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Short Communication

Mass mortality of regular sea urchin *Salmacis virgulata* L. Agassiz and Desor, 1846 at Dhanushkodi, Southeast coast of Tamil Nadu, Gulf of Mannar, India

C H Ramesh, S Koushik, T Shunmugaraj & M V Ramana Murthy

National Centre for Coastal Research (NCCR),
NCCR Field Office, Ministry of Earth Sciences (MoES),
Mandapam – 623 519, Tamil Nadu, India

*[E-mail: chrameshpu@gmail.com]

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Mass mortality of sea urchin, *Salmacis virgulata* scattered over the periphery of Dhanushkodi beach, was observed on February 13, 2019. More than 100 numbers of recently dead and dying specimens were found within a 10 m^2 area on the sandy beach. Beach profiles indicated several hundreds of exoskeletons of previously dead *S. virgulata* were washed ashore and buried in sand and withering seagrass. The causative agent responsible for mass mortality of *S. virgulata* is yet to be discovered. However, observations on wave approach toward shore indicated possible evidence that it could be due to a combination of strong nearshore waves and currents. This observation raises a critical research concern to investigate etiology of *S. virgulata* for species conservation.

[**Keywords**: Dhanushkodi, Gulf of Mannar, Mass mortality, *Salmacis virgulata*]

Introduction

Sea urchins are the important grazing animal communities in shallow and deeper marine waters and are the well-studied echinoderms for their ecological significance in reef and seagrass ecosystems[1]. These echinoids play a significant role in structuring both the primary producers and consumer components in the reef ecosystem[2]. The gonads of sea urchin are an excellent source of “roe” for food delicacy in Japan and France[3]. So far, 105 sea urchin species are reported from India’s east coast and 30 species from Tamil Nadu coast[3]. Among these, the most common and abundant sea urchin in the Bay of Bengal is the regular sea urchin *Salmacis virgulata*[4] contributing to 70 % of echinoid landings at Mandapam[3]. This species has been well studied in the Indian context compared to purple sea urchin *Strongylocentrotus purpuratus*, which was studied elsewhere[1].

Salmacis virgulata is reportedly contained high fatty acid concentration (39.56 mg), mainly alpha-linoleic acid (53.26 %), vitamins (C, A, D, E, B1, B2, B5, B6, B12), chemical elements K, Cu, Fe, and Zn[5] and essential amino acids like Isoleucine, Leucine, Lysine Methionine, Phenylalanine, Threonine, Tryptophan, Valine and Histidine[6]. This species also displayed potential antibacterial activity against *Salmonella typhi*, *Proteus mirabilis*, *Vibrio cholerae* and *Proteus vulgaris*; antifungal activity against *Aspergillus niger*, *Candida albicans* and *Penicillium citrinum* and also higher antioxidant activity (77.51 %)[7]. Such a vital marine component and food source of coastal waters are recently found to die in a larger amount on the sandy beach of Dhanushkodi. In this study, mass mortality of *S. virgulata* at Dhanushkodi was observed and discussed the possible causes of this mortality.

Materials and Methods

Study area, Dhanushkodi (09°08’54.57” N, 079°26’58.34” E) is situated to the South-East of Rameswaram and extends about 18 miles far to the west of Talaimannar, Sri Lanka. A shoreline survey was conducted on February 13, 2019, at Dhanushkodi to investigate the beach profile changes occurring at the Gulf of Mannar and Palk Bay channel interface. Satellite images also clearly indicated the beach’s extension due to sediment deposition over some time through highly triggering wave action, currents, and heavy wind speed (Fig. 1). In such area, the mass mortality of *S. virgulata* was observed.

Results and Discussion

Over hundreds of dead and dying specimens were sighted at Dhanushkodi beach, southeast coast of India (Fig. 2). There were no signs of epizootic infections on *S. virgulata* exoskeletons. Fishing activities are also prohibited here and are controlled by local police, suggesting that this incident was not due to fishing related activities. The arrangement pattern of dead specimens of *S. virgulata* onshore indicated that they might be washed ashore by strong waves and currents. Heavy wind speed, intense wave action, and sediment transportation are observed during this study (Fig. 3). There are no pieces of evidence or signs of pollution, algal blooms, boat activities, and other dead marine animals. Any bad

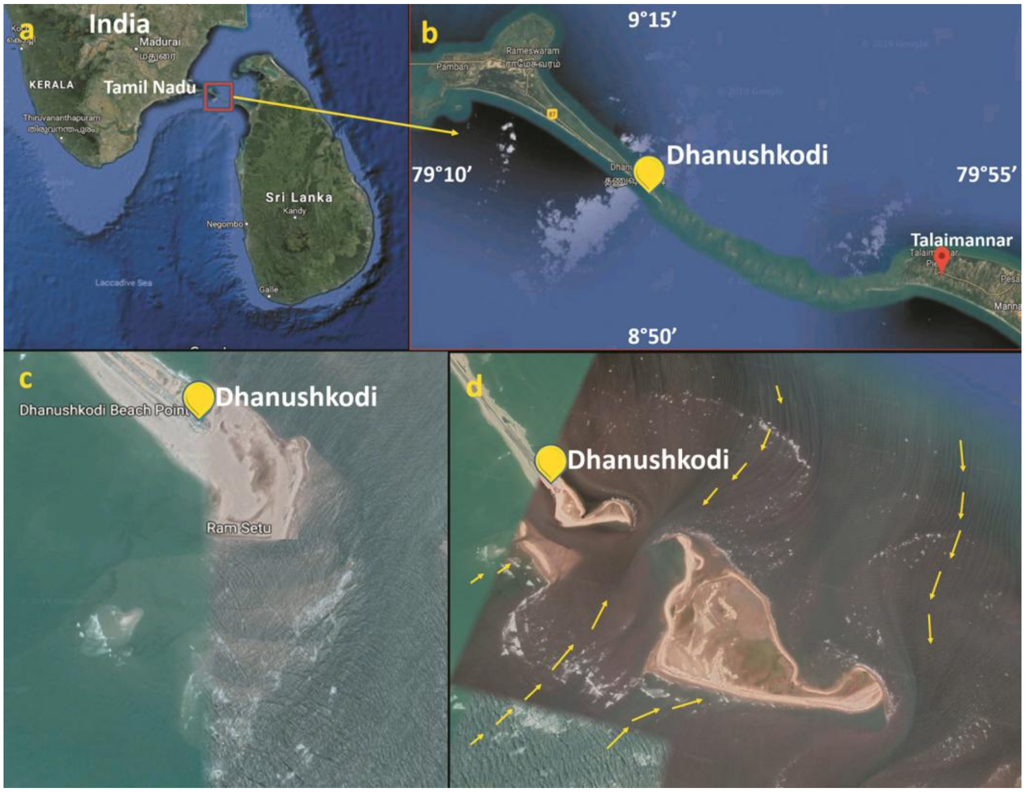

Fig. 1 — (a) Study area, Dhanushkodi between India and Sri Lanka; (b) Dhanushkodi at Gulf of Mannar and Palk Bay connecting channel; (c) Aerial view of Dhanushkodi beach few years ago; and (d) Dhanushkodi during 2020 showing extended beach due to sediment deposition caused by wind waves (yellow arrow marks) and intense current patterns.

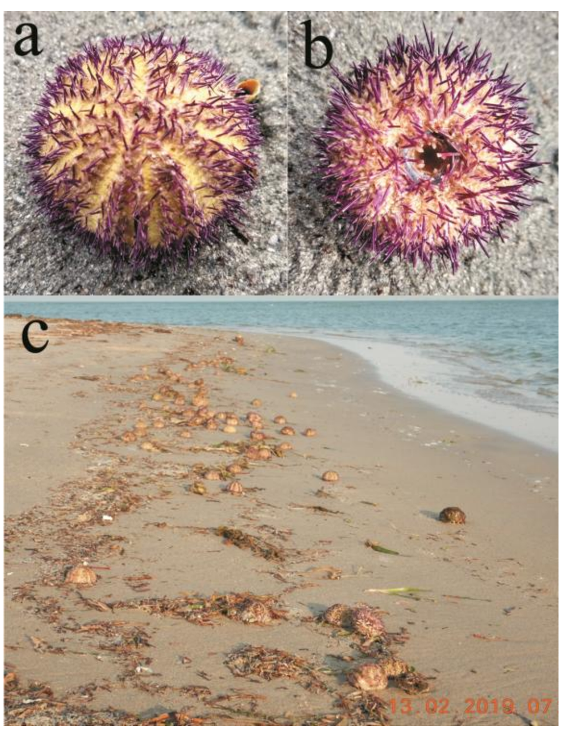

Fig. 2 — (a) Dorsal and (b) ventral views of *S. virgulata*; and (c) mass mortality of *S. virgulata* on sandy beach

odour or anomalies from the dead specimens was also not noticed. Dead specimens of *S. virgulata* were found to be eaten by seagulls. The previously washed ashore specimens of dead *S. virgulata* and seagrass *Cymodocea* sp. at the study site strongly indicated that this area is strongly affected by the waves and current pattern. Previously, many drowning incidents were also reported from the Dhanushkodi beach. Because of rough sea conditions, fishing activities are prohibited to avoid drowning incidents. The gradual changes in beach morphology also support the impact of waves and currents on this study site (Figs. 1c & d). Therefore, we infer that the mortality was not due to the waterborne virulent pathogens. However, pathological investigations on these specimens are underway to analyze the microbial communities associated with *S. virgulata*.

A brief review of the mass mortality of different sea urchin species revealed various reasons for die-off, including disease, pollution, storms, osmotic shock, and unknown causes (Table 1). *Diadema* and *Strongylocentrotus* species have reportedly experienced mass mortality events due to pollution,

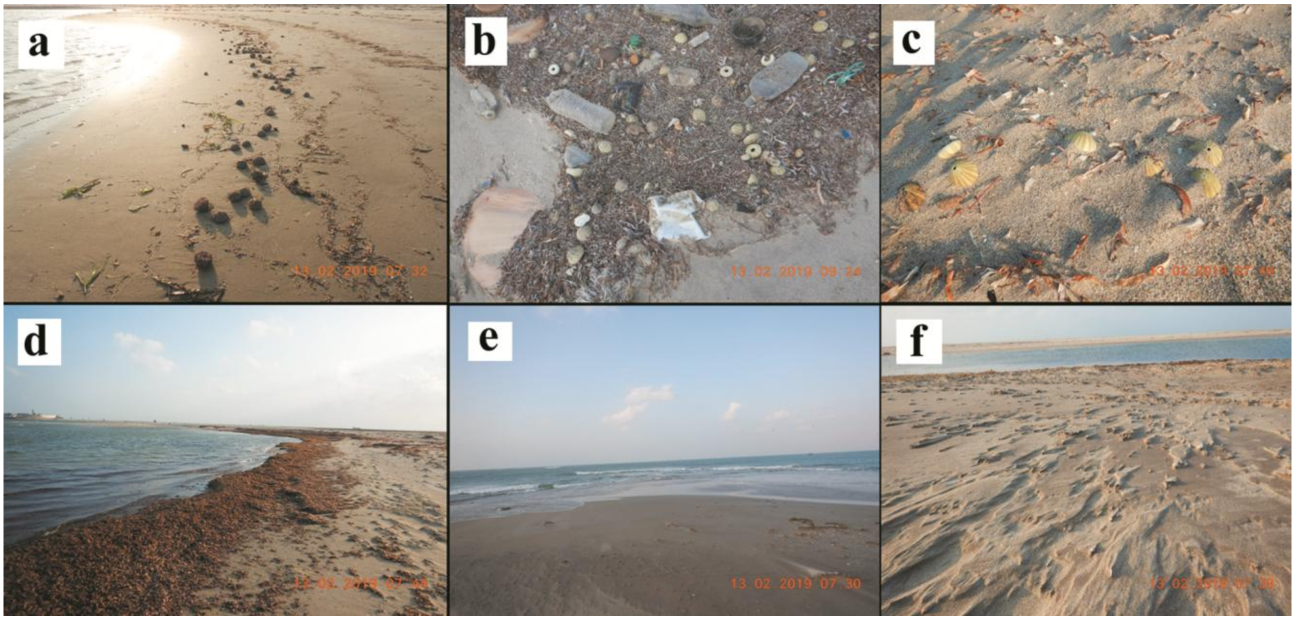

Fig. 3 — (a) Recently dead specimens of *S. virgulata* at Dhanushkodi beach; (b) spineless and bare test of previously dead samples of *S. virgulata* mixed with washed ashore seagrass; (c) sediment buried bare test of previously dead *S. virgulata*; (d) washed ashore seagrass *Cymodocea* sp.; (e) triangular approach of rough waves at the study site; and (f) hardened sand indicating the effect of wind on sediment transport.

Table 1 — Mass mortality of different species of sea urchins in around the world

S. No	Species mortality	Geographical area	Likely cause of mortality	Month & Year	Reference
1.	*Diadema antillarum*	Jamaica	Pathological	1983	Hughes *et al*.[8]
2.	*Diadema antillarum*	Caribbean	Unknown causative agent	1983-1984	Carpenter[2]
3.	*Diadema antillarum*	Puerto Rico		1996	Weil *et al*.[9]
4.	*Diadema mexicanum*	Western Mexico	Disease	May, 2009	Benitez-Villalobos *et al*[10]
5.	*Strongylocentrotus purpuratus*	Northern California	Harmful algal bloom	August, 2011	Jurgens *et al*[11]
6.	*Strongylocentrotus purpuratus*	Malibu	Osmotic shock from low-salinity lagoon water & severe storm	2010-2011	Hendler[12]
7.	Sea urchin	Kamchatka coast, Russia	Storm or industrial waste discharges	October, 2013	Online
8.	Sea potatoes	Penzance beach, UK	Strong storms	August, 2018	Online
9.	*Salmacis virgulata*	Dhanushkodi, India	Strong currents and waves	February, 2019	Present study

diseases, currents, and storms (Table 1). The present study reports the first case report on mass mortality of *S. virgulata* from Dhanushkodi. Because of the rough waves and current patterns, the population of *S. virgulata* may continually face similar consequences in this geographical location.

The population density of benthic communities and abiotic parameters in this particular region needs to be assessed for understanding dramatic changes in population dynamics over time and possible factors responsible for such changes. The combined dynamics of winds, waves, and currents are potential issues that are not addressed well from this geographic area. In this unusual incident, a large amount of seagrasses was also found to be washed ashore on to beach (Fig. 3d). Large scale mortality of *S. virgulata* could be related to combination of strong currents and waves or else to unknown enzootic microbial infection. Further studies need to be performed to identify the pathogenic agents, if at all are responsible for *S. virgulata* mortality, subsequently to conserve the species and to predict the future consequences like this.

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Conflict of Interest

Authors do not have any conflict of interest to declare.

Author Contributions

CHR, SK, and TS did field surveys and wrote manuscript. TS & MVRM guided the project, edited and approved the manuscript.

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