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Systematic notes on two new *Obelia* species (Cnidaria: Hydrozoa: Campanulariidae) collected from Shah Bunder, Indus deltaic area (Pakistan)

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Abstract
The genus *Obelia* belongs to the family Campanulariidae, an important and widely distributed family of hydrozoans (Cornelius 1982). The present study concerns the taxonomy of two *Obelia* species: *Obelia geniculata* (Linnaeus, 1758) and *Obelia longissima* (Pallas, 1766) in zooplankton samples of Shah Bunder (Indus deltaic area). These species are documented for the first time from the coastal areas of Pakistan.

Keywords: systematic, *Obelia*, Shah Bunder, Indus delta (Pakistan)

Introduction
Gelatinous microscopic group of zooplankton contains of varied taxonomy of marine organisms which comprises tunicates, ctenophores and cnidarians. Cnidarians have distinctive characteristics that are transparent body structure, absence of exoskeleton and soft bodied texture. This transparent group of aquatic life are necessary core of food web and ecosystem. Cnidarians are primary consumers of marine ecosystem and consumed by many marine mammals especially shark utilize these microbes for their survival. Due to lack of consideration towards this group still thousands of species are unidentified.
The Indus delta is one of the largest sediment bodies in the modern ocean basins, ranked as 6th largest delta on the globe stretching 150 km along the Arabian Sea. It has an extensive creek system which is the home for mangrove forest having high biological productivity and provides excellent shelter, nursing and breeding grounds for many fishes and crabs especially shell fish.
Cnidarians are divided into five classes: Hydrozoa; Anthozoa; Scyphozoa; Staurozoa and Cubozoa. The Anthozoa and Scyphozoa are familiar, but the class Hydrozoa is less recognized, in large part because numerous of the species are microscopic [1]. Studies on hydroids from the Pakistani coast include [2-18]. The medusa stages of *Obelia* sp. are common in coastal and offshore plankton [19-42]. The genus *Obelia* contains 11 species worldwide [43]. The present paper is based on the taxonomy of planktonic caught hydrozoans species of *Obelia geniculata* and *Obelia longissima.*

Materials and Methods
Sampling was conducted throughout pre-monsoon (January – April), monsoon (May – September) and post-monsoon (October – December) seasons from the permanent sampling station in Shah Bunder (24º 08'39" E 67º 55'18" N) (Figure 1) during 2018. Physico-chemical parameters including water temperature, air temperature, salinity, pH, dissolved oxygen and transparency was recorded. Plankton samples were collected with the help of Hydro-Bios ring trawl net of 500 and 250µ mesh size through horizontal towing of 10 minutes haul at constant speed of 0.5 m/s in the surface waters during high tide. Hydro-Bios digital flow meter was used to record the volume of water passed through the net. Samples were immediately preserved in 5% formalin. In the laboratory samples were split into aliquots (sub samples) which were sorted out into different taxonomic groups under a stereo microscope (Leica WILD M3C).

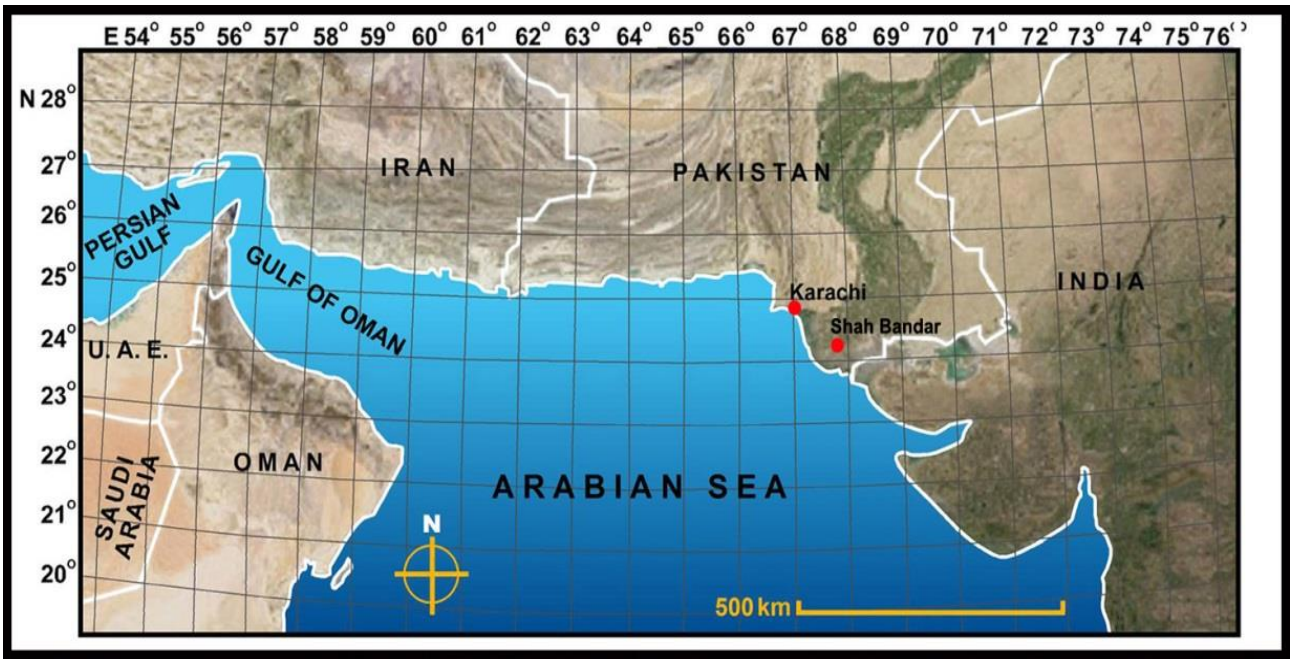

Fig 1: Map showing the collection site

Systematics
Kingdom: Animalia
Phylum: Cnidaria
Subphylum: Medusozoa
Class: Hydrozoa
Subclass: Hydroidolina
Order: Leptothecata
Family: Campanulariidae
Genus: *Obelia* Peron and Lesueur, 1810
Obelia geniculata (Linnaeus, 1758)
Obelia longissima (Pallas, 1766)

Taxonomy
Genus *Obelia* Peron and Lesueur, 1810
***Obelia geniculata* (Linnaeus, 1758)**
Sertularia geniculata Linnaeus 1758: 812.
Obelia geniculata: Hincks, 1868: 149, pl. 25 figs 1, 1A; Hilgendorf 1898: 204–205, pl. 17, figs 2, 2a; Hartlaub, 1901: 362; 1905: 581, fig. D2; Bartlett 1907: 42; Linko 1911: 227–231, fig. 43; Stechow 1913b: 8, 22, 69, figs 26–27; 1919: 50; 1923: 114; Nutting, 1915: 73, pl. 18 figs 1–5; Uchida 1925: 90; Johnson and Snook 1935: 60, fig. 43; Briggs 1939: 14; Fraser 1939c: 159; Hiro (= Utinomi) 1939: 174, fig. 6; Fraser 1940b: 497; 1948: 214; 1944: 158, pl. 28 fig. 130; Hodgson 1950: 3, figs 1–4; Kulka 1950: 80, fig. 1; Russell, 1953: 302, fig. 185A; Ralph 1956: 281–285, figs 1a, 2b; Hakushi *et al*., 1957: 217, pl. 108, fig. 3; Ralph 1957: 831, fig. 4i; Yamada 1958: 51, 54; Millard 1959: 250; Yamada 1959: 41; Naumov 1960: 261–263, figs 15B, 37, 147, 148; Kato *et al*., 1961: 195; Ralph 1956: 285, fig. 1b-1d; 1961c: 104, 107; 1961d: 236; Itô & Inoue 1962: 449, pl. 8, fig. 67; Kawahara 1962: 33; Mammen 1965: 14, figs 39–40; Nishihira 1965: 77; Yamada 1965: 361; Millard 1966a: 483; 1966b: 491; Nishihira 1966: 187; Rho 1967: 342–343, fig. 1; Nishihira 1968a: 120; 1968b: 126; Ralph and Thomson 1968: 1–21, pls 1-3; Naumov, 1969: 282, figs 147–148; Rho 1969: 164–165, figs 3–4; Day *et al*. 1970: 12; Shepherd and Watson 1970: 140; Calder, 1970: 1522, pl. 4 fig. 7; 1971: 55, pl. 4C; 1975: 303, fig. 4E–F; Nishihira 1971: 104; Roberts 1972: 300 et seq.; Rho and Chang 1972: 4; Morton and Miller 1973: 152; Millard and Bouillon 1974: 6; Rho and Chang 1974: 140; Cornelius 1975: 272–278, figs 1, 5; Millard 1975: 229, fig. 75A–B; Gordon and Ballantine 1977: 100; Rho 1977: 259, 417, text-fig. 9A, pl. 17, fig. 72; Honma and Kitami 1978: 10; Millard 1978: 195; Stepanjants, 1979: 36, pl. 5 fig. 7; Haderlie *et al.*, 1980: 47; Morri, 1981: 69, fig. 22; Cornelius 1982: 119– 120; Hirohito 1983: 6, 17; Austin 1985: 53; Staples and Watson 1987: 218; Gili *et al*., 1989: 108, fig. 32C; Lin Sheng 1989: 341; Cornelius and Ryland 1990: 133, fig. 4.11; Park 1990: 79; El Beshbeeshy, 1991: 114, fig. 26; Cairns *et al*. 1991: 23; Dawson 1992: 13; Watson 1992: 220; 1994a: 66; Bouillon *et al.* 1995: 84; Cornelius 1995b: 301–303, fig. 70; Hirohito 1995: 76–78, fig. 22a-b; Kalk 1995: 199, fig. 7.20; Migotto, 1996: 90, fig. 16E; Ramil *et al.*, 1998a: 200; Medel and Vervoort, 2000: 54; Schuchert, 2001b: 155, fig. 135; Peña Cantero and García Carrascosa, 2002: 162, fig. 31D; Vervoort and Watson, 2003: 427, fig. 104F–H; Bouillon *et al*., 2004: 200, figs 114H–I, 115A–E; Watson, 2005: 583.
Laomedea geniculata Coughtrey 1875: 290, pl. 20, fig. 42; 1876a: 299; 1876b: 24; Marktanner-Turneretscher 1890: 208, pl. 3, fig. 9; Hartlaub 1901b: 362.
Obelia geniculata var. *subsessilis* Jäderholm, 1904a: 2, fig. 2.
Clytia geniculata Bennitt 1922: 248
Campanularia geniculata Kato 1949: 215.
Laomedea geniculata Leloup, 1974: 19, fig. 16.

Description
Umbrella flat. Stomach short, with quadrangular base, without peduncle; mouth with four short simple lips. Four straight radial canals. Gonads circular, sac-like, hanging from middle to end-regions of radial canals. Numerous short solid marginal tentacles, somewhat stiff, not extensile; with axial core of single row of gastrodermal cells; each tentacle with small basal swelling, with short gastrodermal root into mesogloea of umbrella margin. No cirri.

Size: Diameter of full-grown umbrella 2.5 - 6.0 mm.

Distribution: Cosmopolitan.

Habitat: Typically found in coastal and offshore waters. Floats, pilings, rocks, shells and other solid substances.

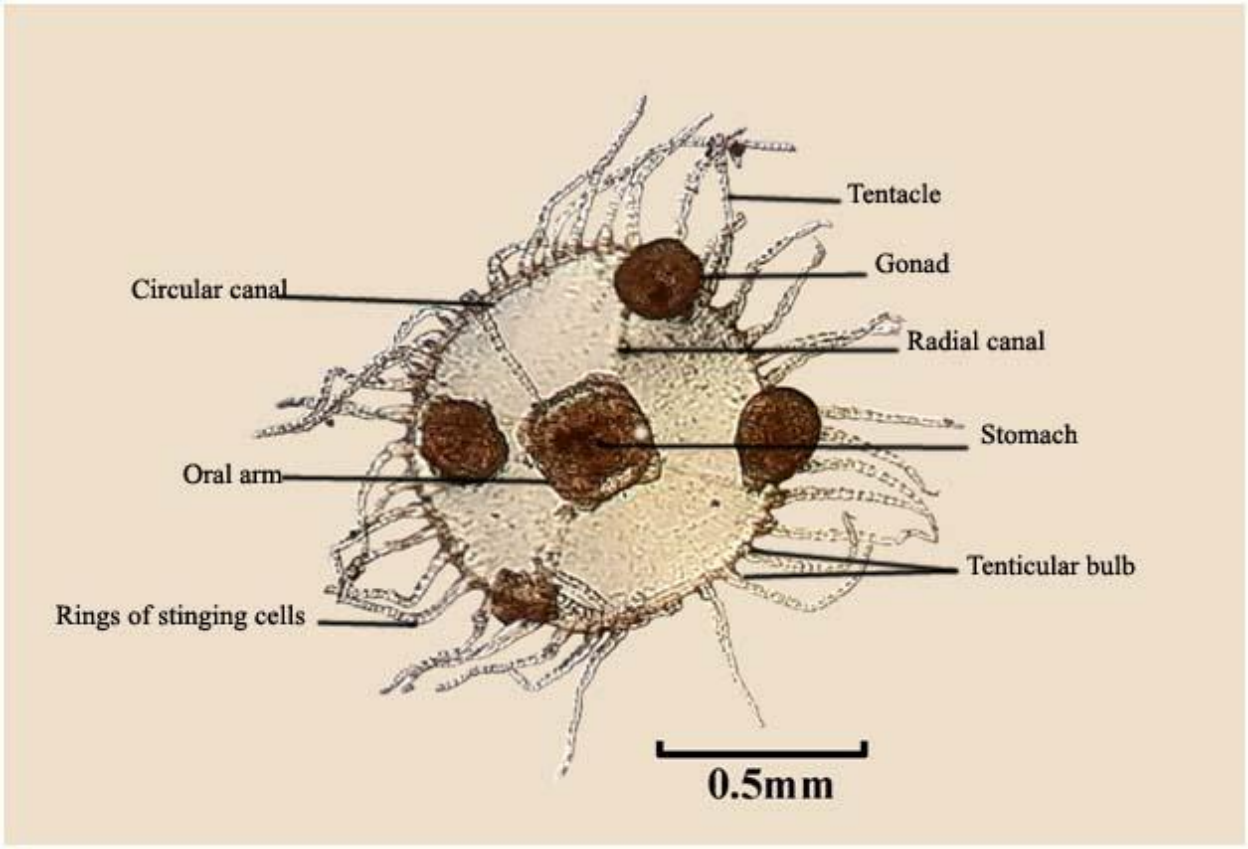

Fig 2: *Obelia geniculata* (Linnaeus, 1758)

***Obelia longissima* (Pallas, 1766)**
Sertularia longissima Pallas, 1766:119-121.
Gonothyraea longissima (Pallas, 1766):119.
Laomedea longissima (Pallas, 1766):119.
Campanularia flabellata Hincks, 1866:297.
Laomedea flabellata (Hincks, 1866):297.
Obelia flabellata (Hincks, 1866):297.
Obelia plana Haeckel, 1879.
Obelia longissima Linko 1911: 231-238, fig. 44; Kudelin 1914: 469; Stechow 1923b: 7; Johnson and Snook 1935: 61, fig. 44; Fraser 1937: 88-89, pl. 18, fig. 92; 1948: 215; Ricketts and Calvin 1950: 415; Ralph 1956: 283; 1957: 831–832, figs 4j, k, 5a-h; Yamada 1959: 42; Miller and Batt 1973: 41, 125, fig. 25; Morton and Miller 1973: 152, fig. 54, no. 5; Gordon and Ballantine 1977: 100; Rho and Park 1980: 21–22, pl. 3, figs 4–6; Kozloff 1983: 49; Austin 1985: 53; Cornelius 1990: 557–564, figs 5–6; Cornelius and Ryland 1990: 134, fig. 4.11; Park 1990: 79; 1992: 288; Bouillon *et al*., 1995: 85; Cornelius 1995b: 304–308, fig. 71; Park 1995: 12.

Description
Obelia longissima is easily distinguishable from other members of this genus by the formation of its stem. It forms a series of internodes that are zig-zag in their arrangement, and it is jointed at each bend. There are several annulations after each joint. Presently under each joint the internodes are thickened on alternate sides, forming a 'shelf' for the support of ringed pedicels which in turn, support the hydrothecae. The hydrothecae are obconical in shape and have a smooth outer margin.
Polyp stage is permanently attached to their substrate but, very, they can be pelagic. Hydranth, with an apical mouth surrounded by tentacles. Aboral tentacles, scattered or in one or several whorls. Sometimes, tentacle arrangement is asymmetrical. The number of tentacles differs greatly, mostly oscillating between 8 and 50, sometimes less; very the number of tentacles is much higher, as in some solitary polyps.

Distribution: Cosmopolitan.

Habitat: Predominately sub tidal species, intertidal representatives being constrained to low shore pools. Polyp stage found as a delicate fur-like growth on the rocks, stones, mollusc shells, and sea weeds. Usually grows on kelp fronds, in conditions of moderate wave exposure.

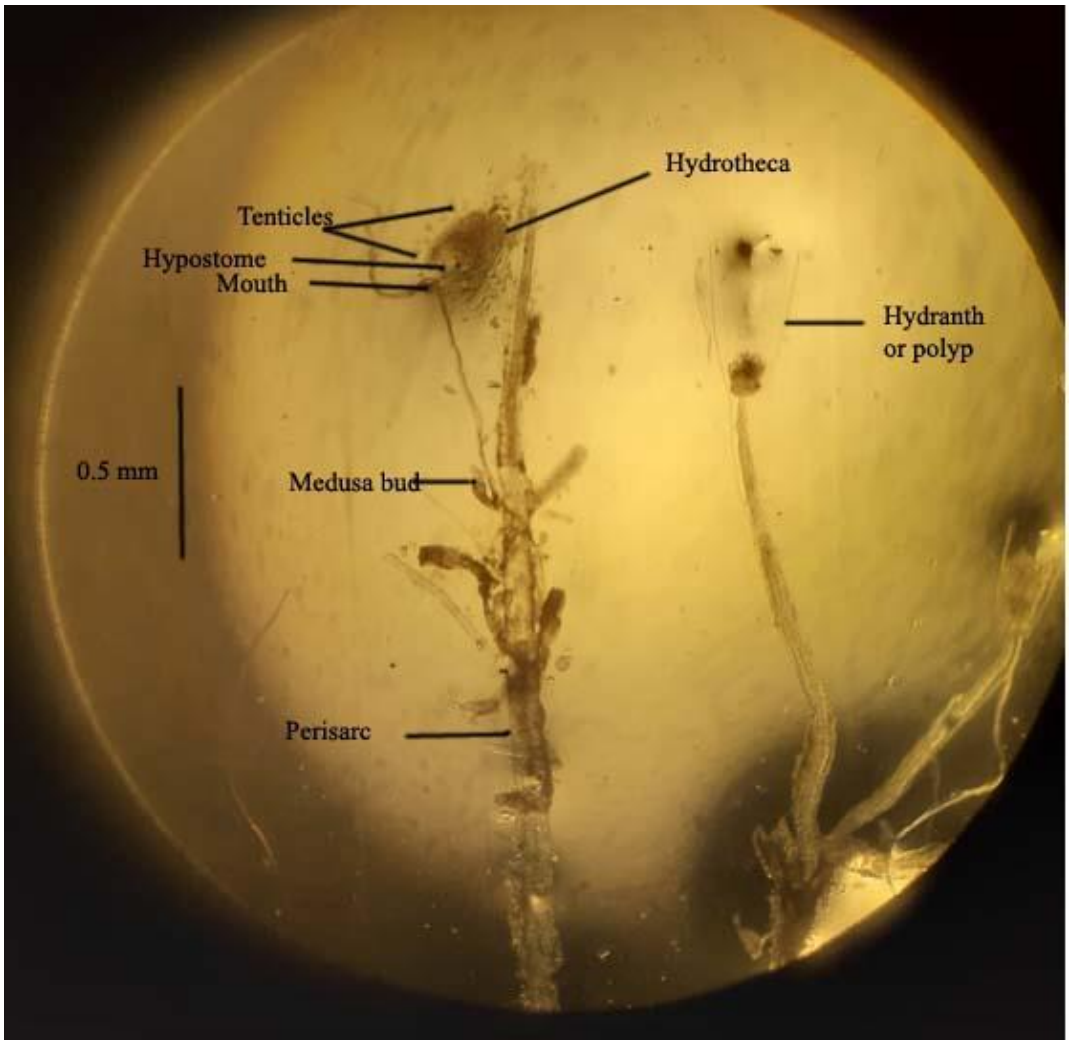

Fig 3: *Obelia longissima* (Pallas, 1766)

Conclusion

The life cycle of *Obelia geniculata* (Linnaeus, 1758) and *Obelia longissima* (Pallas, 1766) includes free-living medusa, planula, and sessile colonial polyp stages. The class Hydrozoa has a life cycle in which a sexually reproducing, free swimming medusa phase alternates with an asexually reproducing sessile hydroid stage. The latter often exists as a colony, which can be as well male or female, giving rise by asexual reproduction to male or female medusae, in that order. Despite that members of the class Hydrozoa are quite unimposing, at both phases of the life cycle they are both predators and prey in marine food web, so they are playing an important role in ocean ecology between the plankton and the benthos [44].

Hydroid species modified to a wide disparity in environmental factors and with cosmopolitan distributions tend to be more tolerant of polluted waters [44, 45] other than that *Obelia longissima* and other *Obelia* species are important members of fouling communities [45, 46].

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