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Mass occurrence of the cubomedusa *Copula sivickisi* (Cnidaria: Cubozoa) at Seto Harbor, Shirahama, Wakayama, Japan in summer of 2013; a possible recent example of global warming

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Abstract More than 200 very young medusae of *Copula sivickisi* (Stiasny) were collected within totally 60 minutes at two nights in June, 2013 at the Seto Harbor, Shirahama, Wakayama, Japan. This mass occurrence might be related to recent global warming at Shirahama, known as the northernmost distributional locality of this cubozoan species. It is assumed that the polyp stage of this species may live in the surrounding areas, because there jellyfish were small size (most are less than 1.6 mm height) that was conceivable as the newly released one from the polyp.

Keywords: box jellyfish, medusa, plankton, polyp, global warming

Introduction

Species of the Cubomedusae (Cnidaria: Cubozoa) are known as one of the most feared coastal marine animals due to the powerful stings caused by many species (Bentlage et al. 2010). Most of the species are of medium to large sized jellyfishes (5 - 20 cm in bell height), but also a few small species have been known. One of such small species is *Copula sivickisi*, described by Stiasny (1926) as *Charybdea sivickisi*, based on animals from the Philippines. The species, like other members of the family Tripedaliidae, presents sexual dimorphism (Straehler-Pohl et al. in press) and exhibit complex copulatory behaviour (Lewis & Long 2005; Lewis et al. 2008). But their unique features are adhesive pads on the exumbrella that enable them to attach and rest in any substrate (Hartwick 1991). In the present paper, mass occurrence of very young medusae of this species, that is an outstanding phenomenon, is reported at the northernmost distributional place, *i.e.*, Shirahama, Wakayama Prefecture, Japan.

Materials and Methods

On the nights of 13th and 14th June 2013, we mounted a light spot (torch) near the pillars of a fishing dock at Shirahama (Seto Harbor, 33°41'19.07"N, 135°20'39.5"E). Few minutes after the setting of the light spot, we noticed many small medusae of the present species swimming near the light focus, being attracted to plankton aggregations. The weather was warm and no wind, with sea surface very calm. Using small hand nets, these medusae were collected from the water, put into a bucket with clean seawater and transported to the laboratory. The morphology was observed and photographed in the living state.

Results and Discussion

Copula sivickisi was found at Shirahama, Wakayama, Japan, only a few times for a century (1929, 2006, 2008) and in very small numbers (Uchida 1929; Lewis et al. 2008; Kubota unpublished data). Shirahama, affected by the warm current Kuroshio, is the northernmost distribution locality in the world of this species (Lewis et al. 2008). During each night of the two days in early summer, we sampled more than 100 specimens in 30 minutes. We observed that most of the collected specimens were very tiny specimens, and only a few showing the beginning stage of gonad formation. The specimens ranged from 1.2 - 3.2 mm height and 0.8 - 1.8 mm in diameter (at velarium aperture), but most were less than 1.6 mm height (Fig. 1) that is conceivable as the newly released medusa from the polyp (viz. Werner 1975; Yamaguchi & Hartwick 1980; Straehler-Pohl & Jarms 2011).

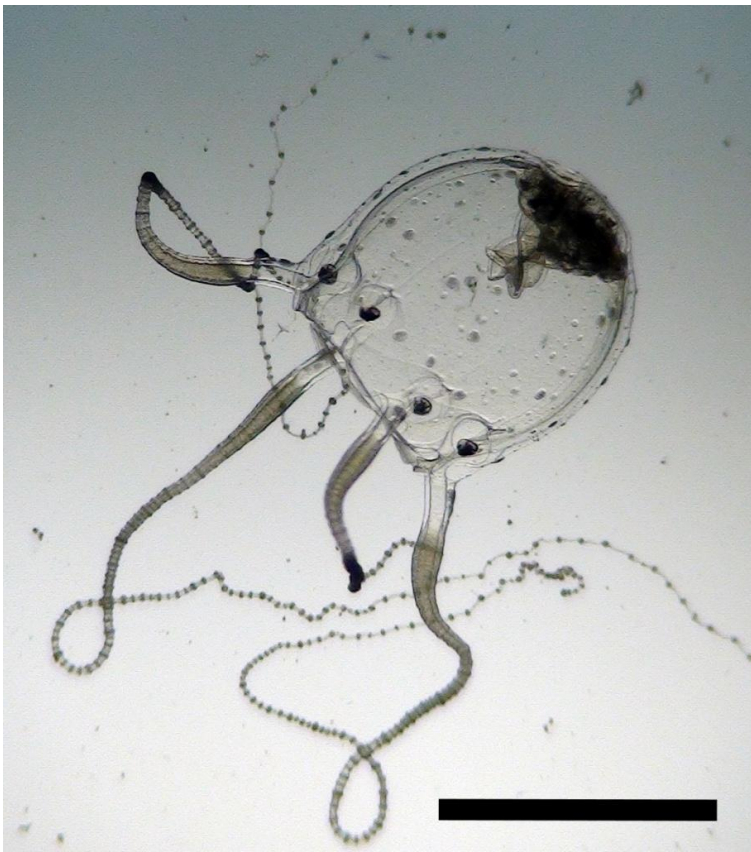


Figure 1. Side view of very young medusa of *Copula sivickisi* (Stiasny, 1926) collected from Shirahama, Wakayama, Japan. The specimen was anesthetized. Scale bar = 1 mm.

During the following mornings, most of the specimens were attached to the sides of the bucket or any substrate put inside it (Fig. 2). Therefore, this cubomedusa takes a rest in the daytime in contrast to the active behavior at night.

Abundance data, even without identical sampling methods, is noticeable, because it demonstrates some relevant biological aspects of the species. Kingsford et al. (2012) stated that they took three years (summers) in a number of sites in Australia to obtain less than 200 specimens of the present species, *C. sivickisi*. In contrast, we obtained more than that number in less than totally 60 minutes at Shirahama this time, then the population size of this young specimens there is now very impressive. It is surmised that such a mass occurrence of tropical *C. sivickisi* at Shirahama may be related to recent global warming, according with the well-established phenomenon exemplified for a green mussel, *Perna viridis* (Linnaeus, 1758) and tropical animals (Kubota 2011).

Due to the small size of the specimens found and high concentration, we assume that the species can reproduce in the area, and the polyp stage may occur in the surrounding areas. Based on this, we emphasize the need of studies focusing on the biology and ecology of cubozoans, like Acevedo et al. (2013), Colins et al.

(2013), Courtney & Seymour (2013), and Toshino et al. (2013).



Figure 2. Side view of very young medusa of *Copula sivickisi* (Stiasny, 1926) from Shirahama, Wakayama, Japan attached to a piece of marine angiosperm. Note tentacles contracted inside the bell. Scale bar = 1 mm.

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