

Stellamedusa ventana, a new mesopelagic scyphomedusa from the eastern Pacific representing a new subfamily, the Stellamedusinae

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This paper describes a new species, genus, and subfamily within the Scyphomedusae. *Stellamedusa ventana* is a relatively large scyphomedusa that reaches up to 9.4 cm in diameter. The medusa is rare, with only seven observations in over a decade of extensive surveys of the Monterey Bay and Sea of Cortez using remotely operated vehicles. *Stellamedusa ventana* continues the trend found in several other deep-sea semeanostome medusae in lacking marginal tentacles. The exumbrella and oral arms are covered with large nematocyst laden projections which are able to capture food items of various sizes in the laboratory. A large cydippid ctenophore was found in the gut of one captured specimen.

INTRODUCTION

Scyphozoan jellyfish are among the largest and most conspicuous members of the worlds pelagic fauna. They inhabit a wide diversity of habitats and depths, being found in virtually all marine areas on the planet. They are important predators in all these habitats, specializing in everything from other jellies to crustaceans to fish eggs and larvae (Arai, 1997; Purcell et al., 2001).

Several large, poorly known scyphomedusae have been described from the mesopelagic down to the bathypelagic zones. The large *Stygiomedusa gigantea* (Browne, 1910) is mainly mesopelagic, being found in the surface waters only in high latitudes (Larson, 1986). This medusa is unusual not just for its viviparous reproductive strategy (Russell, 1959; Russell & Rees, 1960; Russell, 1967), but for its absence of marginal tentacles, previously a hallmark of the family Ulmaridae. The finding of new medusae lacking marginal tentacles continued with the discovery of both *Deepstaria enigmatica* Russell, 1967 and *D. reticulum* Larson et al., 1988. Recently, a large scyphomedusa also lacking any tentacles was described from both sides of the Pacific (Matsumoto et al., 2003). This new medusa, *Tiburonia granrojo*, was placed into a new subfamily, the Tiburoniinae. As technology has allowed researchers to dive to ever increasing depths, new scyphomedusae continue to be found. We are entering a renaissance of species discovery with the use of new tools and technology.

On seven occasions between 1990 and 2003 a unique mesopelagic scyphozoan jellyfish was observed (Figure 1), and on six occasions captured, using a remotely operated vehicle (ROV) in Monterey Bay, California and in the Sea of Cortez (Gulf of California). This medusa is sufficiently different from all other known species to justify the creation of a new subfamily, the Stellamedusinae. A description of this new species follows, with notes on its feeding behaviour and ecology. An expanded key of the semeanostome scyphomedusae is included to account for this new subfamily and its unique features.

MATERIALS AND METHODS

Seven specimens were observed over 13 years (Figure 2 and Table 1). Six of these medusae were collected. All observations and collections of the medusae were made in Monterey Bay, California and in the Sea of Cortez with the ROV 'Ventana' and ROV 'Tiburón' (Robison, 1993). The 'Ventana' video system employed a broadcast quality three-chip Sony DXC-3000 (1988–1999), and a Sony High Definition HDC-750A camera with an HDCA-750 back (1080i format) (1999–present). The 'Tiburón' video system employed a Panasonic high resolution three-chip camera. Video was recorded on high-quality BetaCam or HDTV tapes for subsequent analysis and annotation. Animals were captured for laboratory observation in 7.5-l 'detritus samplers' (Youngbluth, 1984; Robison, 1993). Specimens of *Stellamedusa ventana* were collected with the ROV and brought back to the laboratory within three hours. The medusae were placed into 26 cm (width) × 100 cm (diameter) planktonkreisels (Raskoff et al., 2003) in a dark, temperature-controlled room where they were photographed, filmed, and feeding experiments performed.

SYSTEMATICS

Order SEMAEOSTOMEAE L. Agassiz, 1862

Family ULMARIDAE Haeckel, 1879

Subfamily STELLAMEDUSINAE subfam. nov.

Genus *Stellamedusa* gen. nov.

Stellamedusa ventana sp. nov.

(Figures 1–4)

Type material

The type specimen was collected on 15 May 1990 at 175 m depth, at 36°70.726'N 122°00.94'W in Monterey Bay, California. The holotype specimen has been deposited at the California Academy of Science (CASIZ no. 162749). Paratypes are housed at the Monterey Bay Aquarium Research Institute (MBARI).



Figure 1. Colour illustration of *Stellamedusa ventana* compiled from photographs and video observation.

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Etymology

The generic name *Stellamedusa* references the comet-like appearance of the medusae when swimming with the oral arms streaming out behind the bell. *Stella* (Latin): Star, comet. The species is named after the MBARI operated ROV 'Ventana', the vehicle which discovered, photographed, and collected the first known specimens of this species. Therefore *ventana* is considered as a noun in apposition.

Diagnosis

Subfamily Stellamedusinae: tentacles completely lacking. The canals are simple, not netlike (not anastomosed), and may have blind centripetal canals. The subfamily is monotypic.

Stellamedusa ventana is a scyphomedusae with a hemispherical to round bell, up to 9.4 cm in diameter (Figures 1 & 3A, Table 2). The exumbrellar surface of the bell is heavily laden with small bumps which are composed of dense aggregations of nematocysts (heterotrichous microbasic euryteles) (Figure 4). There are three or four gonads and three or four oral arms with larger nematocyst laden bumps (Table 2, Figure 4). All surfaces are a translucent blue-white colour. Tentacles are completely lacking. The canals are simple, not netlike (not anastomosed). Marginal ring canal projections often bifurcated on each side of a rhopalium (Table 2, Figure 3B).

Description

Gastrovascular system

The oral arms have a median groove folded inside the fleshy v-shaped arms. The oral arms are covered with prominent bumps which terminate in large nematocyst clusters (giving the medusae the common name 'Bumpy') (Figure 4B). The oral arms terminate into a mouth which leads to the central stomach cavity. The interradial stomach pouches house many gastric filaments as well as the gonads. The gastric filaments have numerous gland cells as well as microbasic eurytele nematocysts. The radial canals connect into the peripheral walls of the stomach pouches.

Gonads

There are three or four horseshoe shaped interradial gonads within the central gastrovascular area (Table 2). The gonads are translucent milky white ribbons on the periphery of the stomach pouches, without any dense tissue. The gonads of the specimen collected on 5 October 2001 were examined microscopically and photographed.

The specimen was a male with motile sperm. No sperm strings were observed spontaneously releasing from the medusae in captivity (as happens in other scyphomedusae, such as *Aurelia* spp.) Underlying each stomach pouch is one subgenital pit with a circular orifice.

Canals

Stellamedusa ventana has between 15 and 18 straight radial canals which run from the gastric pouches to the marginal ring canal (Figure 3A, Table 2). Often found between the radial canal are blind centripetal canals which originate at the margin and run parallel to the radial canals (Table 2). The centripetal canals are the same width and from 1 cm to 1/2 the length of the radial canals. Two specimens were observed with no centripetal canals. There are short, blind projections of the ring canal running towards the margin, in between each lappet and rhopalium. These projections are non-branching, except on each side of the rhopalium where they often (89%) bifurcate (Figure 3B, Table 2).

Marginal sense organs

There are eight marginal sense organs, each with a rhopalium, located on the margin of the bell (Figure 3A, Table 2). The exumbrellar sensory pits are highly rugous (Figure 3B). A short rhopalium canal stretches from the ring canal to the rhopalium. A statocyst is connected to the structure by a short, broad bulb. On each side of the rhopalium the short, blind projections of the ring canal often bifurcate. In addition, the lappets on each side of the rhopalium are connected by a very thin web of epidermal tissue. This webbed structure is only found between lappets on each side of the sensory structures, all other lappets are nonwebbed. No ocelli were observed.

Nematocysts

All nematocysts were all found to be microbasic euryteles of length $11.40 \mu\text{m} \pm 0.26$ and width $8.51 \mu\text{m} \pm 0.30$ (mean \pm SE; N=15). Cnidae were found in dense aggregations on the exumbrellar surface as well as on the oral arms (Figures 3 & 4).

Remarks

Feeding and swimming behaviour

Six specimens were collected and brought back to the laboratory for observation and documentation. Two specimens, from 16 March 1999 and 5 October 2001 were kept in a tank for several weeks and fed various food items (*Artemia*, shrimp, squid). The food items placed into the

Table 1. All known records of *Stellamedusa ventana*, with the associated physical characteristics of their location at the time of capture.

Date	Location	Latitude	Longitude	Depth (m)	Temperature (°C)	Salinity	Oxygen (ml/l)	Collected
15/05/1990	Monterey, CA	36°70.726'N	122°00.94'W	176	n.d.	n.d.	n.d.	Yes
07/08/1990	Monterey, CA	36°70.651'N	122°02.879'W	164	9.3	33.99	n.d.	Yes
16/03/1999	Monterey, CA	36°83.606'N	121°97.482'W	200	8	34.02	1.65	Yes
20/09/1999	Monterey, CA	36°79.966'N	122°04.266'W	312	7.4	34.18	1.9	No
05/10/2001	Monterey, CA	36°71.661'N	122°00.091'W	552	6.1	34.24	0.4	Yes
17/03/2003	Sea of Cortez	27°01.115'N	111°39.164'W	152	12.7	34.63	0.37	Yes
23/03/2003	Sea of Cortez	24°31.752'N	109°20.019'W	197	12.3	34.55	0.12	Yes

n.d., no data collected.

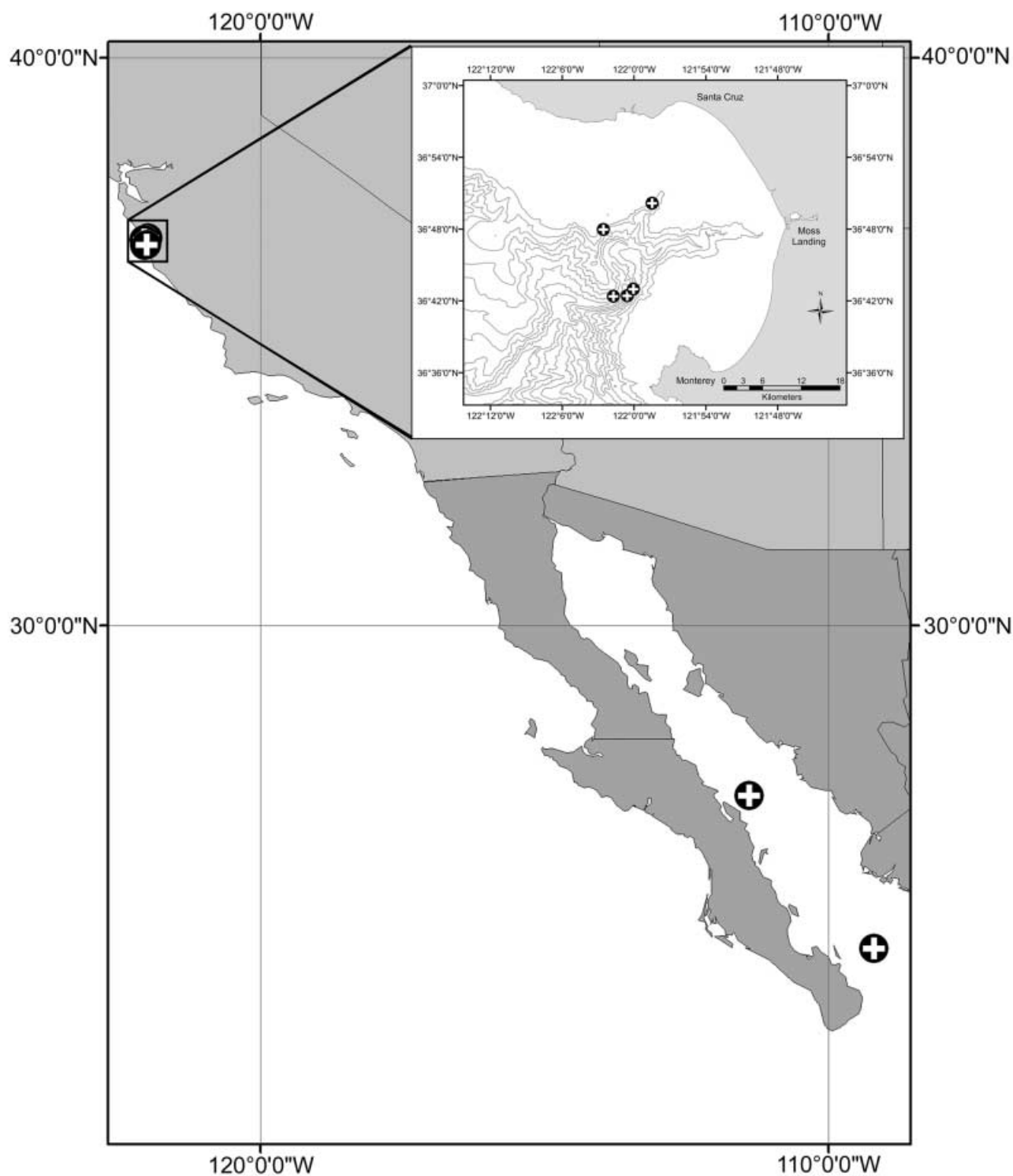


Figure 2. Map of all sightings of *Stellamedusa ventana* within Monterey Bay, California and the Sea of Cortez (Gulf of California).

Table 2. Morphological characteristics of all collected specimens.

Date Collected	Bell Diameter (cm)	Gonad Number	Radial Canal Number	Centripetal Canals	Rhopalia Number	Number of Rhopalia Canal Bifurcations
15/05/1990	7.7	4	18	16	8	16
07/08/1990	8.5	3	16	15	8	16
16/03/1999	5.8	4	15	6	8	13
05/10/2001	9.2	4	18	7	8	10
17/03/2003	8.5	4	16	0	8	16
23/03/2003	8.6	4	16	0	8	n.d.

n.d., no data collected.

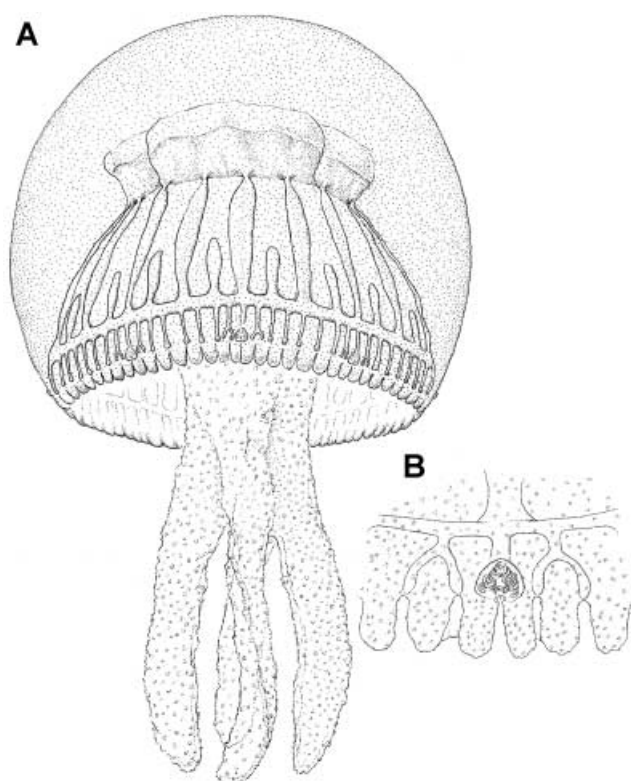


Figure 3. Diagram of *Stellamedusa ventana*. (A) Whole specimen; (B) enlarged view of the margin of the bell showing the sensory structures.

tanks hit the exumbrellar surface of the bell and were captured by the small batteries of nematocysts on the bell. These captured prey then slowly moved down the bell to the margin of the umbrella. Once at the margin, the feeding events were similar to those of other scyphomedusae, with the oral arms bending up to the umbrellar edge and attaching to the food item. The oral arm then pulled back from the margin and resumed its typical orientation. The prey were slowly transported up the inner fold of the oral arms and into the mouth and gastric cavity. Pieces of squid and shrimp greater than 2 cm² were routinely captured and ingested, while smaller pieces were often released. It is hypothesized that this species feeds in a similar manner in the wild. Other medusae have been shown to capture small prey on their umbrellar surface (Heeger & Möller, 1987), but there are few reports of such large food items being captured on the umbrellar surface. The specimen collected on 17 March 2003 in the Sea of Cortez was found with a large, whole cydippid ctenophore in the gut cavity, suggesting that gelatinous prey may be its principle diet, as has been found for many other deep water medusae (Raskoff, 2002).

The fact that new species of large scyphomedusae are still being discovered in the midwaters of the oceans shows how much there is left to be explored and understood in the deep sea. With new submersible technology allowing researchers to probe to ever greater depths and stay in the water for longer periods of time, we will undoubtedly continue to discover large new denizens of the deep.

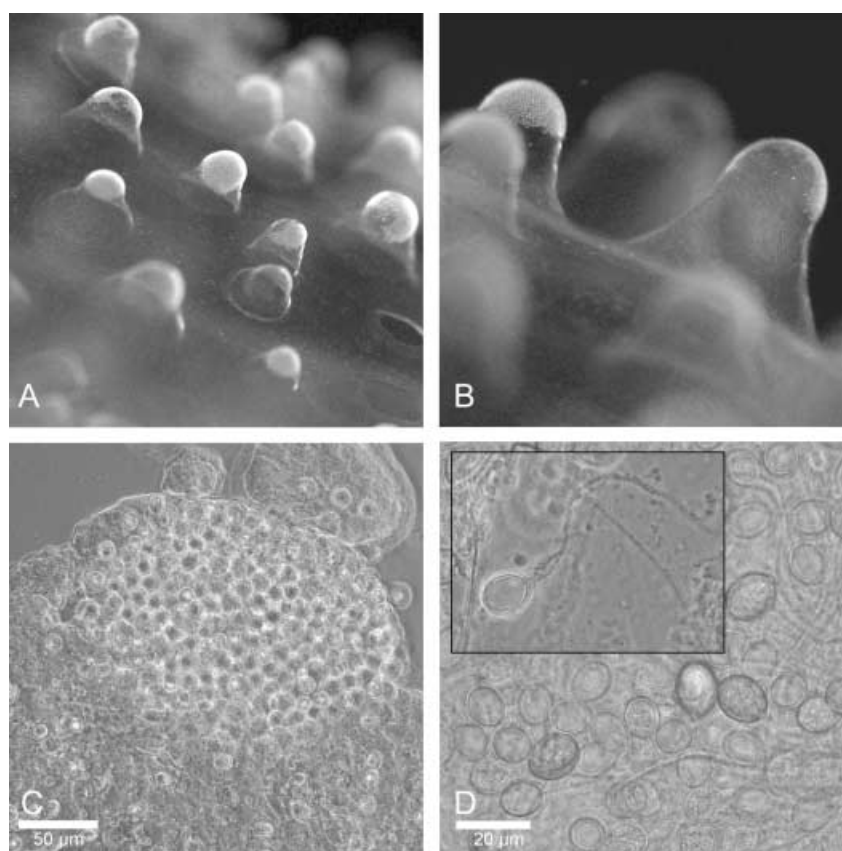


Figure 4. Photographs of the nematocyst clusters and cnidae of *Stellamedusa ventana*. (A & B) Dissection microscope views of large nematocyst clusters on top of epidermal projection found all over the exumbrella and oral arms; (C) nematocyst cluster under compound microscope; (D) discharged and undischarged nematocysts.

Key to subfamilies

Modified from Matsumoto et al., 2003 and Larson, 1986. Family ULMARIDAE (Larson, 1986).

Gastric cavity with peripherally radiating canals (either simple or branched) which join marginal ring canal. Oral arms either broad and curtain like or narrow and tapering; lips usually with nematocyst-lined papillae or digitata. Gonads either inverted or everted. Tentacles either marginal or subumbrellar or absent.

Key to subfamilies

1. With tentacles 2
- Without tentacles 5
2. Gonads inverted 3
- Gonads everted 4
3. Gonads separate, horseshoe shaped Aureliinae
- Gonads: contiguous and forming ring Poraliinae
4. Tentacles marginal Ulmarinae
- Tentacles subumbrellar Sthenoniinae
5. Gastrovascular canals forming netlike anastomoses . 6
- Gastrovascular canals not netlike, simple
- Stellamedusinae
6. Gastrovascular canals variably thickened, forming netlike anastomoses which peripherally decrease in size. Length of oral arms several times that of bell height. Stygiomedusinae
- Gastrovascular canals uniformly thin, forming netlike anastomoses of fairly equal size. Length of oral arms less than three times bell height 7
7. Five thin oral arms contained within the bell margin Deepstariinae
- Four to seven thick oral arms extending beyond the bell margin. Tiburoniinae

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