba Aquarium as small immature leptomedusae. In Japanese waters six species representing five genera of the family Eirenidae [1] have hitherto been found [2–11]: *Eirene hexanemalis* (Goette, 1886) [4], *Eirene menoni* Kramp, 1953 [8], *Eutima japonica* Uchida, 1925 [2, 9], *Eutonina indicans* (Romanes, 1876) [3, 5, 6], *Tima formosa* L. Agassiz, 1862 [2, 5], and *Eugymnanthea japonica* Kubota, 1979 [10, 11]. Except for the last species, their description is originally based on mature medusae collected from the natural seas in Japan. The hydromedusa in question, though obtained by culture, is apparently different from all known species of the Eirenidae. In the present paper characteristics of this medusan species are evaluated based on 51 mature and immature specimens.

MATERIALS AND METHODS

Very young medusae, about 1 mm in diameter, provided with four tentacles, occurred in seawater tanks of the Toba Aquarium, Mie Prefecture, Japan on August 12–26, 1989. Their occurrence was also detected during the period between February 4 and April 21, 1990. In these tanks the natural seawater taken just in front of the Toba Aquarium was stored at room temperature. Many such immature medusae without any trace of gonads were picked up and reared to maturity in either 2800 ml, 900 ml, or 200 ml vessels filled with natural seawater from Toba or occasionally in artificial seawater (Jamarin U) at 25–28°C, being fed with *Artemia* nauplii for up to 69 days. Eighteen mature medusae selected and examined were all males (Nos. 1–18). The 13 specimens were measured immediately after being narcotized with MgCl₂ solution, while the others were measured after preservation in formalin-seawater (see Tables 1, 5). The nematocyst equipment was examined on one living 45–46 day old specimen (No. 5) under a phase-contrast microscope, and Figs. 7–10 were drawn on this occasion. The development of medusa was observed not only on these specimens. The other 33 immature ones were also reared for 6–11 days and then preserved in formalin-seawater. Among them the development was examined in detail on two medusae (Nos. 11, 12)

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as shown in Table 5. They were reared in 900 ml vessels filled with seawater from Toba at 26–27°C, fed sufficiently with *Artemia* nauplii, and seawater was changed every day. Figures 1–6 were drawn from specimens preserved in formalin-seawater solution. Figures 1–10 were made, with a drawing apparatus, Nikon SMZ 10 and Olympus BH-DA.

***Eirene lacteoides* n. sp.**

(Figs. 1–11)

[Japanese name: *Kobu-eirene-kurage*, new]

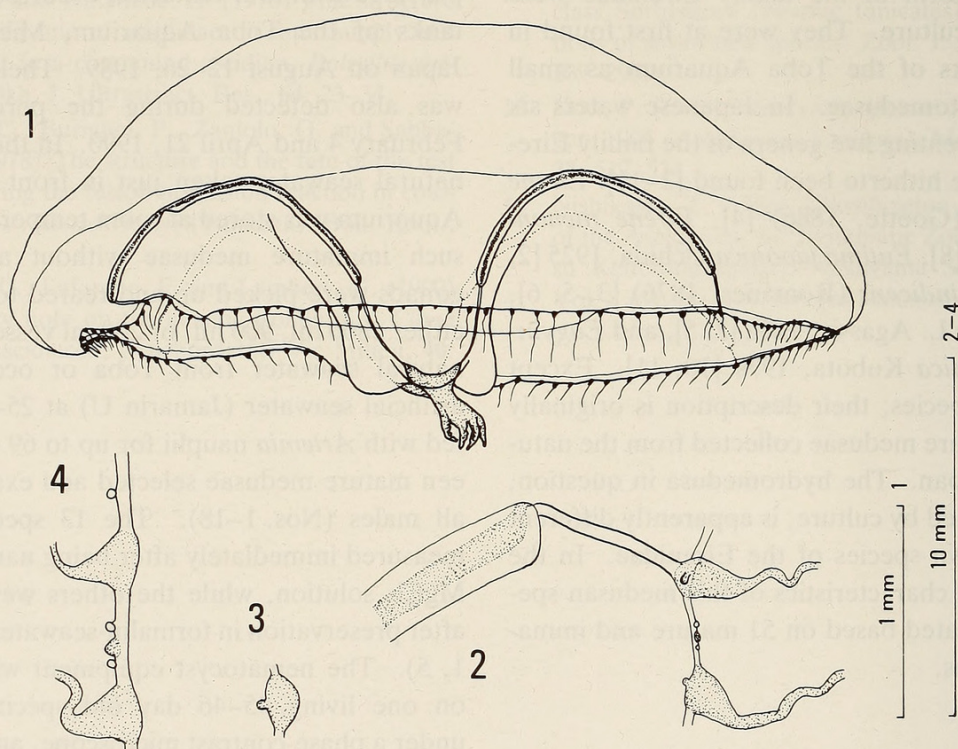
Type-series

The type-series is deposited in the collection of the Zoological Institute, Faculty of Science, Hokkaido University, Sapporo, Japan [ZIHU-498 (holotype: specimen number 1); ZIHU-499 (paratypes: Nos. 2–4, 6–8)], Seto Marine Biological Laboratory, Kyoto University, Japan [SMBL Type Nos. 370–372 (paratypes: Nos. 9, 12, and 33 im-

mature medusae)], Institut des Sciences Naturelles de Belgique, Bruxelles, Belgium [U.L.B.Z.J.B.C. 2E (paratypes: Nos. 10, 11)], British Museum (Natural History), London, UK [1991. 3. 1. 1–2 (paratypes: Nos. 13, 14)], Royal Ontario Museum, Toronto, Canada [ROMIZ B1152–1153 (paratypes: Nos. 15, 16)], National Science Museum (Nat. Hist.), Tokyo, Japan [NSMT-Co 562 (paratype: No. 17)], and Toba Aquarium, Toba, Mie Prefecture, Japan [TAMBL C1 (paratype: No. 18)].

Description of holotype

The holotype was examined when it was 20 days old and reexamined after preserved in formalin-seawater on the 24th day. The umbrella is wider than high, measuring 24.7 mm in diameter and 10.7 mm in height (Fig. 1; Tables 1, 3). The peduncle is not wide even at its base and protrudes from the velar opening for a short distance when it is well-extended (Table 3). Four projections are



FIGS. 1–4. The morphology of the holotype (Specimen no. 1) of *Eirene lacteoides* n. sp. 1: Side view. The peduncle broadens due to slight contraction of body. 2: A marginal portion of the umbrella, showing two tentacular bulbs, each with an adaxial papilla (one in oral view, the other in oblique view), two statocysts and a marginal wart, and a distal portion of the male gonad produced along the radial canal. 3: A papilla on the adaxial side of a well-developed tentacular bulb, viewed from aborally (tentacles are not drawn). 4: A marginal portion of umbrella, showing statocysts and a marginal wart between two successive tentacular bulbs, viewed from abaxially. Note no papillae on this side, and statoliths disappeared due to preservation.

TABLE 1. Diameter and the number of marginal swellings of the mature medusa of *Eirene lacteoides* n. sp.

| Specimen number | Days of rearing (=age) | Umbrellar diameter in mm | Total number of | |
|-------------------|------------------------|--------------------------|------------------|----------------|
| | | | tentacular bulbs | marginal warts |
| 1* | 20 | 24.7 | 105 | 17 |
| 1 ^{1)*} | 24 | 21.6 | 119 | 11 |
| 2 | 12 | 18.7 | 61 | 25 |
| 3 | 12 | 14.0 | 45 | 22 |
| 4 | 36 ²⁾ | 19.8 | 75 | 28 |
| 5 | 44 ²⁾ | 19.8 | 65 | 10 |
| 6 | 43 ²⁾ | 19.8 | 68 | 26 |
| 7 ¹⁾ | 19 | 16.7 | 90 | 17 |
| 8 ¹⁾ | 19 | 15.4 | 75 | 7 |
| 9 ^{1,3)} | 19 | 13.2 | 65 | 16 |
| 10 ⁴⁾ | 19 | 15.7 | 63 | 18 |
| 13 | 30 | 30.7 | 141 | 12 |
| 14 | 35 | 28.5 | 157 | 8 |
| 15 | 35 | 29.3 | 149 | 7 |
| 16 | 36 | 30.7 | 148 | 14 |
| 17 ¹⁾ | 38 | 24.0 | 153 | 9 |
| 18 ¹⁾ | 69 | 15.9 | 155 | 2 |

*: The holotype. Nos. 2–18 are paratypes and for measurements of Nos. 11 and 12, see Table 5.

¹⁾ Measured after preserved in formalin-seawater.

²⁾ Reared in an artificial seawater for 2–3 weeks at $25 \pm 2^\circ\text{C}$ after keeping them in natural seawater from Toba at $27 \pm 1^\circ\text{C}$ (the others were reared in natural seawater from Toba at $27 \pm 1^\circ\text{C}$).

³⁾ Umbrella is contracted when preserved.

⁴⁾ A specimen with five radial canals.

TABLE 2. Number of statocysts and statoliths of *Eirene lacteoides* n. sp.

| Specimen number | Total number of | | Relative abundance of the number of statoliths per statocyst | | | |
|-----------------|-----------------|------------|--|-----|----|---|
| | statocysts | statoliths | 0 | 1 | 2 | 3 |
| 1* | 146 | 147 | 0 | 145 | 1 | 0 |
| 2 | 118 | 125 | 0 | 111 | 7 | 0 |
| 3 | 94 | 100 | 0 | 88 | 6 | 0 |
| 11 | 293 | 311 | 0 | 275 | 18 | 0 |
| 12 | 205 | 226 | 2 | 181 | 21 | 1 |
| 13 | 267 | 285 | 0 | 251 | 14 | 2 |
| 14 | 254 | 264 | 0 | 244 | 10 | 0 |
| 15 | 263 | 279 | 0 | 248 | 14 | 1 |
| 16 | 257 | 274 | 0 | 241 | 15 | 1 |
| 17 | 289 | — | — | — | — | — |
| 18 | 235 | — | — | — | — | — |

*: The holotype.

—: Unavailable due to disappearance while preservation (see Table 1).

TABLE 3. Measurements of various body portions of *Eirene lacteoides* n. sp., in mm taken from living specimens

| Specimen number ¹⁾ | Umbrellar height | Thickness of jelly at the apex | Length of | | | Width of | |
|-------------------------------|------------------|--------------------------------|-----------|-----------|-----------|----------|-------|
| | | | peduncle | manubrium | oral lips | stomach | gonad |
| 1* | 10.7 | 6.7 | 6.7 | 1.7 | 2.3 | 2.7 | 0.3 |
| 2 | 8.0 | 4.7 | 4.0 | 1.3 | 1.5 | 1.5 | 0.2 |
| 3 | 6.0 | 5.6 | 4.0 | 0.9 | 1.3 | 1.1 | 0.2 |
| 4 | 9.5 | 5.2 | 5.7 | 1.6 | 0.8 | 1.2 | 0.3 |
| 5 | 10.3 | 5.6 | 5.2 | 1.3 | 1.1 | 1.4 | 0.1 |
| 6 | 10.3 | 5.7 | 4.9 | 1.3 | 1.4 | 1.6 | 0.2 |
| 11 | 12.7 | 6.0 | 5.5 | 1.5 | 2.0 | — | 0.3 |
| 12 | 8.7 | 3.6 | — | 2.0 | 1.2 | — | 0.3 |
| 13 | 12.7 | 6.5 | 7.3 | — | 1.1 | — | 0.2 |
| 14 | 12.7 | 6.1 | 6.0 | 1.3 | 1.4 | — | 0.2 |
| 15 | 10.1 | 6.0 | 4.8 | 0.8 | 1.2 | — | 0.1 |
| 16 | 15.7 | 8.0 | 6.0 | 0.8 | 1.0 | — | 0.1 |

¹⁾ For ages of medusae, see Tables 1 and 5.

*: The holotype.

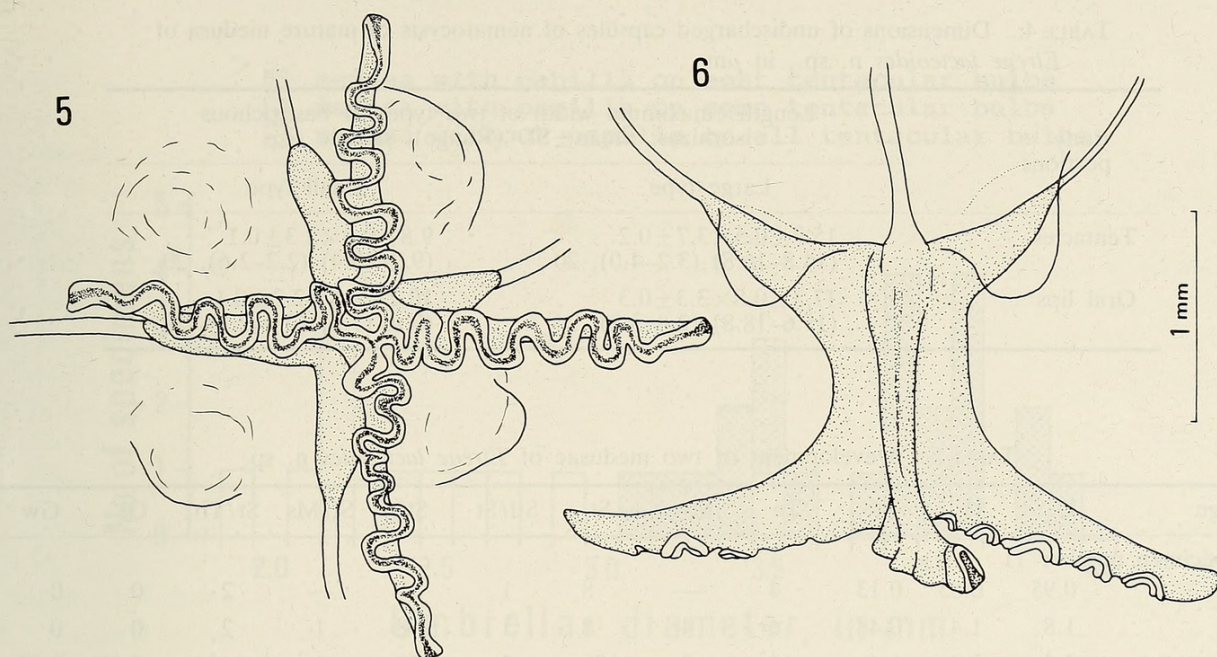
—: Not measured.

found interradially at the distal end of the peduncle. Even when the peduncle broadens due to the contraction of the body, the projections are still apparent, being conical in shape. However, extreme body contraction may lead to disappearance of the projections. The jelly at the umbrellar apex is as thick as the length of the peduncle (Table 3). The manubrium is short, measuring 1.7 mm in length, and provided with four well-developed oral lips which are crenulated and folded many times (cf. Fig. 5). The oral lips are longer than the length of the manubrium; their tips are pointed (Table 3; cf. Fig. 6). The stomach is small, being cruciform in section (cf. Fig. 5). The four gonads are linear, extending from the base of the peduncle close to the umbrellar margin along the four radial canals (Figs. 1, 2), but never reaching the ring canal. In a quadrant 25–27 tentacles are present (27–34 ones, 4 days thereafter) and totally 105 in number (119, 4 days thereafter). The tentacular bulbs are swollen and well-demarcated from the tentacles (Fig. 4). A papilla exists on the adaxial side of every well-developed tentacular bulb (Figs. 2, 3) and also on some small tentacular bulbs bearing very short tentacles. The number of marginal warts in a quadrant varies

between 2–7 (2–4, 4 days thereafter), and 17 in all (11, 4 days thereafter) (Table 1). Neither lateral nor marginal cirri are found. In a quadrant 30–40 statocysts are produced, and totally 146 in number (Table 2). The number of statocysts is slightly greater than that of the marginal swellings (= tentacular bulbs + marginal warts) in every quadrant since two statocysts are frequently found between two successive marginal swellings. Most of the statocysts contain one statolith, and only one statocyst contains two (Table 2).

Variation

In a quadrant, up to 44 tentacles, 28 marginal warts, and 84 statocysts were found. The maximum number of tentacles, marginal swellings, and statocysts per specimen was 159, 170, and 304, respectively (Tables 1, 2, 5). Two statocysts are sometimes adjoined together in aged medusae, and in 69-day-old specimen (No. 18) up to five statocysts were found between two successive marginal swellings. A statocyst contained maximally three statoliths as a very rare case (Table 2). The number of crenulations per lip was more than ten (Fig. 5). An aperture which may function as an excretory pore (excretion of particles was observed



FIGS. 5, 6. A paratype (Specimen no. 9) of *Eirene lacteoides* n. sp. 5: Oral lips, cruciform stomach, and conical projections of the peduncle, viewed from orally. 6: Side view of the manubrium and the projections of the peduncle.

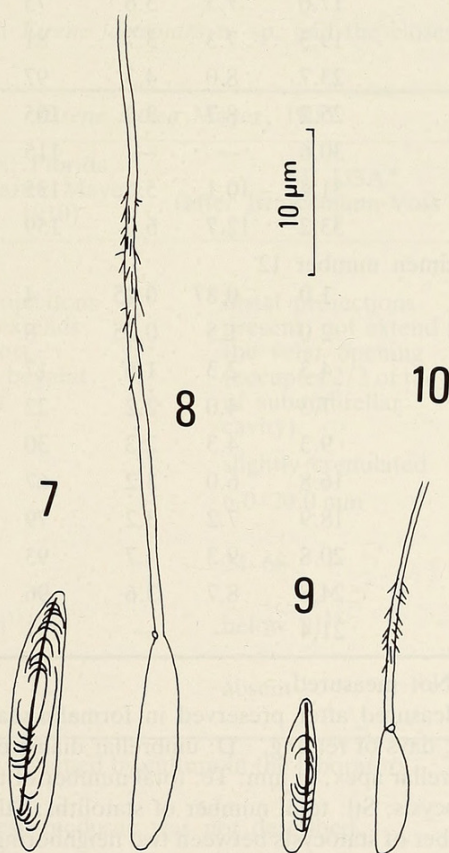
at higher magnification), seems to be present on the adaxial papillae. The gonads, radial canals, the projections of the peduncle, and the oral lips were rarely five in number (No. 10). Such abnormal conditions took place in the development of a medusa, though normal in its early developmental stages.

Nematocysts

Two types of basitrichous isorhizas were found on tentacles and oral lips of the mature medusa (Figs. 7–10). The dimensions of these nematocysts are shown in Table 4. The exumbrellar nematocysts, found in early developmental stages of the medusa, disappeared in due time.

Development of medusa

The growth of medusae was rapid (Table 5, see also Table 1). When the umbrella became over 4.5 mm in diameter, the gonads appeared (on the 6th to 8th day). At this developmental stage the peduncle was also visible. After 11 to 13th day, when the umbrella was over 14.0 mm in diameter, the gonads attained the maximum width and fully matured, the projections of the peduncle were already distinct, and the number of statocysts was



FIGS. 7–10. Undischarged and discharged capsules of two types of basitrichous isorhizas in the mature medusa (Specimen no. 5) of *Eirene lacteoides* n. sp.

TABLE 4. Dimensions of undischarged capsules of nematocysts of mature medusa of *Eirene lacteoides* n. sp., in μm

| Body portions | Length \times maximum width of two types of basitrichous isorhizas: Mean \pm SD (Range), sample size | |
|---------------|--|---|
| | Large type | Small type |
| Tentacles | 15.7 \pm 0.5 \times 3.7 \pm 0.2 (14.8–16.8) (3.2–4.0), 20 | 9.8 \pm 0.3 \times 2.3 \pm 0.1 (9.2–10.4) (2.2–2.6), 20 |
| Oral lips | 17.3 \pm 0.8 \times 3.3 \pm 0.3 (15.6–18.8) (2.8–3.8), 24 | 10.2 \pm 0.4 \times 2.2 \pm 0.1 (9.6–11.2) (2.0–2.2), 20 |

TABLE 5. Development of two medusae of *Eirene lacteoides* n. sp.

| Age | D | H | J | Te | Mw | St | Stl/St | Stl | St/Ms | St/Tb | Gl | Gw |
|--------------------|------|------|------|-----|----|-----|--------|-----|-------|-------|------|------|
| Specimen number 11 | | | | | | | | | | | | |
| 1 | 0.95 | 0.85 | 0.13 | 4 | — | 8 | 1 | 8 | — | 2 | 0 | 0 |
| 3 | 1.8 | 1.4 | 0.48 | 6 | 4 | 8 | 1 | 8 | 1 | 2 | 0 | 0 |
| 6 | 4.5 | 2.3 | 1.4 | 18 | 9 | 29 | 1 | 29 | 1 | 1–2 | 0.50 | 0.05 |
| 8 | 7.9 | 4.1 | 2.2 | 27 | 12 | 50 | 1 | 50 | 1–2 | 1–3 | 1.4 | 0.10 |
| 9 | 11.7 | 5.0 | 2.5 | 31 | 20 | 62 | 1–2 | 63 | 1–2 | 1–3 | 1.4 | 0.10 |
| 11 | 14.4 | 5.7 | 3.3 | 53 | 26 | 88 | 1–2 | 91 | 1–2 | 1–3 | 4.5 | 0.23 |
| 13 | 17.6 | 7.3 | 3.6 | 75 | 14 | 117 | 1–2 | 123 | 1–2 | 1–3 | 6.3 | 0.25 |
| 15 | 19.3 | 7.3 | 3.7 | 81 | 21 | 122 | 1–2 | 125 | 1–2 | 1–3 | 7.1 | 0.20 |
| 17 | 23.7 | 8.0 | 4.3 | 97 | 11 | 169 | 1–2 | 180 | 1–2 | 1–3 | 8.5 | 0.25 |
| 19 | 25.2 | 8.7 | 3.3 | 105 | 11 | 212 | 1–3 | 234 | 1–3 | 1–4 | 9.5 | 0.30 |
| 23 | 30.6 | — | — | 115 | 27 | 238 | 1–2 | 261 | 1–2 | 1–4 | 12.3 | 0.25 |
| 26 | 31.4 | 10.1 | 5.6 | 135 | 14 | 251 | 0–2 | 269 | 1–2 | 1–3 | 11.6 | 0.27 |
| 31 | 33.2 | 12.7 | 6.0 | 159 | 11 | 293 | 1–2 | 311 | 1–2 | 1–4 | 13.3 | 0.30 |
| Specimen number 12 | | | | | | | | | | | | |
| 1 | 1.0 | 0.87 | 0.15 | 4 | 4 | 8 | 1 | 8 | 1 | 2 | 0 | 0 |
| 3 | 2.0 | 1.5 | 0.55 | 8 | 1 | 8 | 1 | 8 | 0–1 | 1 | 0 | 0 |
| 6 | 4.3 | 2.3 | 1.6 | 17 | 4 | 26 | 1 | 26 | 1–2 | 1–2 | 0 | 0 |
| 8 | 7.3 | 4.0 | 2.2 | 22 | 13 | 44 | 1 | 44 | 1–2 | 1–3 | 1.4 | 0.08 |
| 9 | 9.3 | 4.3 | 2.3 | 30 | 18 | 56 | 1 | 56 | 1–2 | 1–3 | 1.4 | 0.10 |
| 13 | 16.8 | 6.0 | 3.2 | 67 | 17 | 113 | 1–2 | 115 | 1–2 | 1–3 | 6.0 | 0.23 |
| 15 | 18.9 | 7.2 | 3.2 | 79 | 16 | 124 | 1–2 | 129 | 1–2 | 1–3 | 6.4 | 0.23 |
| 17 | 20.8 | 9.3 | 4.7 | 93 | 3 | 129 | 0–2 | 136 | 1–2 | 0–3 | 8.1 | 0.25 |
| 19 | 24.8 | 8.7 | 3.6 | 96 | 4 | 205 | 0–3 | 226 | 1–3 | 1–5 | 9.6 | 0.30 |
| 42 ¹⁾ | 21.4 | — | — | 141 | 21 | 304 | — | — | 0–3 | 0–8 | 8.7 | 0.23 |

—: Not measured.

¹⁾ Measured after preserved in formalin-seawater.

Age: days of rearing. D: umbrellar diameter, in mm; H: umbrellar height, in mm; J: thickness of jelly at the umbrellar apex, in mm; Te: total number of tentacles; Mw: total number of marginal warts; St: total number of statocysts; Stl: total number of statoliths; Stl/St: range of number of statoliths per statocyst; St/Ms: range of number of statocysts between two neighboring marginal swellings; St/Tb: range of number of statocysts between two neighboring tentacular bulbs; Gl: length of gonads, in mm, measured from aboral side; Gw: maximum width of gonads, in mm.

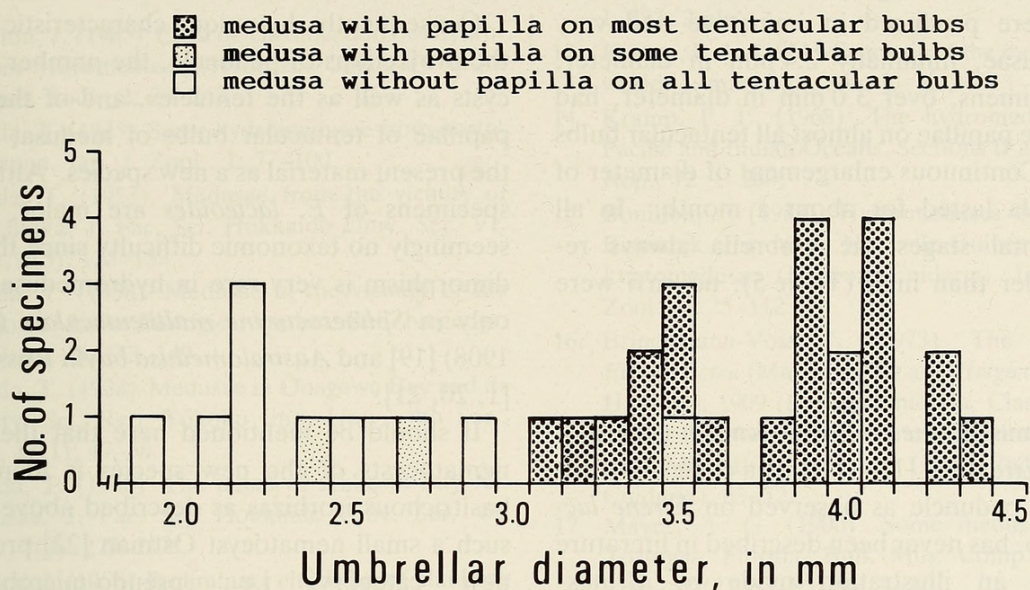


FIG. 11. Frequency distribution of the number of immature medusa in *Eirene lacteoides* n. sp. according to the presence (plentiful or scarce) or absence of adaxial papilla on tentacular bulbs.

TABLE 6. Distinguishing characters of mature medusa between *Eirene lacteoides* n. sp. and the closest congener *Eirene lactea*

| Species | <i>Eirene lacteoides</i> | <i>Eirene lactea</i> Mayer, 1900 | |
|---------------------------|---|--|--|
| Locality | Toba, Mie Pref., Japan* (present study) | Tortugas, Florida, USA** (after Mayer 1900, 1910) | SE USA* (after Brinckmann-Voss 1973) |
| Distinguishing characters | | | |
| Peduncle | distal projections present; extends for a short distance beyond the velar opening | distal projections absent; extends for a short distance beyond the velar opening | distal projections present; not extending to the velar opening (occupies 2/3 of the height of subumbrellar cavity) |
| Oral lips | fairly crenulated | simple | slightly crenulated |
| Diameter of umbrella | 24.7 mm (6.0–33.2 mm) ³⁾ | 5 mm ⁴⁾ | 6.0–20.0 mm |
| Number of tentacles | 105 (45–159) ³⁾ | 18–22 ⁴⁾ | 24–68 |
| Number of statocysts | 146 (94–304) ³⁾ | below 44 ¹⁾ | below 91 ¹⁾ |
| Adaxial papilla | present on well-developed tentacular bulbs | absent ²⁾ | absent |

*: Mature medusae (male in *E. lacteoides* and female in *E. lactea*) obtained by culture in the laboratory. The origin of the hydroid colony is not known.

** : Mature medusae collected from the natural sea. Sex of these medusae was not described.

¹⁾ Undescribed precisely, therefore calculated based on description.

²⁾ After Brinckmann-Voss 1973, pp. 65–66.

³⁾ Following measurements of the holotype, those of paratypes are shown in parentheses.

⁴⁾ The holotype is not designated.

always more than that of the marginal swellings (= tentacular bulbs + marginal warts). The adaxial papillae were produced in immature and very small medusae, minimally 2.4 mm in diameter; young specimens, over 3.0 mm in diameter, had always these papillae on almost all tentacular bulbs (Fig. 11). Continuous enlargement of diameter of the umbrella lasted for about a month. In all developmental stages the umbrella always remained wider than high (Table 5); no cirri were produced.

Remarks

In the genus *Eirene* and other known genera of the family Eirenidae [12–17] such a conical projection of the peduncle as observed on *Eirene lacteoides* n. sp. has never been described in literature except for an illustration made by Brinckmann-Voss [16] of the laboratory-reared female medusae of *Eirene lactea* (Mayer, 1900). However, Brinckmann-Voss (per. comm.) did not think the projections might provide a distinguishing character for a new species. The original material of *E. lactea* is small, 5 mm in umbrellar diameter (see Table 6), and it had no projections on peduncle. Accordingly it seems that the projections are not produced in *E. lactea* if the medusa of this species matures in a small size.

On the other hand, as was described above, the adaxial papillae were already produced at immature stages (the diameter of the umbrella over 2.4 mm) in *E. lacteoides*, whereas the papillae were not found in *E. lactea* even though the species was smaller in size or developed fully to the umbrellar size of 20.0 mm [16]. Further, *E. lacteoides* tends to have more statocysts, more tentacles, and more crenulated oral lips than those of *E. lactea* (Tables 5, 6).

When the peduncle of the present new species is contracted, it may become wider at its base and looks like that of *Eirene pyramidalis* (L. Agassiz, 1862) that also has an excretory pore [12, 13]. However, *E. pyramidalis* does not possess any distal projection on the peduncle despite attaining a similar size or much more, up to 35 mm in diameter [12, 13]. Further, *E. pyramidalis* has maximally 100 statocysts and the same number of tentacles [17], showing thus much smaller numbers

in these two meristic characters than those of *E. lacteoides* (see Table 6).

Consequently, by unique characteristic states of the projections of peduncle, the number of statocysts as well as the tentacles, and of the adaxial papillae of tentacular bulbs of medusa, we treat the present material as a new species. Although all specimens of *E. lacteoides* are males, there is seemingly no taxonomic difficulty since the sexual dimorphism is very rare in hydromedusae; so far only in *Sphaerocoryne multitentaculata* (Warren, 1908) [19] and *Australomedusa baylii* Russell, 1970 [1, 20, 21].

It should be mentioned here that the kind of nematocysts of the new species is identified as basitrichous isorhizas as described above, but for such a small nematocyst Östman [22] proposed a new category, i.e., pseudo-microbasic b-mastigophore, through her SEM investigations.

Distribution

Besides the specimens taken in the Toba Aquarium, several laboratory-reared male medusae of *E. lacteoides* were also obtained by Mr. S. Takayama in the Uozu Aquarium, Toyama Prefecture, in 1991. Further, one well-developed, laboratory-reared medusa photographed by Dr. Y. Hirano, which was originally found in the Oarai Aquarium, Ibaraki Prefecture in 1983, could also belong to the present species, but this needs further examination. No specimens referable to the present new species have been collected from the natural sea.

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