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Cover: Tamil Lacewing *Cethosia nietneri* with colour pencils and watercolours for the background; detailing with fine liners by Elakshi Mahika Molur.

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SHORT COMMUNICATION

First record of the sea slug *Lobiger serradifalci* (Calcara, 1840) (Gastropoda: Sacoglossa: Oxynoidae) from the Indian coast

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Abstract: The present study confirms the presence of a Sacoglossan (Mollusca) species, *Lobiger serradifalci* (Calcara, 1840), from India. The distribution of this species has not yet been documented in India. It has been reported from Turkey, Italy, France, Greece, Israel, and now, for the first time, from the western coast of India. *L. serradifalci* was discovered under green seaweeds in the lower intertidal zone. The species was found to remain hidden within various types of green seaweeds in the region. The study provides comprehensive details on its morphology, habitat, and taxonomy.

Keywords: Intertidal Sacoglossans, marine gastropods, sap-sucking sea slugs, western coast of India.

Gastropod molluscs, which comprise snails and slugs, are incredibly diversified in terms of species diversity, morphology, habitat, and numerous other characteristics. They have significant body plan differences and extend to freshwater, marine, and terrestrial habitats (Bieler 1992). Indian sea slugs were classified into 361 distinct species (Apte & Desai 2017), with an additional 33 species reported in the Gulf of Kachchh (Apte et al. 2010) and 24 species reported on a checklist from several islands and reefs in the Gulf of Kachchh of the Gujarat coast (Rao & Sastry 2005). There are 95 species found throughout the Gujarat coast; seven of these are found in Saurashtra (Poriya et al. 2015; Vadher et al. 2020). The food habits of gastropods include herbivores, omnivores, carnivores, and parasites, some of which drill through the shells of other animals to feed. One of the few examples of specialized herbivores in the marine environment is the fascinating clade of opisthobranch molluscs known as the Sacoglossans. Each sacoglossan species is generally associated with a single genus or species of macroalgae and shows a close evolutionary relationship with its algal host(s) (Krug 2011). Sacoglossa, also known as the "solar-powered sea slugs," are divided into two clades: the shelled families, Oxynooidea, and the shell-free families, Plakobranchacea (Handeler et al. 2009). The superfamily Oxynooidea comprises four families, including the Oxynoidae, which includes sea snails and bubble snails (Bouchet et al. 2005). Out of the three genera of the Oxynoidae family, *Lobiger* (Krohn 1847) comprises only five species: *L. nevilli* Pilsbry, 1896; *L. sagamiensis* Baba, 1952; *L. serradifalci* Calcara, 1840; *L. souverbii* P. Fischer, 1857; *and L. viridis* Pease, 1863 (MolluscaBase 2023). The present study marks the first record of *L. serradifalci* from the Indian coast, specifically along the Adri coast of Gujarat. Given its highly cryptic nature, the observation of *L. serradifalci* proves to be particularly challenging, especially when concealed beneath green algae. The elusive nature of *L. serradifalci,* combined with its habitats with green algae, imparts an added layer of difficulty to its discovery. The species' predominantly green coloration further camouflages

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it within its surroundings, making it one of the most challenging Sacoglossan species to discern in this coastal ecosystem. This research has provided information on the habitat, morphology, and systematics of this species.

Material and Method

The specimens of sacoglossans, referred to as the genus *Lobiger*, were occasionally observed in the intertidal zone of the coast during field visits. The specimen was collected from a tide pool on the Adri coast (21.60194 ˚ N, 70.47611 ˚E) on January 22, 2024 (Image 1A). The Adri coast is located on the west coast of India and has a mixed type of intertidal habitat with rocky outcrops studded with sand (Image 1B). The supratidal zone is covered with sand; the upper, middle, and lower intertidal zones are rocky-sandy. A single sample was collected, cleaned and preserved in a 10% buffered formalin solution. The morphological characteristics of the species were observed using a stereo zoom microscope (Model S.N.-391). The voucher specimen was deposited at the Museum of the Department of Zoology, Bahauddin Government Science College, Junagadh. Standard references were used for identification, including Calcara (1840), Gonor (1961), Thompson (1988), Jensen (1996), and Furfaro et al. (2020). We used the WoRMS database (2023) to determine this species' current taxonomic status on MolluscaBase.

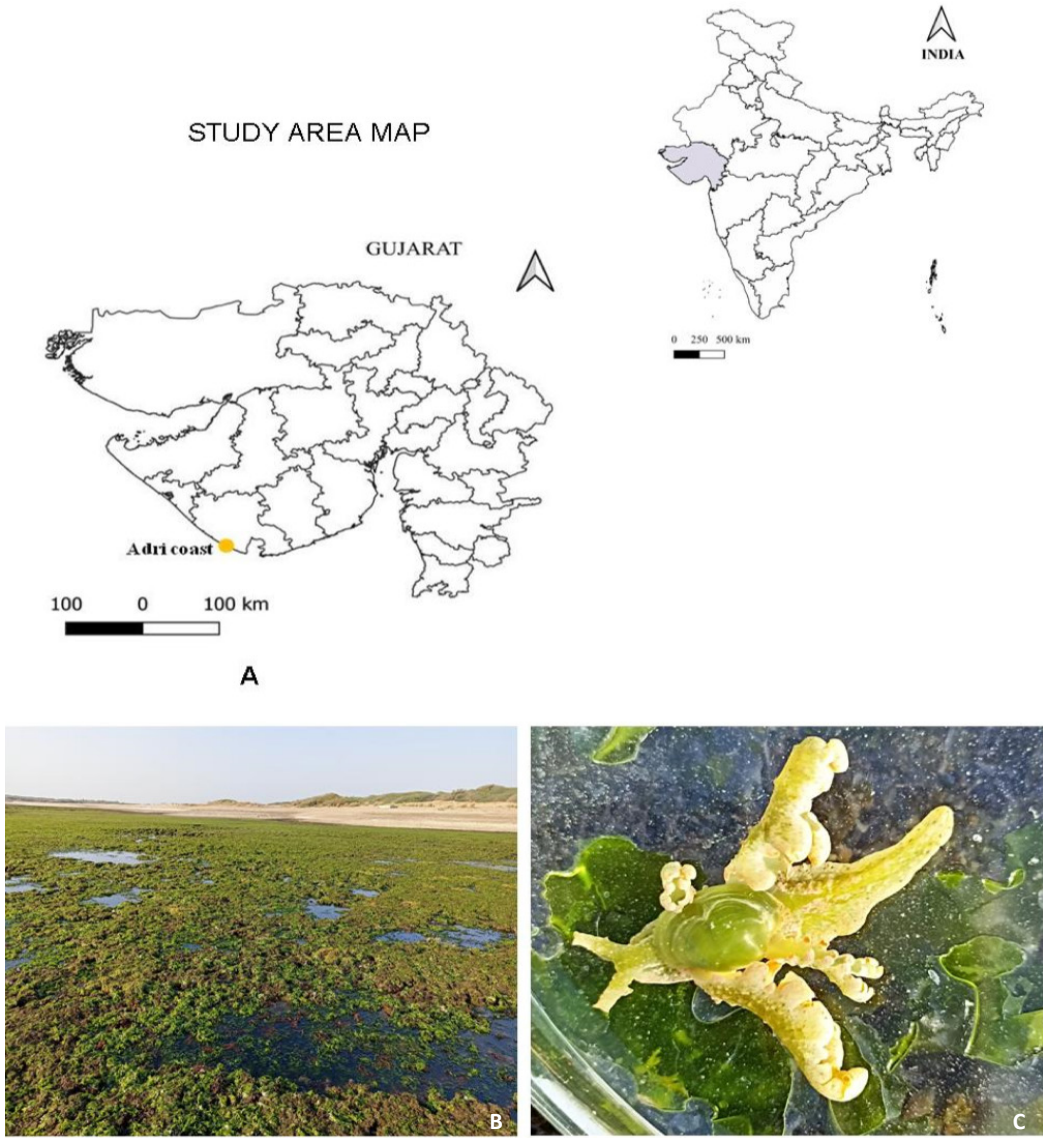

Image 1. A—Map of the study site, Adri Coast (Gujarat), western coast of India | B—Intertidal habitat | C—*Lobiger serradifalci* associated with green seaweed. © Dimpal Dodiya.

Results and Discussion

Systematics

Phylum: Mollusca Linnaeus, 1758
Class: Gastropoda Cuvier, 1797
Order: Sacoglossa Ihering, 1876
Family: Oxynoidae Stoliczka, 1868
Genus: *Lobiger* Krohn, 1847
Species: *Lobiger serradifalci* (Calcara, 1840)

Synonyms (taken from WoRMS)

Lobiger serradifalci (Calcara 1840), *Bulla serradifalci* (Calcara 1840), *Lobiger philippi* (Krohn, 1847)

Morphological Description

The specimen is 20 mm in length, with a light yellow coloration across its entire body and a greenish hue beneath the shell (Image 2B). The external shell is translucent, showing the clear grass-green colour of the underlying mantle and the rhinophores are one pair (Image 2A). There are a few scattered white papillae on the head and tentacles (Image 2A). The foot and perfectly smooth body were completely covered in green seaweed, indicating that the species prefers seaweed-covered rocky substrates. The two pairs of parapodia are large and small, smooth, stumpy, and flattened, with white on surface and green & yellow inside, almost invariably fused together, and have pinkish dorsal edges (Image 2A,B). The parapodia lobe is long compared to the shell, which is highly elevated and slightly tipped backward and the outer side is white with brown speckling (Image 2D). The foot's region features tubercles, and in addition, the tail has a median ridge covered by two comparative, less lateral ridges (Image 2A,C). The body sides are smoother than those above the level of the parapodia lobes and have less developed tubercles.

Habitat

The specimen was found beneath green seaweeds *Caulerpa racemosa* and *Ulva* Lactuca (Image 1C) in the lower intertidal zone, which had large, deep-tide pools and areas covered with various kinds of seaweed.

Geographical Distribution

The present study confirms the presence of *Lobiger serradifalci* on the Indian coast. It was first reported from the Bay of Palermo, Mediterranean Sea (Calcara 1840); the Turkish coast (Pruvot-Fols 1954); Palermo, Messina, Naples, Marseilles, the Balearic Islands, and Banyuls (Wirz-Mangold & Wyss, 1958); the Bay of Mersin (formerly Icel) in the Eastern Mediterranean and on the southern coast of Turkey (Swennen 1961); Villefranche-sur-Mer (Alpes-Maritimes), France (Gonor 1961); Israel (Barash & Danin 1982); Taranto (Perrone 1983); Aghios Andreas (Ionian Sea), Greece (Thompson 1988); the Salento Peninsula in Southeast Italy (Furfaro et al. 2020).

Remarks

The morphological characteristics of *L. serradifalci* align with previous observations made by Thompson (1988). Externally, *L. serradifalci* bears a resemblance to the *Lobiger souverbii* species, as both inhabit *Caulerpa* fronds and exhibit an elongated green body with a shell (Marcus 1977; Jensen & Clark 1983). *L. serradifalci* has a light grass-green body, flattened & in-rolled parapodia, and a pink-white exterior with brown speckling. In contrast, *L. souverbii* presents distinctive morphological features, including parapodial margins that are red with dots. The mantle is yellowish-green in color beneath its transparent shell, with several shorter blue lines scattered throughout the dorsal surface. *L. souverbii* also possesses two pairs of long, upright parapodia (Ichikawa 1993). *L. serradifalci* resembles another saccoglossan species, *Lobiger viridis*. Its whole body is bright yellow in colour and one pair of short rhinophores are present above the animal's mouth. Species have been commonly found on the Indian coast, like Poshitra Reef, Ashaba Island, the Gulf of Kachchh, and Andaman Island (Parasharya 2012; Apte & Desai 2017). It is possible that *L. serradifalci* is present in intertidal habitats but due to its close resemblance, it may have been overlooked and misidentified as *L. viridis* in a previous study.

The earliest study indicated *Caulerpa racemosa* as food of *L. serradifalci* (Marcus 1977; Jensen & Clark 1983). Few studies have also reported the phylogenetic relationship between Sacoglossans and their food plants (Kay 1968; Clark & Busacca 1978). All shelled Sacoglossans use *Caulerpa sp.* as their main food source, which demonstrates the phylogenetic relationships between Sacoglossa and their food plants (Jensen 1997; Parsons 1994). *L. serradifalci* also uses *Caulerpa* sp. (Swennen 1961), including *Caulerpa prolifera* (Gonor 1961; Gavagnin et al. 1994), and *C. racemosa* (Marcus 1977; Jensen & Clark 1983) as a main food source. During the present study, species were also found beneath the green seaweed *C. racemosa* habitat in the lower intertidal zone of the Adri coast.

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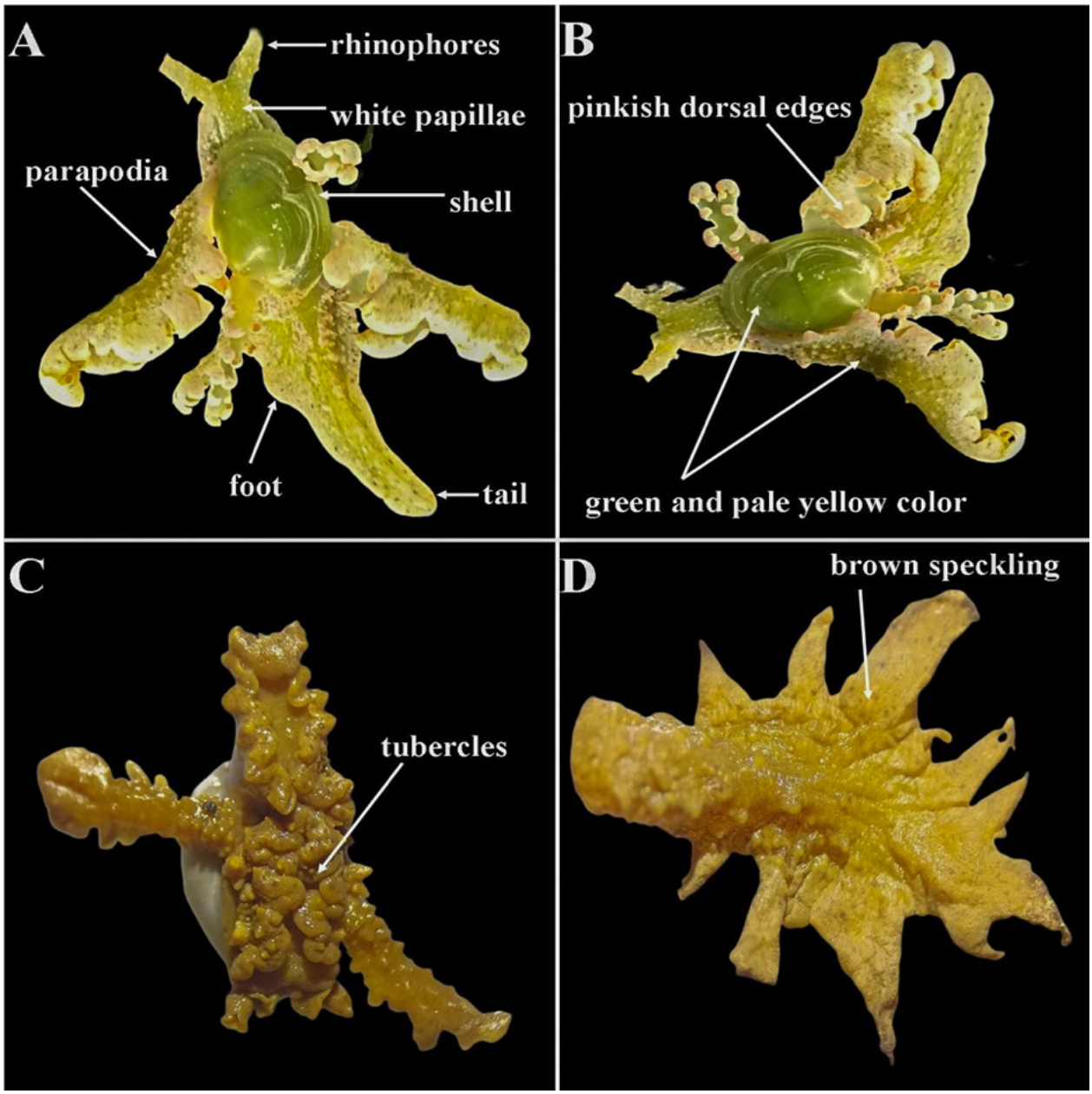

Image 2. ***Lobiger serradifalci*** **specimen: A—dorsal view, morphological characters (rhinophores, white papillae, parapodia, shell, foot, tail) | B—pinkish dorsal edges, green and pale yellow color | C—tubercles | D—brown speckling. © Dimpal Dodiya.**

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