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First record and description of marine flatworm *Pseudoceros susanae* (Newman & Anderson, 1997) from Indian mainland

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Abstract
Pseudoceros susanae belongs to the order Polycladida in the phylum Platyhelminthes, has been reported for the first time from South Saurashtra coast of Gujarat, India. The *Pseudoceros susanae* found distributed to coastal areas like, the Chhara, Mul Dwarka, Dhamlej, Sutrapada, and Veraval coasts. Identification was mostly based on external morphological characteristics, with a particular on their live colors and patterns. This work reveals that polyclads are significantly different in Gujarat, as well as require for more research using both morphological and genetic information to identify their identities.

Keywords: flatworm, polycladida, *Pseudoceros*, Saurashtra coast

Introduction

The coastline of Gujarat is longest among Indian states, extending up to 1650 km, constituting about 21% of the Indian coastline (Parikh *et al*. 2019) [16]. The Saurashtra coast is a part of the coastal Kathiawar Peninsula of the Indian subcontinent, located in the southwestern region of Gujarat State (India), and stretches over 865 kilometers. The South Saurashtra coastline from Dwarka to Diu is approximately 300 kilometers long, featuring rocky-sandy and rocky-muddy intertidal zones. This coastline of intertidal zone is defined by structural changes in substratum such as bare rocky areas, areas with algal cover, uneven rocky areas with more pools and fissures, and so on. These environments all have their own assemblage structure (Branch, 1986). Turbellaria is a class of free-living benthic organisms found in both marine and freshwater settings. Polyclads are marine turbellarians, except for the genera Limnostylochus and Limnoplana, all polyclads are marine that belong to the phylum Platyhelminthes, clade Rhabditophora, order Polycladida, which consists of wide flattened forms that are generally smooth, free-living, entirely marine, and usually bottom dwellers (sometimes swimming). Their ciliary motion causes them to glide along the substratum. Because this carnivorous unsegmented flatworm lacks a skeletal structure, it is soft and flexible, allowing it to access nearly all cracks and crevices in the reef (Ehlers, 1986) [4]. Although they have been observed in temperate and deep-sea conditions, they are the most colourful and elegant species found in tropical shallow water and intertidal regions (Quiroga, Bolanos and Litvaitis 2006; Faubel 1983) [20, 5]. Anatomically, these polyclads have a branching and uneven stomach, as well as a plicatus a pharynx. Traditional classifications primarily put taxa with minimal phylogenetic inference in the order Polycladida, which has around 800 identified species (Tyler *et al*., 2006–2018) [21]. Polyclade research have been ignored in India, and little is known about their variety on the east and west coastlines. Earlier research on polyclad worms was done by (Lang (1884) [14], Woodworth (1898) [22], Haswell (1907) [6], Yeri and Kaburaki (1918) [23] and Bresslau (1933)). Marcus (1950) [15], Hyman (1939, 1954a&b, 1955, 1959) [7, 8, 9, 10] and Prudhoe (1985, 1989) [18, 19] also significantly contributed to the taxonomy of polyclads. A few recent investigations, mostly from the coral reefs of Lakshadweep Island, India, have reported this species (Deepak and Reshma, 2011).

The present study report *Pseudoceros susanae* for the first time from the Saurashtra coastline, Gujarat state. Photographs of live specimens were recorded in the field to capture the true colors. The color patterns are described using living specimens. Identification is only based on exterior morphology and color patterns, with the assistance of the aforementioned literature and web sources.

Methodology

The specimens were observed on rocky littoral zone of Chhara (20°44'38.53"N, 70°43'22.06"E), Mul Dwarka (20°46'8.04"N, 70°39'58.65"E), Dhamlej (20°46'38.58"N, 70°36'36.89"E), Sutrapada (20°50'17"N, 70°29'14"E) and Veraval (20°54'36"N, 70°20'23"E) coast of Gujarat (Fig. 1). Identification was confirmed by Photographic evidence, luminous blue body, sometime degraded from white and going to the margin bright orange median

band less wide, with thin central white longitudinal line, two simple pseudo-tentacles in front, formed from the marginal folds of the body. Nomenclature followed as per WoRMS Editorial Board (2022).

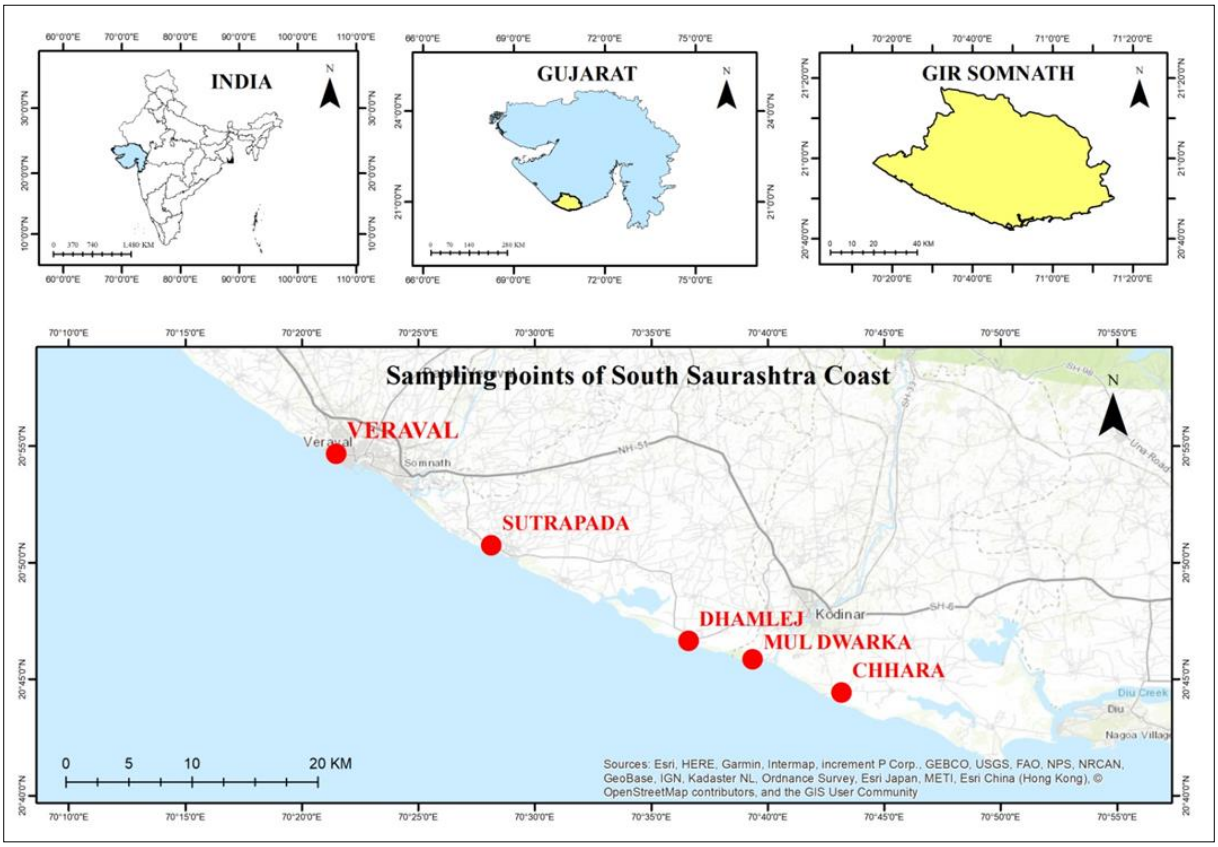

Fig 1: Geographical distribution of *Pseudoceros susanae* from Saurashtra Coast of Gujarat, India

Result and Discussion

The taxonomy of the *Pseudoceros susanae:*
Kingdom: Animalia
Phylum: Platyhelminthes
Order: Polycladida (Lang, 1884) [14]
Suborder: Cotylea (Lang, 1884) [14]
Family: Pseudocerotidae (Lang, 1884) [14]
Genus: Pseudoceros (Lang, 1884) [14]
Species: *Pseudoceros susanae* (Newman & Anderson, 1997)

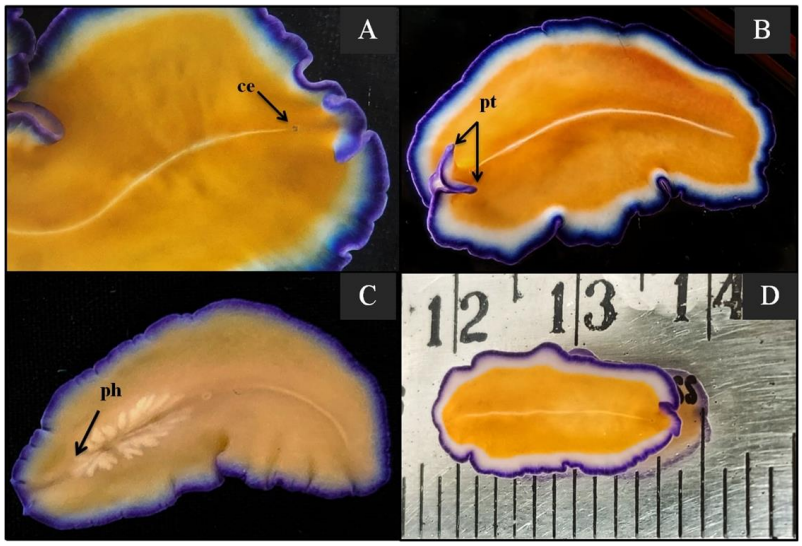

Fig 2: *Pseudoceros susanae* live animal; A-B, dorsal view; showing cerebral eyespot and pseudotentacles; C, ventral view showing the long folds of the pharynx extending posteriorly; D, scale bars; ; 2cm ; ce- cerebral eyespot, pt-pseudotentacles, ph- pharynx

Description

The body is elongated, with some ruffling on the edges. The background is a light blue to a beautiful sky blue, becoming deeper as it gets closer to the edges, bright orange on the dorsal surface with a white stripe in the mid-dorsal area, and a white band in the centre followed by a dark purple band on the border (Fig. 2). The orange region is bifurcated by a longitudinal white stripe that runs from the cerebral eyespot to the posterior edge, commencing prior to the cerebral eyespot and ending anterior to the posterior margin. In pictures, a tiny to large, deep purple marginal band that varies in width may seem brilliant red. Between the orange and blue parts, there is a variable white border, cream on the ventral side with a pale blue border, elongate-oval body with faint ruffles on the margins. Simple folds of the preceding margin are called pseudo-tentacles; they are blue with a dark purple ring, simple, pointy, and upright.

Habitat and Distribution

Pseudoceros susanae is one of, if not the most common, pseudocerotid flatworms found on Maldivian coral reefs, also documented from Komodo Island in Indonesia, Mahe Island in the Seychelles, Lakshadweep and west coast of India, Australia and Papua New Guinea. This is the new record from the Saurashtra coast, Gujarat.

Ecological role

Polyclads are known to prey on the communities they live in within the marine ecology. Polyclads are all carnivorous, acting as mesopredators on crustaceans, ascidians, gastropods, and shellfish (Jennings, 1957; Pérez-Portela and Turon, 2007; Aldana *et al*., 2016; Janiak *et al*., 2017) [12, 17, 1, 11]. Although polyclad diets are not always recognized, certain species have been reported to overcome secondary metabolites in their prey and may operate as specialized hunters (Kubanek, 1995) [13]. Flatworms' community consequences are unknown; however they have the potential to alter tiny invertebrate populations in the ecosystems they occupy, notably intertidal rock pools and benthic systems. Flatworms have been demonstrated to have an impact on the demography of sessile species like barnacles in some places, but only when higher trophic levels are absent, suggesting that their impact on their community is dynamic and complicated (Bolton, Clark and Johnston, 2019) [2].

Conclusion

The color pattern that distinguishes *Pseudoceros susanae* from other Pseudoceros is used to characterize and differentiate it. For specimens from the Chhara and Muldwarka, there were minor differences in color pattern. With further collection from various Indo-Pacific areas, the biogeography and variety in color pattern will become more obvious. The reports of these polyclad species on the Saurashtra coastline, which had previously not been documented from the Gujarat coastlines, clearly show the enormous gaps in the documenting of Gujarat's polyclad fauna. More surveys and studies are required to document fauna of India.

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