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First Record of Sea Urchin *Temnopleurus toreumaticus* (Leske 1778) (Echinoidea: Temnopleuridae) from Estuaries of West Coast of India

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***Abstract*:** Sea urchins are spiny marine benthic organisms under the phylum Echinodermata. Being marine organisms, the larvae are often transported to estuaries by waves and settle on finding a suitable location to mark their presence in estuaries. The present paper deals with the first record of sea urchin *Temnopleurus toreumaticus* from two estuaries along the West coast of India along with its possible implications. Specimens were collected from the upper stretch of Valappattanam (16km from the estuarine mouth) and Dharmadam (7km from the estuarine mouth) estuaries with the salinity ranging from 23 to 35 ppt. The intrusion of saline waters through tidal flux is the major factor for the migration of sea urchins towards the upstream of the estuary. Further studies regarding the settlement and proliferation of sea urchins in estuaries are required to delineate the possible management strategies.

***Keywords*:** Sea urchin, *Temnopleurus toreumaticus,* Estuaries, Salinity intrusion, South West coast India

Sea urchins belong to the class Echinoid which shows pentaradial symmetry and moves using hundreds of tiny tube feet (Raghunathan et al 2012). A total of 138 species of echinoids were reported from all over India (Samuel et al 2017) including sea urchins. Most of them are marine, being intertidal inhabiting chiefly on coral reefs, sandy beaches, muddy flats, and rocky coasts but rarely found in estuaries also. Studies on echinoderms from the Indian estuaries were very few in number and most are from the east coast. The notable works include Naveen Kumar and Raghunathan (2018) from Hoogly-Matlah and Godavari estuary, Mitra et al (2010) from the Subarnarekha estuary, Mahapatro et al (2011) from the Brahmani-Baitarani, Sastry (2008) from Krishna estuary and Kankal and Warudkar (2012) from the Pennar estuary. Indian estuaries represent 3.60 and 0.37% of the total echinoderm species reported in India and the world respectively (Naveen Kumar and Raghunathan 2018). Out of 28 species reported from Indian estuaries under the phylum Echinodermata, only 6 species (*Chaetodiadema granulatum, Temnopleurus toreumaticus, Echinus sp. Clypeaster rarispinus, Laganum decagonale* and *Sculpsitechinus auritus*) belongs to the class Echinoidea. *Temnopleurus toreumaticus* commonly known as striped spine sea urchin is commonly distributed along the coastal waters of India (Usha 2016). It has also been reported from three estuaries along the east coast of India viz., Hoogly Matlah and Godavari estuary(Naveen Kumar and Raghunathan 2018) and Subarnarekha estuary (Mithra et al 2010). This paper records the first-ever report on the unusual incidence of *Temnopleurus toreumaticus* in the upper reaches of two tropical estuaries along the southwest coast of India. The probable causes for the occurrence of this species in the upper estuary and its implications on local fisheries were also discussed.

MATERIAL AND METHODS

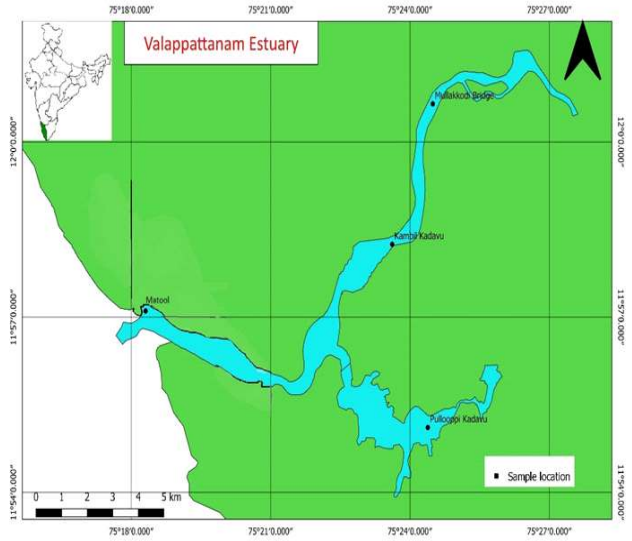
Study area: The incidence of sea urchins was observed during pre-monsoon months (March to May 2022) from the Valappattanam (VAL) (Lat 11°94'99" N, 75°30'14" E) and the Dharmadam estuary (DHA) (Lat 11°48'28"N, 75°27'35"E (Fig. 1a-b) of the Kannur district, North Kerala. The study was conducted in a regular exploratory survey as part of the doctoral research project. The occurrence of sea urchins was observed from 6 sampling locations in VAL and DHA estuary (four from the VAL estuary: Matool, Pulloppi Kadavu, Kambil Kadavu, and Mullakodi Bridge and two from the DHA estuary - Dharmadam Bridge and Parapram Bridge).

Sample collection: The samples were collected through the fishing operations conducted in the region. Major crafts used were plank-built canoes and dug-out canoes which two fishermen can accommodate. Sea urchins were generally caught as bycatch from bottom set gillnets of 18-150 mm mesh size, 70-200m length, which is soaked 4 hours per day, and shore seine 12-26 mm mesh size, length 24-58m which is operated 3-4 hours per day. Salinity was measured from each station by the refractometer (ERMA Japan) with an accuracy of ±0.001 and the reading was measured in ppt. The collected samples were brought to the lab for further detailed morphological and anatomical observation. Taxonomic identification was carried out following the keys of Hedge and Rivonker (2013). By interacting with the local fisherman, information on various implications of the incidence of sea urchins in the estuary was collected.

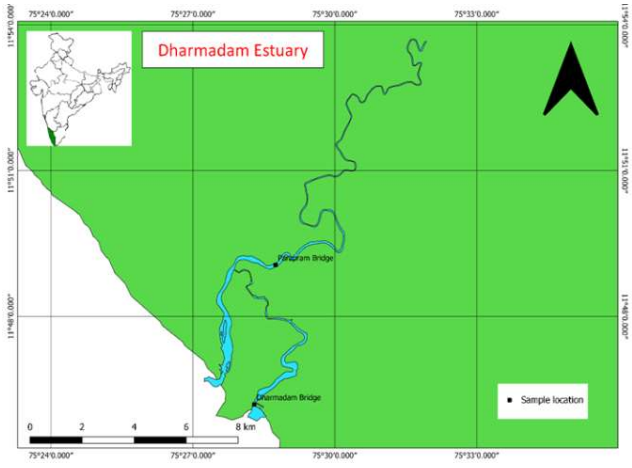
RESULTS AND DISCUSSION

An unusual incidence of sea urchin *Temnopleurus toreumaticus* (Fig. 2 a-b) was observed at the upper stretch of VAL estuary (16 km from the estuarine mouth) and DHA estuary (7 km from the estuarine

mouth) during the pre-monsoon season (March-May 2022). The organisms were encountered in the bottom set gill net (100-150 mm mesh size, 70-200m length) and shore seine (12-26 mm mesh size and length 24-58m) operated for 3-4 hrs. The salinity near the estuarine mouth region (Matool and Dharmadam Bridge) was 30-35ppt and depth 3-5m. Whereas the salinity and depth vary between 23-27ppt and 3-6m at the upper stretches (Pullooppi Kadavu, Kambil Kadavu Mullakkodi bridge, and Parapram bridge) of both VAL and DHA estuaries. The occurrence of this marine species in the upper stretch of the estuary can be attributed to the intrusion of coastal waters into the estuaries during the Pre-monsoon season. The main factors affecting salinity intrusion in the VAL River are the topography (due to unsystematic dredging), the sea level variation, an increase in temperature, and decrease in precipitation (Arunraj and Vasudeo 2015).



a. Valapattanam estuary



b. Dharmadam estuary

Fig. 1. Location of *Temnopleurus toreumaticus* observed in Valapattanam and Dharmadam estuaries

Temnopleurus torumaticus is widely distributed among, Singapore, Madagascar, East Africa the Persian Gulf, the Red Sea, Japan, and on the east coast of Australia (Kroh et al 2011, Sastry 2012, Jeffrey 2015, Sonet et al 2022). Earlier reports from Indian coastal waters show that this species is widely distributed and inhabits sandy and muddy substrata between 5-40 m in depth (Sastry 2012, Usha 2016) (Table 1).

Species Classification and Description

Class: Echinoidea Leske 1778
Subclass: Euechinoidea Bronn 1860
Superorder: Camarodonta Jackson 1912
Order: Temnopleuroida Mortensen 1942
Infraorder: Temnopleuridea Kroh & Smith 2010
Family: Temnopleuridae A. Agassiz 1872
Genus: *Temnopleurus*
Species: *Torumaticus*

Long-spined urchin, with a diameter of about 3-5 cm and height of 1.5-2.5 cm. Primary spines are long, equal to half of the horizontal test diameter, banded with reddish or brown colour bands, and pore-pairs arranged in arcs. The test is Dome-shaped, well sculptured with

a

b

Fig. 2. a. Oral-aboral view of the specimen. b. Discarded by catch species *Temnopleurus toreumaticus* on shore at Matool station (near bar mouth) of Valapattanam estuary

Table 1. Ecological attributes of *Temnopleurus toreumaticus* globally, in other Indian estuaries, and in the present study

Attributes	Global range	Other Indian East Coast Estuaries	Present study
Species	*Temnopleurus toreumaticus*	*Temnopleurus toreumaticus*	*Temnopleurus toreumaticus*
Salinity	20-35ppt	30-35ppt	23-35 ppt
Temp	10-30°c	Not available	29-30.5°c
pH	7.5-8.5	Not available	7.5-8.5
Depth	0-79m	Not available	0-6m
Habitat	Rocky shore, estuaries, sandy and muddy bottoms.	Mostly at Barmouth. Inhabits sandy, muddy, and rocky bottoms	Estuary, rocky, sandy, and muddy bottoms.
References	Nateghi et al 2016	Hoogly-matlah estuary, Godavari estuary (Naveen Kumar and Raghunathan 2018) Subarnarekha estuary (Mithra et al 2010)	Valapattanam and Dharmadam estuary.

a convex aboral surface. The test comprises five pairs of alternately placed ambulacral and interambulacral plates placed at about the level of the ambulacral plates. Ambulacral plates are compound trigeminate, their pore-pairs bearing numerous tube feet (in living specimens). The test Color is Olive green to dark grey. It is covered with soft skin and comprises five pairs of buccal plates. Periproct is roughly circular.

The landings of Sea urchins as bycatch occurs more during the summer season (Dinesh 2015, Hegde and Rivonker 2013). Sea urchin spawning and proliferation may be enhanced by higher water temperatures during summer months along with the reduced predator's abundance (such as fish) caused by intensive fishing (Hereu et al 2012). A significant amount of sea urchin in India is landed by commercial fisheries as bycatch (Saravanan et al 2018). In the present study *Temnopleurus toreumaticus* are mostly caught as bycatch from shore seine (marine) and bottom set gill nets (estuary). The peak spawning period of this particular species was found during December (Saravan et al 2017). The larvae of *Temonopleurus toreumaticus* metamorphosis into juveniles 30 days after fertilization (Kitazawa et al 2014). Chemical cues from rocky areas and the turbulent environment help sea urchin larvae to drift and find a suitable environment for settling (Gaylord et al 2013). Both VAL and DHA estuaries have hard substratum which may also be a favourable factor for the mass settlement of sea urchins in the regions. Based on the opinions of fishermen, sea urchins are been caught as bycatch in recent years making it difficult for them to sort fish from the nets once get entangled. An average of 10-15 sea urchins get caught in each net during this particular proliferation period (pre-monsoon time). Sea urchins may seem harmless due to their sedentary nature but have the potency to sting humans using their long venomous spines when stepped on them accidentally. Stings cause severe pain and swell when the edge of the spine is broken and left inside the skin. A rinsing with methylated spirit and hot water may help in providing relief from the pain and immobilize the affected area of the body (James et al 2010).

Sea urchins demonstrate physiological and dietary flexibility, whereby individuals can make metabolic and behavioral adjustments, or switch to alternative foods (e.g., drift algae, turfing algae, invertebrates, detritus) when preferred food is scarce (Ling and Johnson 2009, Suskiewicz and Johnson 2017). *Temnopleurus toreumatics* mostly feeds on green seaweed *Caulerapa peltate* and *C.serulata* and seagrasses *Cymodocea serrulata* and *Syringodium isoetifolium* (Saravanan 2022). Even though most overgrazing events seem to affect areas of <0.5km^{2}it can cause long-term effects such as decreased sediment stabilization, reduction of algal beds and associated fauna. This can eventually alter the food web structure if left unnoticed. Factors influencing overgrazing include bottom-up (nutrient enrichment), top-down (reduced predation control due to e.g., overfishing), "side-in" mechanisms (e.g., changes in water temperature), and natural population fluctuations (Eklof et al 2008).

CONCLUSION

The present communication deals with the incidence of long-spined sea urchin *Temnopleurus toreumaticus* (Leske 1778) from the upper stretches of VAL and DHA estuaries of Kerala along the southwest coast of India during pre-monsoon months. The salinity intrusion during the pre-monsoon period is the major factor for the migration of sea urchins towards the upstream of the estuary. Fisherfolks find very difficult to remove once they are caught on the net accidentally. Despite the numerous ecological role sea urchin provides to the ecosystem; excess settlement causes reduction in algal beds which indirectly affects the fishes which depend on them. This can even result in an ecological shift if overlooked. The study recommends strong monitoring system during the occurrence of this seasonal occurrence.

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AUTHORS CONTRIBUTION

Swetha KC: Sample collection, analysis, conceptualisation, and manuscript preparation, Jayalakshmi KJ: Overall supervision, conceptualisation, and review, Usha Parameswaran: Identification of Sample , Sreekanth GB: Review and editing.

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