

New record of *Cunina simplex* (Hydrozoa, Trachylinae) from Japan

Sho Toshino^{1*}, Hisashi Akiyama², Kei Okayama², Yuichi Nozoe², Hinako Yamaguchi² & Akihiro Kawakubo²

¹ Kuroshio Biological Research Foundation, 560 Nishidomari, Otsuki, Hata, Kochi 788-0333, Japan

² Saikai National Park Kujukushima Aquarium 1055 Kashimae, Sasebo, Nagasaki 858-0922, Japan

Abstract: Four species of the genus *Cunina*, *C. duplicata*, *C. peregrina*, *C. globosa* and *C. octonaria*, have been reported from Japanese waters. However, some of species still unidentified. In this study, six specimens of an unidentified *Cunina* species collected from Kochi, Nagasaki and Okinawa prefectures were examined by morphological observations. The present study reports detailed observations of the morphology of one species newly recorded in Japan: *Cunina simplex*. This species possesses the following unique morphological characters: four manubrial pouches and four primary tentacles. This study reported *C. simplex* as the fifth described species from Japan.

Key words: Cuninidae, gelatinous plankton, Hydrozoa, medusa, Narcomedusae

Introduction

The family Cuninidae (Narcomedusae) currently contains 14 species in three genera, *Cunina*, *Sigiweddellia* and *Solmissus* (Bouillon *et al.* 2006; Daly *et al.* 2007; WoRMS 2022). The genus *Cunina* is the largest taxon, comprising ten species (Bouillon *et al.* 2006). *Cunina* was established by Eschscholtz (1829) with the description of two new species *C. campanulata* Eschscholtz, 1829 and *C. globosa*, and associated with *Aegina*, *Aequorea*, *Eurybia*, *Mesonema* and *Polixena* in the family Aequoreidae. Haeckel (1879) established the genus *Cunioctantha* and subsequently two new species were added to it, *Cunioctantha fowleri* Browne, 1906 = *Cunina fowleri* (Browne, 1906) and *Cunioctantha tenella* Bigelow, 1909 = *Cunina tenella* (Bigelow, 1909). However, *Cunioctantha* is now regarded as a synonym of *Cunina* (Kramp 1961). Bigelow (1913) erected the family Cuninidae, which then included three genera *Cunina*, *Solmaris* and *Solmissus*. Twenty-five species of *Cunina* have been described during the 19th and 20th centuries, however, nine species were synonymized as *Cunina* and *Solmissus* (Cuninidae), *Solmaris* and *Pegantha* (Solmarisidae). The taxonomic validity of six species of *Cunina* are uncertain or disputed by different experts (WoRMS 2022).

Most *Cunina* species have been reported from the deep sea in offshore areas (Gili *et al.* 1998), however, some species have been reported in shallow waters (Minemizu *et al.* 2015). They are known to be holoplanktonic medusae with medusa-bearing parasitic polyps (Russell 1953; Kramp 1961; Bouillon & Boero 2000). In *Cunina proboscidea*, the young eventually develop into sexually active but reduced medusae with four

tentacles, which degenerate after shedding their gametes (Stschelkanowzew 1906; cited in Hyman 1940). *Cunina peregrina* has two life cycles that occur simultaneously: asexual budding of actinula larvae from the parent medusa which develop into fully developed medusae; and sexual reproduction producing an egg and phorocyte pair which develops into an actinula and a four-tentacle reduced medusa (Lucas & Reed 2009).

To date, four described *Cunina* species *C. duplicata*, *C. peregrina*, *C. globosa* and *C. octonaria* have been reported from Japanese waters (Kubota & Gravili 2007; Lindsay *et al.* 2008; Kitamura 2009; Minemizu *et al.* 2015; Lindsay *et al.* 2017 [Table S1]). While, some reported *Cunina* species are still unidentified (Kubota 2004; 2006; Minemizu *et al.* 2015). The current study outlines a morphological analysis of one *Cunina* species and provides a new record of *Cunina simplex* Bouillon, Pagès, Palanques, Puig & Heussner, 1998 in Japan.

Materials and Methods

Collection and fixing

Six medusae of *Cunina simplex* were collected from near the water surface (within about 1 m) using a dip net (mesh size 0.2 mm) or a scoop (17 cm in diameter) at fishing ports in Kochi, Okinawa and Nagasaki prefectures, western and southern Japan, during the day on 2 October 2016, 7 December 2017 and 19 October 2021, respectively (Table 1, Fig. 1). The captured medusae were fixed in 3% formalin-buffered seawater for taxonomic observations after anesthetization using an aqueous solution of MgCl₂. The specimens were deposited at the Kuroshio Biological Research Foundation (KBF) and the National Museum of Nature and Science, Tsukuba, Japan (NSMT).

*Corresponding author: toshino@kuroshio.or.jp

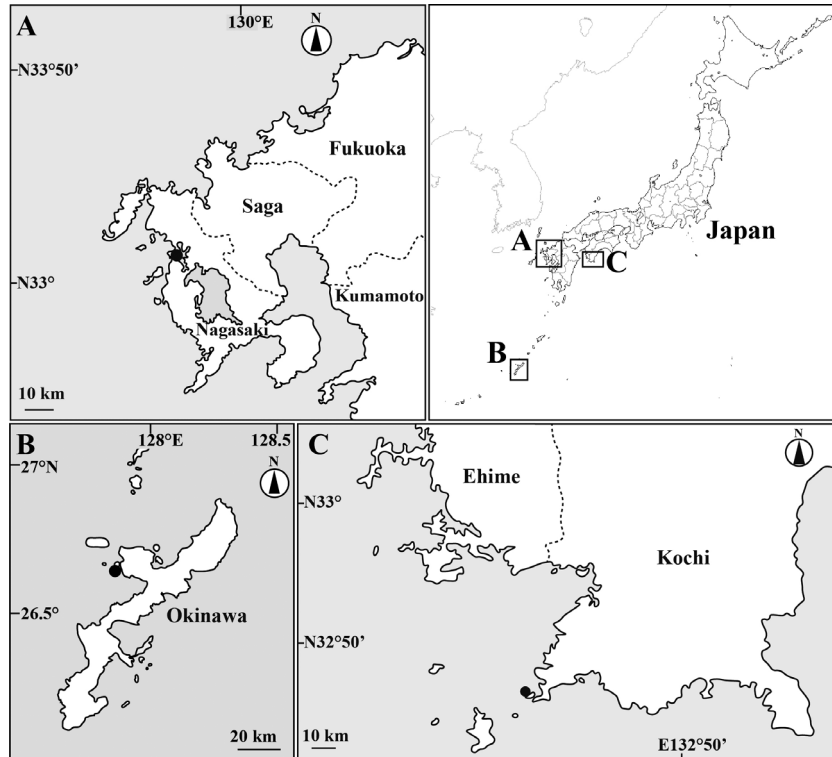


Fig. 1. Map of the sampling sites. A= Tawaragaura, Sasebo, Nagasaki Prefecture. B= Sesoko Island, Motobu, Okinawa Prefecture. C= Kashiwajima, Otsuki, Kochi Prefecture. Black circle=sampling site.

Table 1. Collection details of *Cunina simplex* in this study. UH = umbrella height; UD = umbrella diameter.

Specimen No.	UH (mm)	UD (mm)	Date	Sampling site	Lat./Long.	Collector
KBF-M 26	0.9	1.7	2016/10/2	Kashiwajima Fishing port, Otsuki, Kochi Prefecture, Japan	32°46'13.3"N 132°37'38.3"E	Sho Toshino
KBF-M 27	0.7	1.6	2017/12/7	Sesoko Island, Motobu, Okinawa Prefecture, Japan	26°38'09.6"N 127°51'55.3"E	Sho Toshino
KBF-M 28	1.0	2.2	2017/12/7	Sesoko Island, Motobu, Okinawa Prefecture, Japan	26°38'09.6"N 127°51'55.3"E	Sho Toshino
KBF-M 29	0.9	1.9	2017/12/7	Sesoko Island, Motobu, Okinawa Prefecture, Japan	26°38'09.6"N 127°51'55.3"E	Sho Toshino
NSMT-Co1806	0.7	1.7	2017/12/14	Sesoko Island, Motobu, Okinawa Prefecture, Japan	26°38'09.6"N 127°51'55.3"E	Sho Toshino
NSMT-Co1807	2.1	3.9	2021/10/19	Tawaragaura, Sasebo, Nagasaki Prefecture, Japan	33°7'0"N 129°40'23"E	Hisashi Akiyama

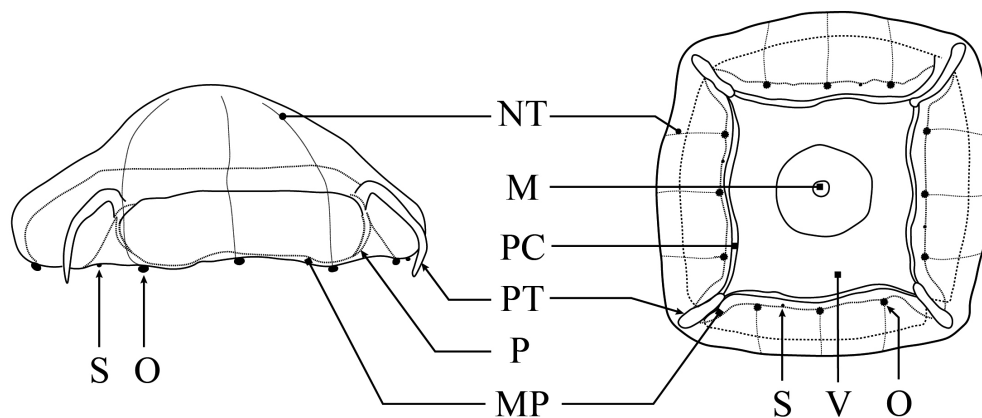


Fig. 2. Key characters for identification and measurement of parts of the *Cunina*. M = mouth; MP = Manubrial pouch; NT = nematocyst track; O = otoporpae; P = peronia; PC = peripheral canal; PT = primary tentacle; S = statocyst; V = velum.

Morphological investigation

Taxonomic observations and measurements were conducted on live specimens collected from Kochi, Nagasaki and Okinawa prefectures according to Mayer (1910) and Gili *et al.* (1998) (Fig. 2). Medusae were placed and flattened on a watch glass (diameter 50 mm). Umbrella height was measured from the apex of the umbrella to the umbrella margin. Umbrella diameter was measured across turnover of exumbrella. Measurements were made with ImageJ software (Schneider *et al.*, 2012) to the nearest 0.1 mm.

Results

Class Hydrozoa Owen, 1843

Subclass Trachylinae Haeckel, 1879

Order Narcomedusae Haeckel, 1879

Family Cuninidae Bigelow, 1913

Genus *Cunina* Eschscholtz, 1829

Cunina simplex Gili, Bouillon, Pagès, Palanques, Puig & Heussner, 1998

New Japanese name: Shuriken-yadori-kurage
(シュリケンヤドリクラゲ)

Figs. 3–6

Cunina simplex Gili *et al.* 1998: 120, Fig. 7.

Description. Medusa umbrella nearly hemispherical, wider than high, lateral walls thin, apex thickened mesoglea (Fig. 3A, 5A, 6A). Umbrella height 0.9–2.1 mm and umbrella diameter 1.6–3.9 mm. Manubrium large, circular. Manubrial pouches four, perradial, tongue-shaped, undivided narrowing in width from base outwards (Fig. 3B, 4B, 5B, 6B). Gonads on manubrium and walls of the manubrial pouches (Fig. 4B). Primary tentacles four, leaving umbrella opposite to the center of each stomach pouch, with four peronia (Fig. 4C). Specimen from Nagasaki bears single ovoid nematocyst cluster on

each tentacle tip. Secondary tentacles absent on umbrella margin. Peripheral canal narrow (Fig. 4D). Marginal lappets rectangular, large. Statocysts one to two per quadrant (Fig. 4D, 5C, 6C). Otoporopae two to three, circular per quadrant. Nematocyst tracks on the exumbrella running from above otoporopae to near apex of exumbrella in Nagasaki specimen (Fig. 4A), while the tracks are obscure in the Kochi and Okinawa specimens (Fig. 5B, 6B).

Discussion

Cunina simplex was described by Gili *et al.* (1998) from the Lacaze-Duthiers Submarine Canyon and along the Banyuls-sur-Mer coast, northwestern Mediterranean. The morphological inspection of *C. simplex* from Kochi and Okinawa prefectures, Japan agrees well with the morphological description of Gili *et al.* (1998). Gili *et al.* (1998) reported that specimens from the Mediterranean Sea had four primary tentacles leaving the umbrella opposite to the center of each stomach pouch with four peronia and lack nematocyst tracks on the exumbrella. In this study, the specimen from Nagasaki had a single ovoid nematocyst cluster on the tentacle tips and nematocyst tracks on the exumbrella running from above otoporopae almost to the umbrella apex. Additional samples of *C. simplex* collected from Japan and the Mediterranean Sea are needed to clarify whether these morphological characters are intraspecific variations or not.

Cunina simplex has been reported from the Lacaze-Duthiers canyon at 500 m above the bottom over the 1000 m isobath (Gili *et al.* 1998). In this study, *C. simplex* were collected at the water surface (5 to 10 m depth) in Kochi, Nagasaki and Okinawa prefectures, western and southern Japan during fall and winter. The sampling sites are located near a steep valley. The medusae of *C. simplex* likely were upwelled from the midwater by wind-driven currents.

Four described species of *Cunina* have previously been

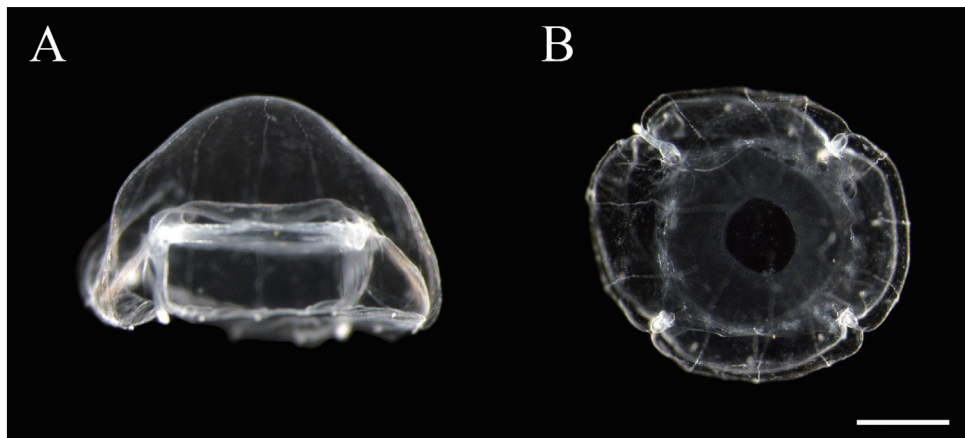


Fig. 3. *Cunina simplex*, Nagasaki Prefecture, live. A. lateral view. B. apical view. Scale bar: 0.5 mm.

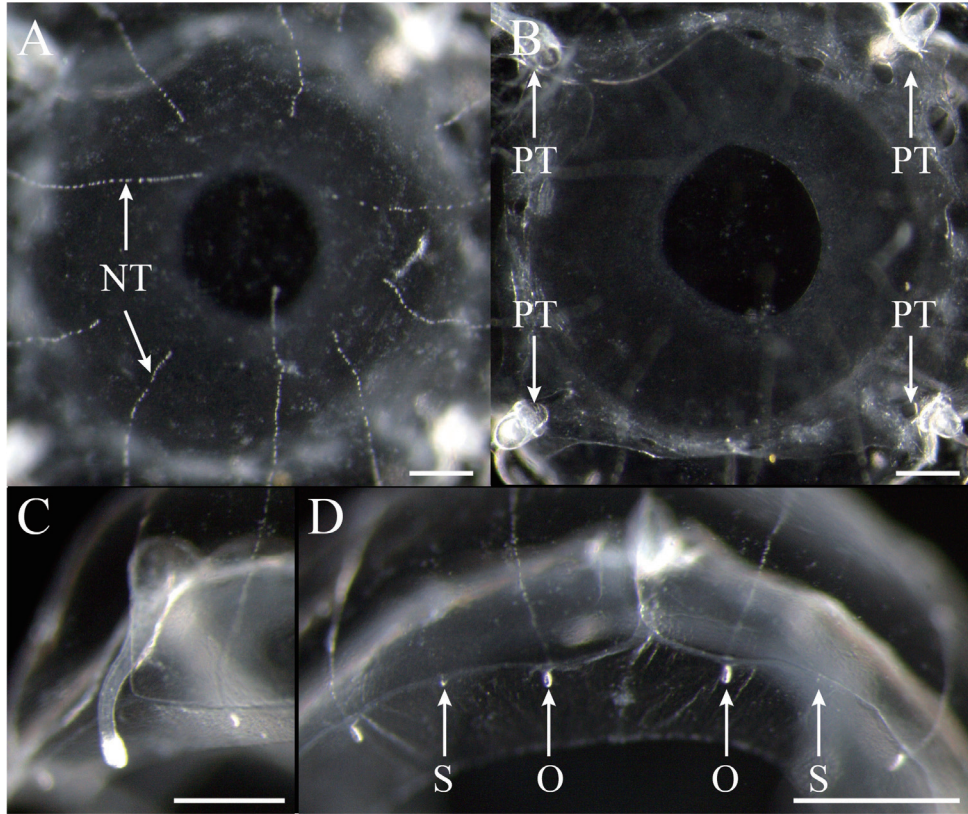


Fig. 4. *Cunina simplex*, Nagasaki Prefecture, live. A. exumbrella. B. velum. C. tentacle. D. otoporpaes and statocyst. Scale bars: 0.2 mm. NT = nematocyst track; O = otoporpaes; PT = primary tentacle; S = statocyst.

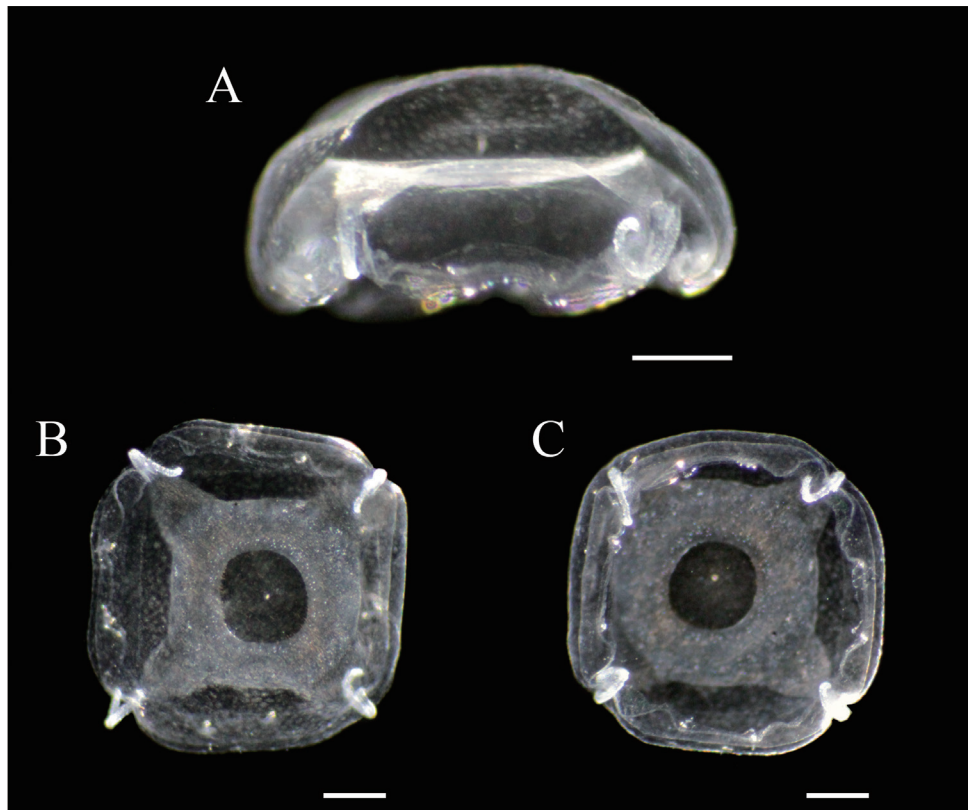


Fig. 5. *Cunina simplex*, Kashiwajima, Kochi Prefecture. A. lateral view. B. apical view. C. oral view. Scale bar: 0.5 mm.

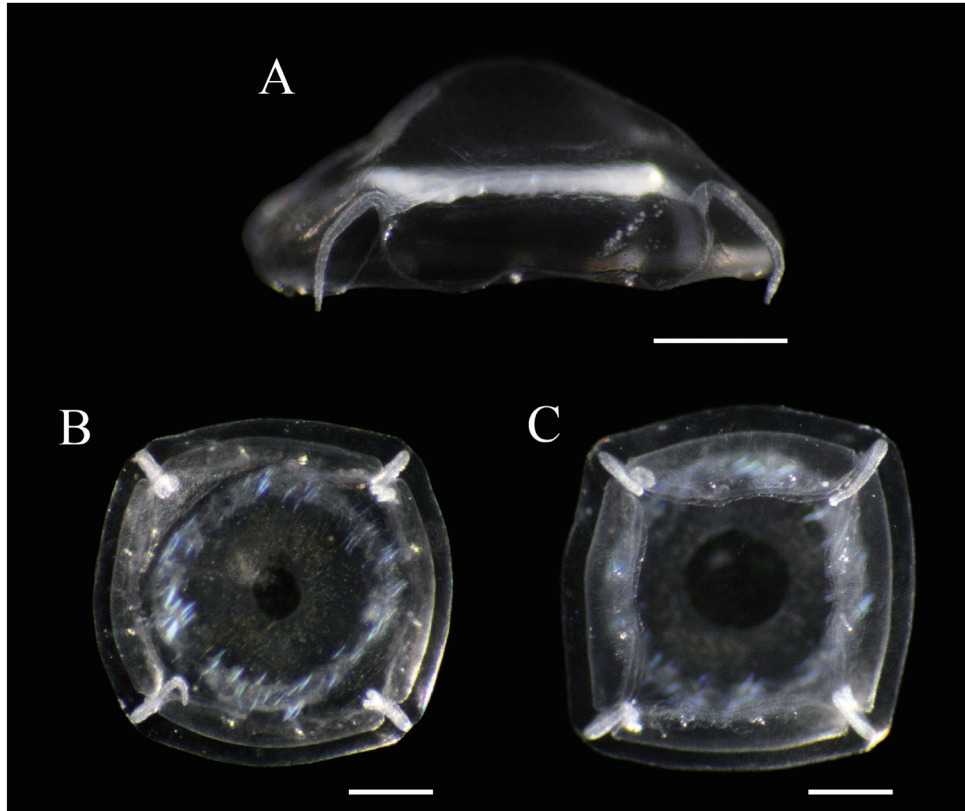


Fig. 6. *Cunina simplex*, Sesoko, Okinawa Prefecture. A. lateral view. B. apical view. C. oral view. Scale bar: 0.5 mm.

reported in Japanese waters (Lindsay *et al.* 2008; Minemizu *et al.* 2015, Lindsay *et al.* 2017). This study reported *C. simplex* as the fifth described species from Japan. However, unidentified *Cunina* species have been reported but remain uninvestigated (Uchida 1928; Kubota 2004, 2006, Minemizu *et al.* 2015). Lindsay gave a preliminary description of a specimen of a putatively undescribed species of *Cunina* from off of Shizuoka with a very large umbrella (up to 150 mm) with twenty-eight tentacles and nematocyst tracks (Minemizu *et al.* 2015). Additional sampling and taxonomic investigations including morphology and molecular phylogenetic analyses are essential to understand the diversity of *Cunina* in Japan.

Acknowledgements

I would like to express our sincere thanks to Junko Fukada, Takuma Mezaki, Yuji Ise, Tatsuki Koido, Kenjiro Hinode, Takaya Kitamura, Reina Tsujimoto, Takeru Yoshioka, Chika Nagaoka (Kuroshio Biological Research Foundation), and the staff at the Sesoko Tropical Biosphere Research Center. I am also grateful to Dr. Dhugal Lindsay for providing references. The research was financially supported by Japan Fund for Global Environment (awarded to the Kuroshio Biological Research Foundation), Suzuki Shohei Marine Biological Research Grant from The University of the Ryukyus Foundation (awarded to S. Toshino), and the JSPS KAKENHI

Grant numbers JP18K14791 and 21K15158 (awarded to S. Toshino).

References

- Bigelow, H. B., 1913. Medusae and Siphonophora collected by the U.S. steamer “Albatross” in the Northwestern Pacific. *Proceedings of the United States National Museum*, **44**: 1–119.
- Bouillon, J., Gravili, C., Gili, J. M. & Boero, F., 2006. An introduction to Hydrozoa. *Mémoires du Muséum National d’Histoire Naturelle*, **194**: 1–591.
- Daly, M., Brugler, M.R., Cartwright, P., Collins, A.G., Dawson, M.N., Fautin, D.G., France, S.C., Mcfadden, C.S., Opresko, D.M., Rodriguez, E., Romano, S.L. & Stake, J.L. 2007. The phylum Cnidaria: a review of phylogenetic patterns and diversity 300 years after Linnaeus. *Zootaxa*, **1668**: 127–182.
- Eschscholtz, F., 1829. System der Acalephen. Eine ausführliche Beschreibung aller medusenartigen Strahltiere. *Ferdinand Dümmler, Berlin*: 1–190.
- Gili, J.M., J. Bouillon, F. Pagès, A. Palanques, P. Puig & S. Heussner, 1998. Origin and biogeography of the deep-water Mediterranean Hydromedusae including the description of two new species collected in submarine canyons of Northwestern Mediterranean. *Sci. Mar.*, **62**: 113–134.

- Haeckel, E., 1879. Das System der Medusen. Erster Teil einer Monographie der Medusen. *Denkschriften der Medicinisch-Naturwissenschaftlichen Gesellschaft zu Jena*, **1**: 1–360.
- Hyman, L., 1940. The invertebrates: protozoa through ctenophora. McGraw-Hill, New York.
- Kitamura, M., 2009. Vertical distribution of planktonic cnidaria in three sites of north-western Pacific. *Kaiyo Monthly*, **41**(7): 382–392.
- Kramp, P. L., 1961. Synopsis of the medusae of the world. *J. Mar. Biol. Assoc. UK*, **40**: 1–469.
- Kubota, S., 2004. Jellyfishes in Aso Bay, Tsushima Island (Tsushima Aso-wan no kurage rui). Transactions of the Nagasaki Biological Society, **57**: 13–15. (in Japanese)
- Kubota, S., 2006. Hydromedusan fauna of the Nansei Islands. Proceedings of the 10th International Coral Reef Symposium: 197–201.
- Kubota, S. & Gravili, C., 2007. A list of hydromedusae (excluding Siphonophora, Milleporidae and Actinulidae) in Japan. *Nankiseibutsu*, **49**: 189–204. (in Japanese)
- Lindsay, D.J., Pagès, F., Corbera, J., Miyake, H., Hunt, J.C., Ichikawa, T., Segawa, K., and Yoshida, H. 2008. The anthomedusan fauna of the Japan Trench: preliminary results from in situ surveys with manned and unmanned vehicles. *J. Mar. Biol. Ass. U. K.* **88**(8): 1519–1539.
- Lindsay, D.J., Grossmann, M.M., Benthage, B., Collins, A.G., Minemizu, R., Hopcroft, R.R., Miyake, H., Hidaka-Umetsu, M. and Nishikawa, J. (2017) The perils of online biogeographic databases: A case study with the “monospecific” genus *Aegina* (Cnidaria, Hydrozoa, Narcomedusae). *Marine Biology Research* **13**(5): 494–512. DOI: 10.1080/17451000.2016.1268261
- Lucas, C. H., & Reed, A. J., 2009. Observations on the life histories of the narcomedusae *Aeginura grimaldii*, *Cunina peregrina* and *Solmissus incisa* from the western North Atlantic. *Mar.Biol.*, **156**: 373–379.
- Mayer, A. G., 1910. Medusae of the World: The Hydromedusae. Carnegie institution of Washington, **109**: 1–735.
- Minemizu, R., Kubota, S., Hirano, Y., Lindsay, D. J., 2015. A photographic guide to the jellyfishes of Japan. Heibonsha, Tokyo, pp. 1–360. (in Japanese)
- Russell, F. S., 1953. The medusae of the British Isles vol. I: Anthomedusae, Leptomedusae, Limnomedusae, Trachymedusae and Narcomedusae. Cambridge University Press, London, pp 1–530.
- Schneider, C. A., Rasband, W. S. & Eliceiri, K.W., 2012. “NIH Image to ImageJ: 25 years of image analysis”. *Nat. Methods*, **9**: 671–675.
- Stschelkanowzew, J., 1906. Die Entwicklung von *Cunina proboscidea*. *Mitteilungen der Zoologischen station in Neapel*, **17**: 433–486.
- Uchida, T., 1928. Studies on Japanese hydromedusae. 2. Trachomedusae and Narcomedusae. *Jpn. J. Zool.* **II**(1): 73–97.
- WoRMS (2022) World register of marine species. <http://www.marinespecies.org>. Accessed 27 April 2022.

(Received April 27, 2022; Accepted August 23, 2022)