

**OCCURRENCE OF *Eugymnanthea* sp. (LEPTOMEDUSAE, EIRENIDAE), AN  
EVOLUTIONARY ADVANCED SPECIES OF THE BIVALVE-INHABITING  
HYDROZOANS, FROM ONGAEL LAKE, PALAU ISLANDS, ASSOCIATED WITH  
*Brachidontes* sp. (BIVALVES, MYTILIDAE)**

By

**Shin KUBOTA<sup>1</sup> and Naoto HANZAWA<sup>2</sup>**

**Abstract**

One of the most evolutionary advanced species of the bivalve-inhabiting hydrozoans *Eugymnanthea* is recently found from Ongael Lake, Palau Islands, associated with *Brachidontes* sp. The morphology of mature male or spent male medusa is described, comparing with two known species of the genus, *E. inquilina* and *E. japonica*, and discussed on its taxonomic position since it shows intermediate character states between the two.

**Introduction**

*Eugymnanthea* is a bivalve-inhabiting hydrozoan associated mainly with *Mytilus galloprovincialis* and *Crassostrea gigas*, and a monophyletic group (Kubota & Collins 2017). In shallow waters this hydrozoan occurs in the Mediterranean Sea (*E. inquilina*) and around the Japanese Sea (*E. japonica*) (Piraino *et al.* 1994; Kubota 2004; Govindarajyan *et al.* 2005). The life cycle of both species comprises a benthic polyp, that lives inside the mantle cavity of bivalves, and a short-lived planktonic simplified medusa with already formed gonads. The mature medusa dies soon after spawning that took place only once in its ephemeral life. The two species of *Eugymnanthea*, which evolved as the most derived bivalve-inhabiting hydrozoans from an ancestral *Eutima*-like progenitor, resemble each other both in the polyp and medusa stages. Their similarity is likely due to a parallel, progenetic evolution, showing their subtle morphological differences (Kubota 2000). Recently, we found *Eugymnanthea* from Palau Islands, an unexpected place, and described its medusan morphology, then discussed its taxonomic position.

- 
1. Seto Marine Biological Laboratory, Field Science Education and Research Center, Kyoto University, Shirahama, Nishimuro, Wakayama 649-2211, Japan  
e-mail: kubota.shin.5e@kyoto-u.ac.jp
  2. Faculty of Science, Yamagata University, Yamagata 990-8560, Japan

### Materials and methods

From a shallow isolated marine lake (4 m deep), Ongael Lake, Palau Islands, marine mussels, *Brachidontes* sp. (Goto *et al.* 2011) were collected in October, 22, 2016 and November 8, 2017. A total of 68 bivalve specimens (34 in 2016; 34 in 2017) were carried back to Japan, then each was separately cultured in a 60cc polystyrene vessel for up to two months in 5 $\mu$ m-filtered natural sea water from Shirahama Town, Wakayama Prefecture, Japan, and fed them with *Artemia* nauplii. Among them of which anterior-posterior axes are 26 – 35 mm, from one host in 2016 and another in 2017, polyps were released, and later from these two hosts medusae were also liberated in the laboratory. In all other individuals of *Brachiodontes* sp., when examined their mantle cavity, no polyps were found. The seawater (c 32 psu) was changed twice every day and almost all of the released mature medusae were examined before they spawned in early morning if not become already spent.

### Results and Discussion

The solitary hydroids are always similar to two species of *Eugymnanthea* as described by Palombi (1935) and Kubota (1979). The present medusa is 0.5-1.18 mm in diameter with eight statocysts (Table 1) like the other two species. No manubrium was found (Fig. 1 A) like *E. inquilina*. The statolith contained in each statocyst is mostly one (Fig. 1 B), but infrequently two like *E. japonica* as described by Kubota (2004). The marginal warts are very few in number (Fig. 1 A-B), maximally only three, usually absent, not like both *E. japonica* and *E. inquilina* (Kubota 1979; 1985; 1989; 2004).

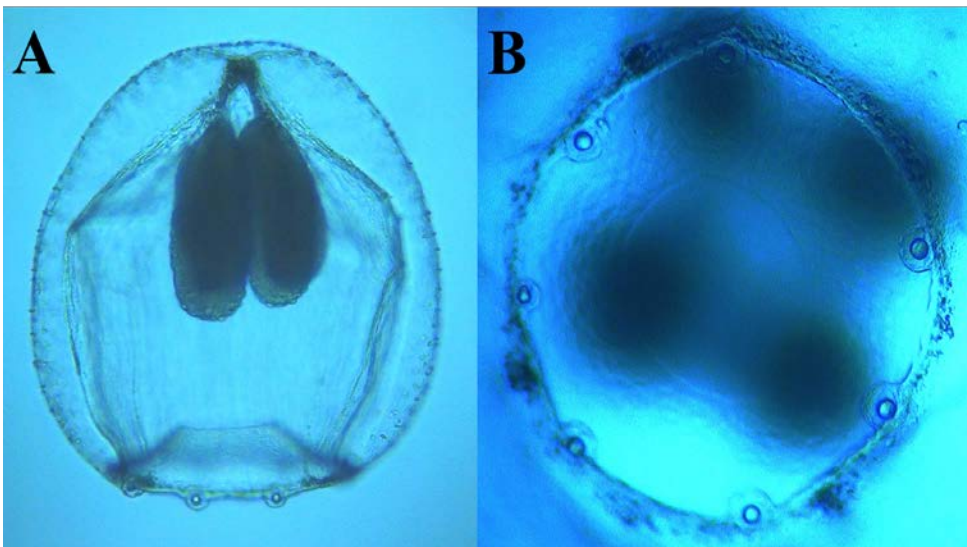


Fig. 1. Side view (A) of a male mature male medusa without manubrium of *Eugymnanthea* sp. from Palau Islands, and its umbrellar margin showing statocysts, statoliths and marginal warts (B).

Table 1. Morphology of mature male or spent male medusa of *Eugymnanthea* sp. from Palau Islands.

Umbrellar diameter in mm	No. of statocysts, No. of statoliths/individual	No. of statoliths/statocyst	No. of marginal warts/individual
1.18 <sup>3)</sup>	8, 9	1–2	1
0.94	4+ <sup>1)</sup> , 4+ <sup>1)</sup>	1	0
0.81	8, 8	1	0
0.75	8 <sup>2)</sup> , 8 <sup>2)</sup>	1	3
0.75	7, 7	1	0
0.63 <sup>#</sup>	8, 8	1	3
0.5	8, 8	1	0
0.5	6, 6	1	0
0.60*	8, 10	1–2	1

1): at least 4 due to damage; 2): one is very small; 3): 3 gonads; #: Fig. 1 A–B; \*: collected in 2017, the others in 2016

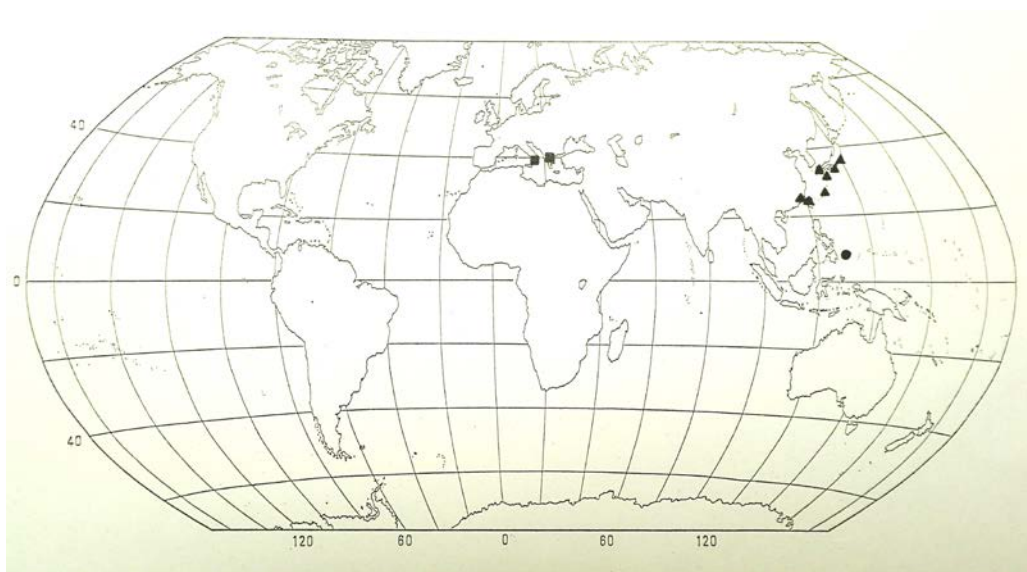


Fig. 2. A geographical distribution of *Eugymnanthea japonica* (▲), *E. inquilina* (■), and *E.* sp. from Palau Islands (●) [after References of this paper]

Judging from such unique combination of the morphological characteristics, the present medusa is concluded an intermediate form between *Eugymnanthea japonica* from the Pacific Ocean [Japan, Taiwan, China: Fig. 2] (Kubota 1979; 1985; 2004; Kubota *et al.* 1999; Kubota & Guo 2007) and *E. inquilina* from the Mediterranean Sea [Italy, Greece] (Palombi 1935; Kubota 1989; Rayyan *et al.* 2002). Therefore, its taxonomic position is not easily decided and problematic for the present, then we treat it here as an unknown species. Further research is required (1) description of morphology of the female medusa, (2) GFP distribution pattern of

medusa, (3) molecular analysis, in order to settle its systematic position.

It is noteworthy here to described that in the laboratory culture at 25°C no medusae of *E.* sp. were liberated, but at 29-30°C medusa could be released. It is known that in Ongael Lake, Palau Islands, a typical oceanic islands located in the tropical area, the water temperature is approximately 30°C and the salinity is 35-37 psu. Usually the medusa of two known *Eugymnanthea* species can easily obtained at 21-26°C (Kubota 1979; 1989; 2004). Therefore, as the above-described morphological traits, a physiological character is different in the present material. Therefore, it is reasonable to treat it as a *E.* sp. It is noted here that in the present bivalves a parasitic copepods are rarely found.

### Acknowledgements

We thank the Ministry of Resources and Development, Government of Republic of Palau (Permit No. RE-16-16 and RE-17-27; 86655-86656) and Government of Koror State (Permit No. 2016-20 and 2017-020) for permitting our research in Palau and exportation of samples to Japan. We also thank Mr. I. Kishigawa and staffs, Carp Corporation for their helpful support on survey in Palau.

### References

- Goto, T.V., H.B. Tamate and N. Hanzawa. 2011. Phylogenetic characterization of three morphs of mussels (*Bivalvia*, *Mytilidae*) inhabiting isolated marine environments in Palau Islands. *Zoological Science*, 28(8): 568-579.
- Govindarajan, A.F., S. Piraino, C. Gravili and S. Kubota. 2005. Species identification of bivalve-inhabiting marine hydrozoans of the genus *Eugymnanthea*. *Invertebrate Biology*, 124: 1-10.
- Kubota, S. 1979. Occurrence of a commensal hydroid *Eugymnanthea inquilina* Palombi from Japan. *The Journal of the Faculty of Science, Hokkaido University, Series VI, Zoology*, 21(4): 396-406.
- Kubota, S. 1985. Systematic study on a bivalve-inhabiting hydroid *Eugymnanthea inquilina japonica* Kubota from Japan. *The Journal of the Faculty of Science, Hokkaido University, Series VI, Zoology*, 24(1): 70-85.
- Kubota, S. 1989. Systematic study of a paedomorphic derivative hydrozoan *Eugymnanthea* (*Thecata-Leptomedusae*). *Zoological Science*, 6: 147-154.
- Kubota, S., C.F. Dai, C.L. Lin and J.S. Ho. 1999. The first occurrence of the paedomorphic derivative hydrozoan *Eugymnanthea* (*Leptomedusae*, *Eirenidae*) from Taiwan, with a report of a new host. *Publications of the Seto Marine Biological Laboratory*, 38(5/6): 219-222.

- Kubota, S. 2000. Parallel, paedomorphic evolutionary processes of the bivalve-inhabiting hydrozoans (Leptomedusae, Eirenidae) deduced from the morphology, life cycle and biogeography, with special reference to taxonomic treatment of *Eugymnanthea*. *Scientia Marina*, 64, Suppl. 1: 241–247.
- Kubota, S. 2004. Some new and reconfirmed biological observations in two species of *Eugymnanthea* (Hydrozoa, Leptomedusae, Eirenidae) associated with bivalves. *Biogeography*, 6: 1–5.
- Kubota, S. and D. Guo. 2007. Records of a bivalve-inhabiting hydrozoan, *Eugymnanthea japonica* (Hydrozoa, Leptomedusae) on the southern coasts of China. *Bulletin of the Biogeographical Society of Japan*, 62: 63-66.
- Kubota, S. and A. Collins. 2017. A single origin of bivalve-inhabiting hydrozoans (Cnidaria, Hydrozoa, Leptomedusae) in the family Eirenidae based on an analysis of 16S rRNA gene. *Biogeography*, 19: 75-79.
- Palombi, A. 1935. *Eugymnanthea inquilina* nuova leptomedusa derivante da un atecato idroide ospite intero di *Tapes decussatus* L. *Pubblicazioni della Stazione Zoologica di Napoli*, 15:159-168, Tav II.
- Piraino, S., C. Todaro, S. Geraci. and F. Boero. 1994. Ecology of the bivalve-inhabiting hydroid *Eugymnanthea inquilina* in the coastal sounds of Taranto (Ionian Sea, SE Italy). *Marine Biology*, 118: 695–703.
- Rayyan, A., J. Christidis. and C.C. Chintiroglou. 2002. First record of the bivalve-inhabiting hydroid *Eugymnanthea inquilina* in the eastern Mediterranean Sea (Gulf of Thessaloniki, north Aegean Sea, Greece). *Journal of the Marine Biological Association of the United Kingdom*, 82: 851–853