

MARINE RECORD

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Cassiopea andromeda (Forsskål, 1775) in the Gulf of Kutch, India: initial discovery of the scyphistoma, and a record of the medusa in nearly a century

Amruta Prasade*, Pooja Nagale and Deepak Apte

Abstract

Background: *Cassiopea andromeda* is reported here after long gap of almost a century from the Gulf of Kutch, Gujarat. This is the first record of scyphistoma form of the species from India and first record of the medusa from the Arambhada coast.

Results: An upside down scyphozoan jellyfish *Cassiopea andromeda* belong to family Cassiopeidae. Identification and description of medusa and scyphistomae were given based on morphological characters.

Conclusions: This paper discusses about the variation in colour form, aggregation of medusae and morphology of polyp.

Keywords: Upside down jellyfish, Scyphistoma, Cassiopeidae, Arambhada, Narara, Gujarat

Introduction

The rhizostome scyphozoan *Cassiopea andromeda* is referred to Cassiopeidae, an unusual family of so-called upside-down jellyfishes that comprises the single genus *Cassiopea* and six currently recognized species (Holland et al, 2004). Circumtropical in distribution (Schembri et al., 2010), these species most often occur in shallow bays, intertidal sand, mangrove mudflats and lagoons (Browne, 1916).

The species has been recorded previously in India as *C. andromeda* var. *maldivensis* from Armara, Gulf of Kutch, Gujarat (Browne, 1916) and from Krusadai Island, Gulf of Mannar, Tamilnadu (Rao, 1931), and as *C. andromeda* from Madras (Menon 1930, 1936) and the Andaman Islands (Venkataraman et al. 2012). Gopalkrishnan (1970) reported *Cassiopea* sp. from Adatra, Gujarat, but provided no photographs or information on its morphology. *Cassiopea andromeda* has been implicated as an invasive or alien species worldwide (Özgür and Öztürk, 2008; Çevik, et al., 2006; Katsanevakis, 2011; Zenetos et al, 2005, 2011) and is referred as ecologically

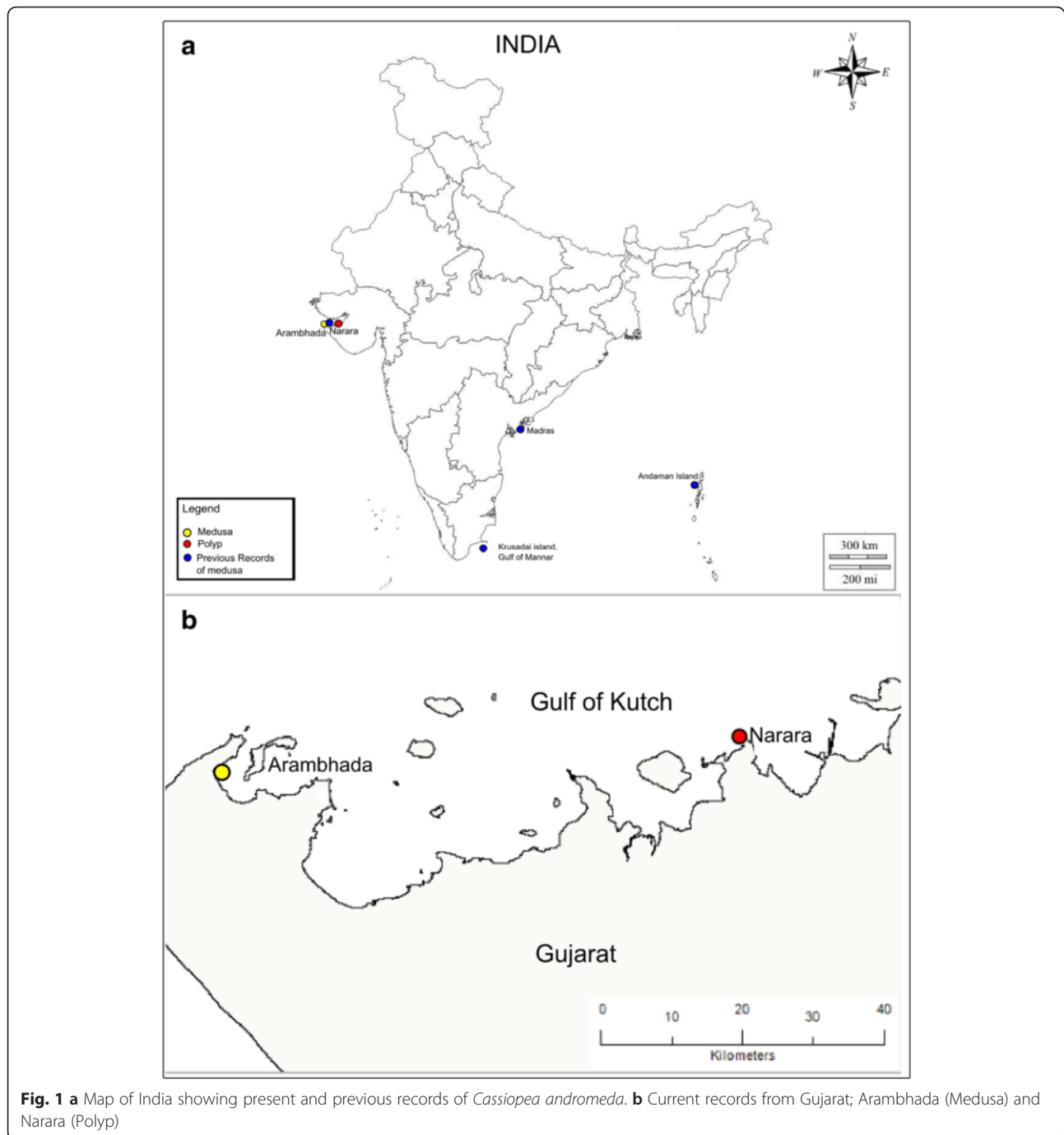
important species considering its invasive distribution (Heins et al, 2015).

The global phylogeography of *Cassiopea* spp. from the Pacific and Indian oceans was investigated by Holland et al. (2004) who provided molecular evidence of the cryptic nature of the genus and of problems raising with species identification based on morphological characters only.

Cassiopea andromeda is a carnivorous species that uses nematocysts to capture its prey. Nutrition is also obtained from photosynthetic dinoflagellate algae (zooxanthellae) present in the oral arms on the ventral side of the body. As with most scyphozoans, the life cycle of *C. andromeda* includes a sessile polypoid or scyphistoma stage eventually giving origin to the medusa stage through monodisk strobilation with a single ephyra developing by the oral part of the polyp (Heins et al, 2015).

Cassiopeid medusae were observed during 2013 at Arambhada, Gulf of Kutch (Fig. 1). Medusa and scyphistoma polyp specimens were tentatively identified as *C. andromeda* (sensu Holland et al 2004), based on descriptions of Mayer (1910) and with the support of D. K. Hofmann who confirmed morphology

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scyphistoma, type of budding and nematocysts are similar to *C. andromeda* (personal communication, 12 February 2015). Our report constitutes the first record of the scyphistoma of *Cassiopea* sp. in India, and the first record of the medusa from Gujarat since 1916. Following its discovery, the Wildlife Trust of India gave accounts of the species in news articles during 2014, reporting it from “India’s first jellyfish lake”.

Material and methods

Scyphistomae from Narara, and medusae from the Arambhada coast, both in the Gulf of Kutch, Gujarat (Fig. 1), were observed on 7 January, 2013 and 28 December, 2013 and average sea water temperature recorded was 21.8 °C and 20.4 °C respectively. Few scyphistomae collected were found attached to rock at intertidal area of dead coral reef. As specimens were preserved immediately, no further study could be made.

Our field work was undertaken under the All India Co-ordinated Project on Taxonomy (AICOPTAX). Polyps were preserved using 4 % formalin in sea water and deposited in collections at the Bombay Natural History Society (ACC. No. BNHS- HY- 0410). Polyp morphology was studied using a stereomicroscope (Leica EZ4 D). Nematocyst studies were carried out following the simple squash method (Östman, 2000) using a compound microscope (Leica DM750). Specimens of the medusa stage were not collected, although photographic documentation was made of both medusa and polyp.

Results

Class Scyphozoa Goette, 1887

Order Rhizostomeae Cuvier, 1799

Family Cassiopeidae L. Agassiz, 1862

Genus *Cassiopea* Péron & Lesueur, 1810

Species *Cassiopea andromeda* (Forsskål, 1775)

Description of observed medusae (Fig. 2)

Umbrella circular, flattened, 10 cm to 15 cm in diameter, usually with subumbrellar surface facing upwards and exumbrella facing downwards; oral arms 8–9 in number, slightly longer than umbrella radius, branched, with about 4 side branches supporting many filaments with zooxanthellae; each arm with numerous small and about 6 large, club-shaped vesicles. Medusae brown, blue or green; umbrella usually brown with white patches on rim.

Description of observed scyphistomae (Fig. 3)

Polyps attached to hard rocky substratum, lemon yellow colored; hypostome slender, straight (Fig. 3a); fully-

grown specimens about 3-4 mm high, deep, cup- or bowl-shaped; calyx 1.35 mm; after preservation hypostome looked quadrate, orifice with outward-folded lips (Fig. 3c); tentacles long, slender, encircling mouth, about 30 to 33 in number. Stalk of polyp about 2-2.5 mm long. Some polyps with single or two connected buds, emerging from lower part of calyx (Fig. 3b and d); buds spindle-shaped, about 0.3 mm in length.

Cnidome

The nematocyst complement observed in tentacles of the scyphistoma comprised large and small microbasic euryteles, birhopaloids and isorhizas (Fig. 3e, f). As the nematocyst analysis was carried out after preservation of polyp, no discharged capsules were observed, for detail description of nematocysts refer Heins et al, 2015.

Discussion

Aggregations of *Cassiopea andromeda* were observed on soft muddy bottoms of the Arambhada coast during low tide. That habitat was dominated by various types of algae, sponges, ascidians and bryozoans. Various color forms of *C. andromeda* were observed, including blue, green, and brown. In a 10-m-long transect within a channel, aggregations of about 15 specimens were observed. Specimens ranged from 10 cm to 15 cm in diameter, whereas collections by Hornell in 1905 (Browne 1916) mentioned sizes from 2 cm to 6 cm.

Significance of endosymbiotic dinoflagellate in carbon metabolism and strobilation in *C. andromeda* has been studied by Hofmann and Kremer, 1981. They concluded that strobilation is just supported but not triggered by dinoflagellate or zooxanthellae photosynthetic activity.



Fig. 2 Medusa of *Cassiopea andromeda*, an upside down Jellyfish (ventral view) from Arambhada, Gujarat, India

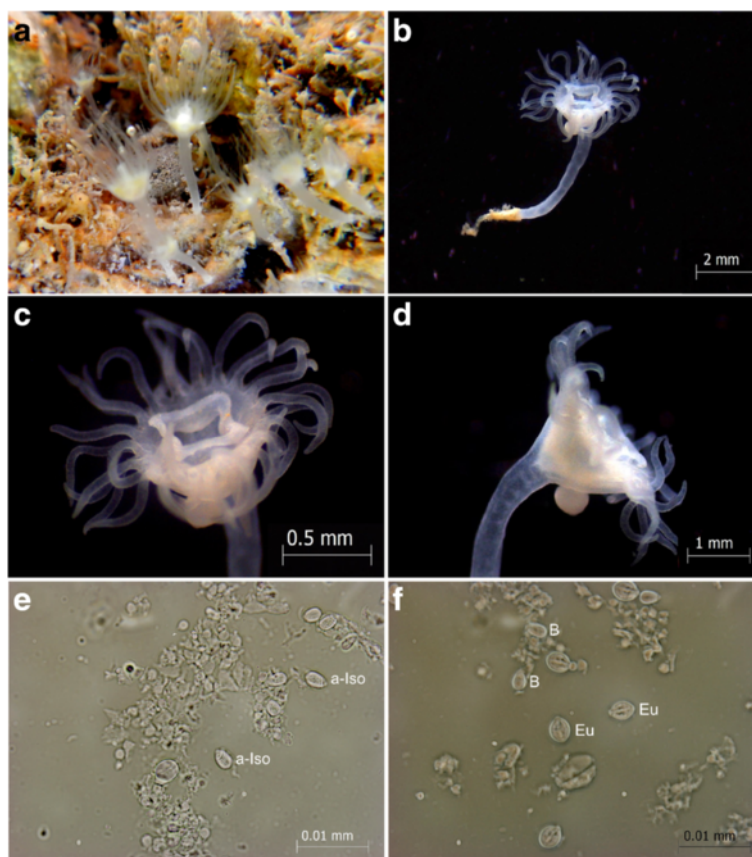


Fig. 3 Scyphistoma of *Cassiopea andromeda*: **a** Mature scyphistoma in life, **b** scyphistoma after preservation, **c** scyphistoma showing tentacles, **d** spindle shaped bud emerging from calyx, **e-f** various nematocysts in tentacle. a-Iso: a-isorhiza, B: Birhopaloids, Eu: Euryteles; Scale bars: B, 2 mm; C, 0.5 mm; D, 1 mm; E-F, 0.01 mm

Various scientists have worked on the scyphistomae of *Cassiopea* spp. Hofmann and Gottlieb, 1991 have studied the asexual reproduction from scyphistomae of *Cassiopea andromeda* through spindle shaped bud formation, illustrating stages in bud formation. Kehls et al. (1999) studied the induction of head and foot formation in buds of *C. andromeda* by the protein phosphatase inhibitor cantharidin. They gave an elaborate diagram of the scyphistomae, which describes morphology of polyp like shape of hypostome (quad-rangular) and bud. A recent research by Heins et al, 2015 gave elaborated knowledge about the scyphistomae of *C. andromeda*, its bud development and nematocysts composition.

Conclusions

Medusa of *Cassiopea andromeda* was reported from the Gulf of Kutch, Gujarat after a gap of a century while scyphistomae easily confirmed up to genus level based on

descriptions about polyp morphology, nematocyst composition and by the experts' comments.

Abbreviations

AICOPTAX, All India Co-ordinated Project on Taxonomy; ACC. No., Accession Number; BNHS, Bombay Natural History Society; HY, Hydrozoa; cm, Centimeter; mm, millimeter

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Availability of data and materials

Not Applicable.

Authors' contributions

AP first reported medusa and polyps during field surveys, identified medusa, and drafted the manuscript. PN identified polyps, carried out nematocyst isolation and helped to draft the manuscript. DA guided the study and final editing of the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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