



## Occurrence of *Oratosquilla oratoria* (De Haan, 1844) and *Oratosquillina gravieri* (Manning, 1978) from the trawl bycatches of Nagapattinam region, Tamil Nadu

S Santhoshkumar<sup>\*,a</sup>, P Jawahar<sup>b</sup>, B Sundaramoorthy<sup>c</sup>, N Jayakumar<sup>c</sup>, A Srinivasan<sup>b</sup> & A Subburaj<sup>a</sup>

<sup>a</sup>TNJFU - Dr. MGR Fisheries College and Research Institute, Thalainayeru, Nagapattinam – 614 712, Tamil Nadu, India

<sup>b</sup>Tamil Nadu Dr. J. Jayalithaa Fisheries University, Nagapattinam – 611 002, Tamil Nadu, India

<sup>c</sup> TNJFU - Fisheries College and Research Institute, Thoothukudi – 628 008, Tamil Nadu, India

\*[E-mail: s.santhoshkumar@tnfu.ac.in]

Received 09 September 2020; revised 17 December 2021

Six species of mantis shrimps were recorded in the trawl catches of Nagapattinam region during January – December, 2018. The occurrence of two species namely *Oratosquilla oratoria* (De Haan, 1844) and *Oratosquillina gravieri* (Manning, 1978) were reported for the first time in the trawl bycatches of Nagapattinam region. The morphometrics of these two species is reported in this paper. Presence of inferodistal spine in the merus of the raptorial claw, rostral plate short and trapezoid to square in shape, 5<sup>th</sup> abdominal segment without submedian patch, 4<sup>th</sup> abdominal segment submedian carinae unarmed in *Oratosquilla oratoria* and rostral plate elongate and rectangle, lateral process of 6<sup>th</sup> thoracic somite with slender, triangular anterior lobe and dactylus of the raptorial claw with 6 teeth in *Oratosquillina gravieri* are chief characters to differentiate from other species.

[**Keywords:** By-catch, Nagapattinam, Mantis shrimps, Squilla, Trawler]

### Introduction

Nagapattinam is one of the important coastal district in Tamil Nadu and it covers the coastal length of 187.9 km in the overall coastal length of Tamil Nadu. Trawlers are the dominant fishing vessel which captures nearly 63 % fishes in Nagapattinam and it leads the way to 13 % of fish production in the total marine fish production of Tamil Nadu next to Ramanathapuram<sup>1</sup>. Considering the shellfishes, mantis shrimps are one of the major unavoidable components of bycatch in the trawlers of Nagapattinam region. These non-selective trawlers generate a considerable amount of fish bycatch<sup>2</sup> including crustaceans. The mantis shrimps are an ecologically important predatory non-target group of crustaceans in the trawl fishery and mass removal of these crustacean groups would invariably have an impact on the others<sup>3</sup>. The utilization of mantis shrimp for food purposes is limited in the Indian region, but they are a favourite food in Japan, China, Hawaii, Vietnam, Philippines and Mediterranean countries. Apart from the ornamental value, these resources are mainly used for preparing fish meal, poultry feed and manure in India<sup>4</sup>. Limited literatures are available on the biology and occurrence of mantis shrimps in the Indian region<sup>5-8</sup>. Comprehensive

studies by Ahyong & Kumar<sup>9</sup> recorded the occurrence of 79 species of stomatopods in the Indian waters. Available studies indicated that the occurrence of *Oratosquilla oratoria* and *Oratosquillina gravieri* is limited in Nagapattinam region. Hence, this study was carried out to report the occurrence and morphometric characteristics of these species along the coastal region of Nagapattinam.

### Materials and Methods

The study was undertaken for the period between January 2018 – December 2018 to observe the fish bycatch landings from the trawlers of Nagapattinam fish landing centre located in the Latitude of 10°45' N and Longitude of 79°50' E along the Nagapattinam region (Fig. 1). During the study period, a considerable amount of mantis shrimps were observed in the trawlers bycatch of Nagapattinam region from July to August 2018. The mantis shrimps were captured by the trawlers which are commonly voyaged 40 to 80 nautical miles from the coast and trawl nets are at a depth ranging from 40 – 120 meters around the Nagapattinam region. The codend mesh size used to catch shrimps is 25 mm. Nearly 130 specimens of various mantis shrimps were gathered from the bycatch of the trawlers and these collections

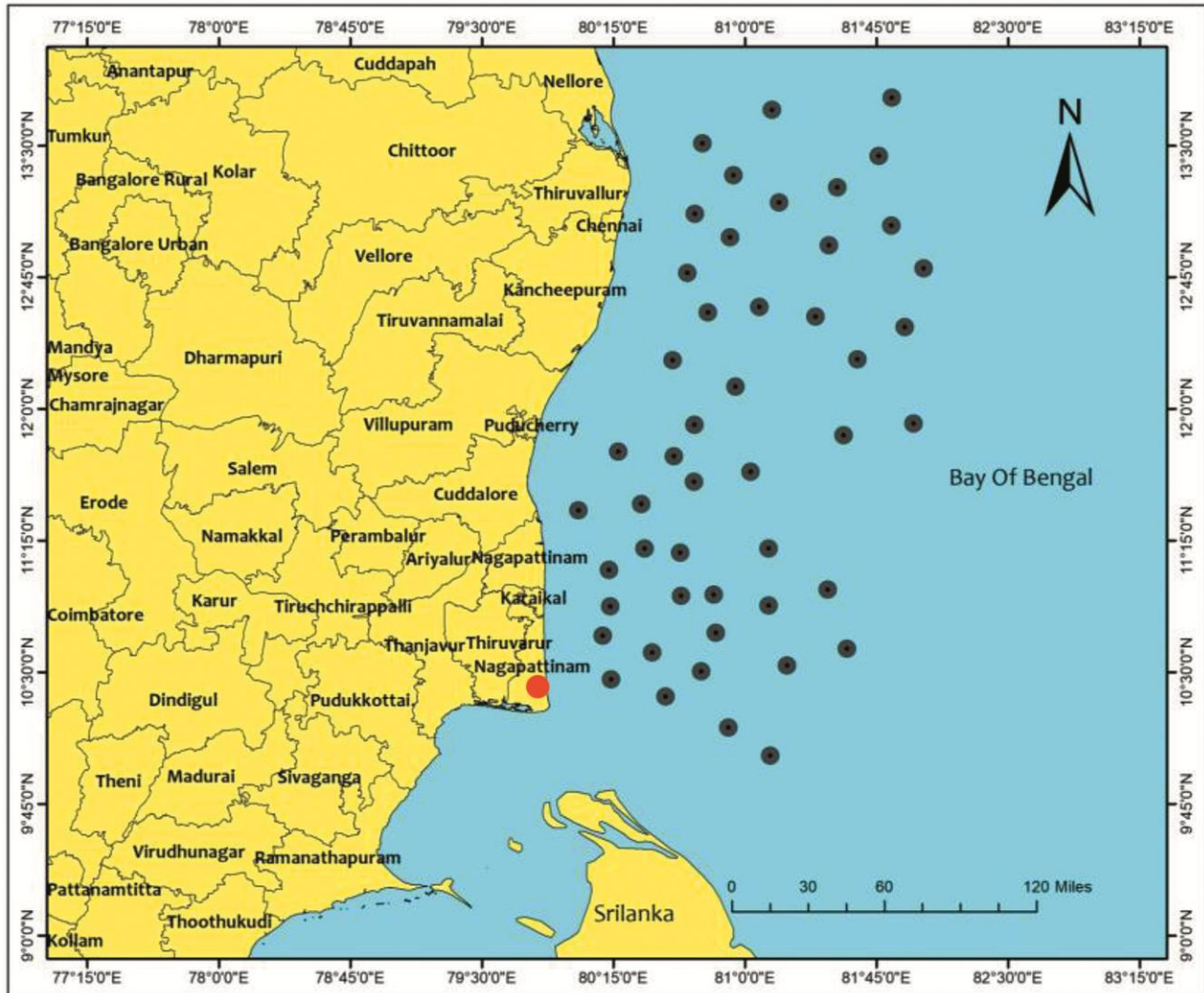


Fig. 1 — Map showing the trawling grounds of Nagapattinam region

were taken to the laboratory for further species-level identification. The morphological characters were observed through the vernier caliper for precise measurements and meristic characters were also observed to confirm the species based on the earlier reports<sup>10-13</sup>. Six species of mantis shrimps were identified from the collections and twenty two morphological characters<sup>14</sup> were observed for *Oratosquilla oratoria* (Catalogue TNR 68) and *Oratosquillina gravieri* (Catalogue TNR 69). These two species are deposited in the college museum for future reference.

## Results

Trawlers are the most dominant gear operated in Nagapattinam region and have an overall length (OAL) ranging from 18 to 20 meters. Most of the trawlers in this region are made up of steel. A total of

430 registered trawlers are operated in Nagapattinam with multiday fishing pattern to catch the fishery resources which generate a considerable amount of bycatch everyday. During the bycatch analysis, an abnormal catch of mantis shrimps was recorded during the months between July and August 2018. Based on the information collected from the fishers, mantis shrimps were caught in the nearshore waters between the regions of Nagapattinam (10°50'13"N – 80°02'49" E) and Kodyakarai waters (10°07'36"N; 79°56' 33" E) with the trawlers operated at depth of 40 – 120 meters in mud/sandy bottoms. Fishers of the Nagapattinam also believed that the commercial finfish catch reduced with the high catch of mantis shrimps in the trawlers.

Based on the morphological observation and identification characters, the occurrence of six species viz., *Carinosquilla lirata* (Kemp & Chopra, 1921),

*Harpiosquilla harpax* (de Haan, 1844), *Miyakea nepa* (Latreille in Latreille, Le Peletier, Serville & Guerin, 1828), *Lysiosquilla sulcirostris* (Kemp, 1913), *Oratosquilla oratoria* (De Haan, 1844) and *Oratosquillina gravieri* (Manning, 1978) were recorded (Plate 1). Among these specimens, *Oratosquilla oratoria* and *Oratosquillina gravieri* were reported for the first time from the Nagapattinam region.

Both the species belongs to the family Squillidae. This family can be differentiated based on the presence of carapace, thorax and abdominal longitudinal ridges, rounded carapace margin and blunt pectinations in the propodus of the raptorial claw.

The genus *Miyakea*, *Oratosquilla*, and *Oratosquillina* in the family Squillidae are having distinguished characters from other genera. The

median carina of the carapace completely lacks the anterior bifurcation in the members of these genera<sup>11</sup> and possess 6 serrated teeth on the opposable margin of the raptorial claw terminal margin<sup>12,13,17</sup>.

#### Key to the three genera of Squillidae

- Relatively small eyes; distinctive uninterrupted median carina on the carapace, splits posterior to the dorsal pit on the midline of the carapace<sup>12</sup>.
- Larger eyes; median carina of the carapace is entire, uninterrupted, from its base to its bifurcate anterior part near the anterior margin<sup>13,17</sup>
- Larger eyes; median carina of the carapace is interrupted at its bifurcation, and the anterior branches of the bifurcation may be indistinct or absent<sup>12,13</sup>.



a) *Carinosquilla lirata*



b) *Harpiosquilla harpax*



c) *Miyakea nepa*



d) *Lysiosquilla sulcirostris*



e) *Oratosquilla oratoria*



f) *Oratosquilla gravieri*

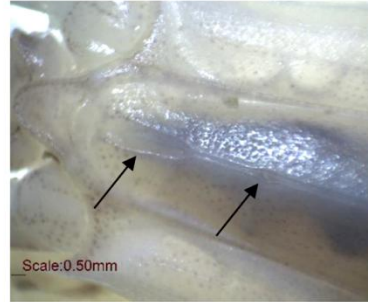
***Oratosquilla oratoria* (De Haan, 1844)**

Rostral plate trapezoid, wider than long; dorsal side pitted; carapace with median carina uninterrupted at base of anterior bifurcation; anterior bifurcation branches distinct. Six teeth in the dactylus of raptorial claw. Carpus dorsal carina tuberculated; propodus of distal margin pectinated with 2 spines; Merus with

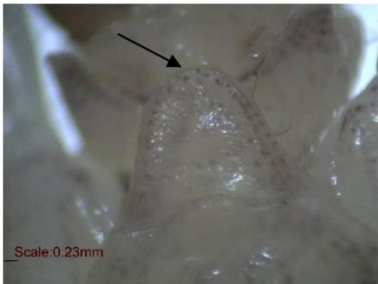
outer inferodistal tooth. Uropodal protopod with a lobe on the outer margin of inner spine rounded, narrower than the adjacent spine. The proximal segment of uropodal exopod subequal to distal segment in length; inner spine of basal prolongation of uropod with a rounded lobe on outer margin, the proximal margin of lobe concave<sup>13,17</sup> (Plates 2 & 3).



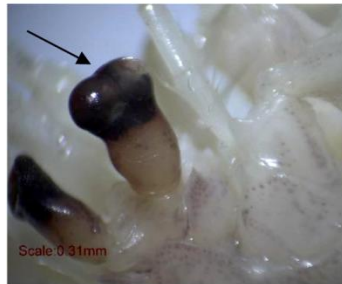
a) Morphology of *Oratosquilla oratoria*



b) Carapace anterior bifid and posterior dorsal pit



c) Rostral plate blunted anterior margin



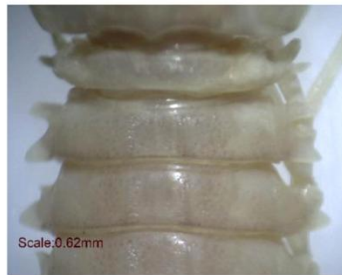
d) Bilobed eye



e) Raptorial claw



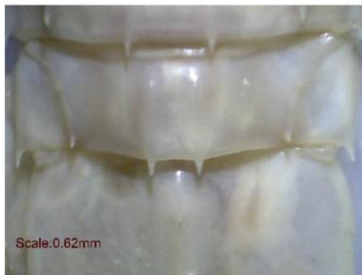
f) Carpus of raptorial claw



g) 5<sup>th</sup> to 8<sup>th</sup> Thoracic somites



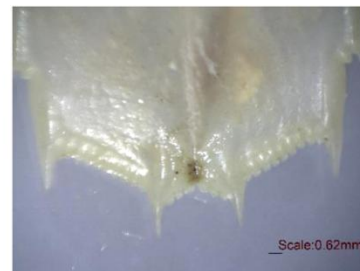
h) Unarmed 4<sup>th</sup> Abdominal segment



i) 5<sup>th</sup> & 6<sup>th</sup> abdominal segment with small ventral spine



j) Basal prolongation of uropod



k) Dorsal view of Telson

The precise measurements were taken for 25 specimens of *O. oratoria* collected from Nagapattinam region. The measurements are as follows: TL 68.2 – 106.3 mm; antennule length 11 – 18 mm (16.1 – 16.9 % of TL); antenna 21 – 38.4 mm (30.8 – 36.1 % of TL); rostral plate 2.1 – 3.8 mm

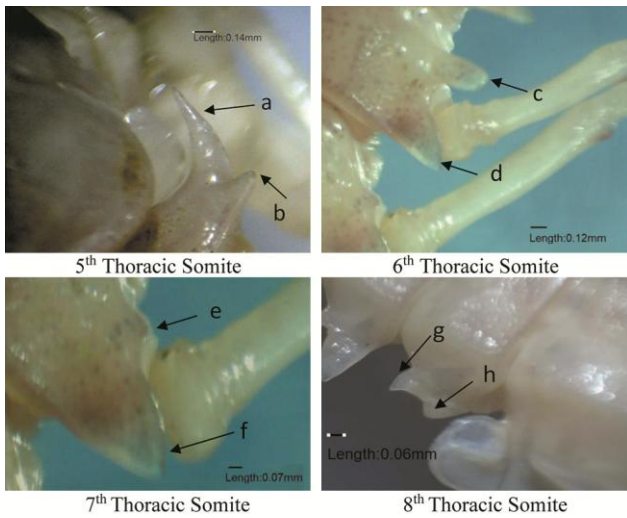
(3.1 – 3.6 % of TL); antennal scale 13.2 – 21.6 mm (19.4 – 20.3 % of TL); raptorial claw 44.7 – 60.6 mm (57.0 – 65.5 % of TL); telson 12.4 – 17.5 mm (16.5 – 18.2 % of TL); uropod 16.7 – 26.7 mm (24.5 – 25.1 % of TL).

The colour of the specimens was dull light brown and the presence of evenly distributed dark dots in the integument was observed in the preserved specimens. There are no dark dorsal patches on the second and fifth abdominal somites<sup>13</sup>. Dactylus of the raptorial claw and 3 pairs of pereopods are in white colour.

***Oratosquillina gravieri* (Manning, 1978)**

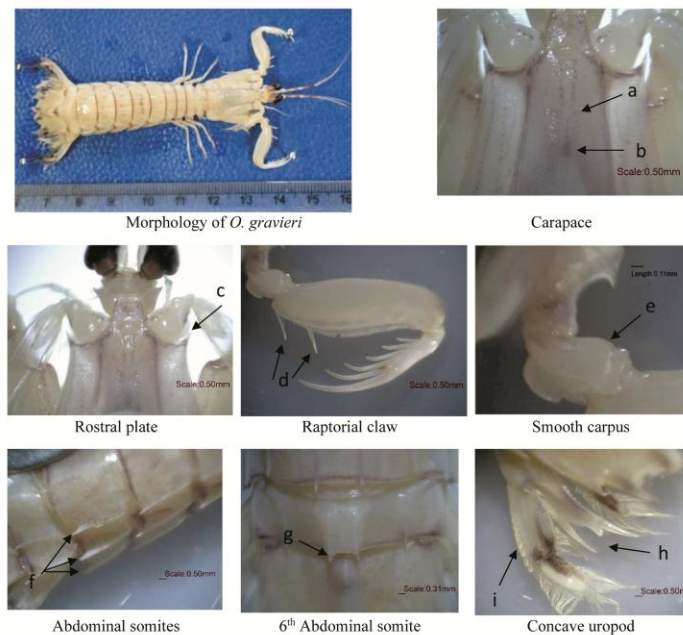
Moderate size; smooth body; dactylus of the raptorial claw with 6 teeth; dorsal ridge on the carpus of raptorial claw smooth, undivided; lobe between spines of basal prolongation of uropod concave. Rostral plate longer than broad; anterolateral spines of carapace not overreaching base of the rostral plate. Lateral process of sixth thoracic somite with slender, triangular anterior lobe, acute apically. Median carina absent. Dactylus of the claw with 6 teeth, outer margin sinuous, with low, obtuse projection basally. Dorsal ridge of carpus undivided. Inferodistal angle on the outer face of merus produced into the slender spine<sup>12</sup> (Plates 4 & 5).

Only one specimen of *Oratosquillina gravieri* was observed in the collection and their precise lengths



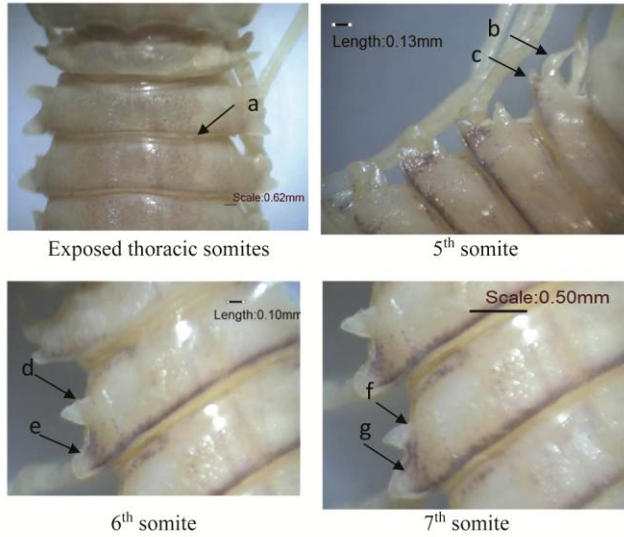
a – Bilobed lateral process; anterior lobe a slender spine directed anteriorly; b – Posterior lobe short, directed laterally; c – Elongate, slender and blunt lateral process anterior lobe; d – Posterior lobe broad, triangular; e – Small triangular anterior lobe lateral process; f – Broad, triangular posterior lobe; g – Anterolateral margin triangular and apex sharp; and h – Sterna keel rounded to bluntly angular

Plate 3 — Thoracic Somites (TS) of *Oratosquilla oratoria*



a – Anterior bifurcation with interruption; b – Posterior dorsal pit; c – Elongated rostral plate and anterolateral spine not reaching base of the rostral plate; d – Sharp pectination with two spines in the propodus; e – Smooth carpus in raptorial claw; f – 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup> & 6<sup>th</sup> AS with intermediate, lateral and marginal spines; g – Ventral spine anterior to uropod; lack of transverse carina; h – Lobe between spines of basal prolongation of concave Uropod; and i – Uropodal exopod with 8 movable spines

Plate 4 — Identification characters of *Oratosquillina gravieri*



a – TS unarmed sub-median and intermediate carina; b – Bilobed lateral process; c – Triangular Posterior lobe; d – Strongly bilobed lateral process; e – Larger, triangular, apex acute posterior lobe; f – Lateral process bilobed, triangular anterior lobe slightly shorter than that of 6<sup>th</sup> somite; and g – Posterior lobe larger, triangular, apex acute, unarmed

Plate 5 — Thoracic segmentation of *Oratosquillina gravieri*

were measured. TL 71.9 mm; antennule 14.5 mm (20.2 % of TL); antenna 33.5 mm (46.7 % of TL); rostral plate 2.7 mm (2.7 % of TL); antennal scale 12.6 mm (17.5 % of TL); raptorial claw 42.6 mm (59.3 % of TL); telson 12.0 mm (16.7 % of TL); uropod 18.6 mm (25.9 % of TL).

The colour of the preserved specimen was pale light brown. Ventral region edge of each segment with dark brown border. Dactylus of the raptorial claw in white colour.

The detailed morphometrical measurements of both the species collected from Nagapattinam region is provided in Table 1.

**Discussion**

The marine fishery production in the Nagapattinam region was 0.91 lakh tonnes during 2018<sup>(ref. 1)</sup>. The crustacean group contributed 7.5 % and the stomatopods contributed 0.7 % of the total marine catch<sup>1</sup>. In a recent study on the mantis shrimps diversity, Trivedi *et al.*<sup>15</sup> updated the checklist of mantis shrimps and reported about 72 species,

Table 1 — Morphometric measurements of *O. oratoria* and *O. gravieri*

Sl. No	Morphometric measurements	<i>Oratosquilla oratoria</i> (N = 25)			<i>Oratosquillina gravieri</i> (N = 1)	
		Maximum (mm)	Minimum (mm)	Range (mm)	Length (mm)	%
1.	Total length including rostral plate	106.28	68.22	38.06	71.86	-
2.	Length of antennules	18.00	11.00	7.00	14.50	20.2
3.	Length of antenna	38.44	21.00	17.44	33.54	46.7
4.	Length of Carapace at median point	22.98	14.12	8.86	15.36	21.4
5.	Width of Carapace below anterolateral angle	11.04	8.00	3.04	8.22	11.4
6.	Width of Carapace at poster lateral end	18.00	11.58	6.42	12.32	17.1
7.	Length of rostral plate	3.76	2.10	1.66	2.68	3.7
8.	Length of Antennal scale	21.60	13.14	8.46	12.56	17.5
9.	Length of median carina (Carapace)	16.70	10.00	6.70	11.86	16.5
10.	Stalk width	3.00	2.00	1.00	4.50	6.3
11.	Length of Ischium	3.44	1.38	2.06	2.68	3.7
12.	Length of Merus	19.06	12.76	6.30	13.00	18.1
13.	Length of Carpus	4.74	2.36	2.38	2.30	3.2
14.	Length of Propodus	19.62	11.18	8.44	12.66	17.6
15.	Length of Dactylus	17.00	11.38	5.62	12.00	16.7
16.	Length of raptorial claw	60.58	44.68	15.90	42.64	59.3
17.	Length of thorax	19.22	12.98	6.24	15.18	21.1
18.	Length of abdomen	47.88	29.42	18.46	32.26	44.9
19.	Telson length	19.42	10.80	8.62	12.00	16.7
20.	Telson width	17.50	12.36	5.14	12.66	17.6
21.	Length of median carina (Telson)	12.78	9.22	3.56	8.20	11.4
22.	Length of Uropod	26.68	16.66	10.02	18.60	25.9

35 genera, and 10 families from Indian waters. He also stated that a maximum number of species were reported under the family Squillidae (43 species, 20 genera) and the highest species diversity was reported in Tamil Nadu (48 species, 28 genera, 8 families). In the present study, among the six species of mantis shrimps identified, *Oratosquilla oratoria* and *Oratosquillina gravieri* are the two squillid species reported for first time from the Nagapattinam region.

*Oratosquilla oratoria* is commonly known as Japanese mantis shrimp, native species of the Northern Western Pacific regions particularly from the coasts of Japan, China, Taiwan and Vietnam<sup>18</sup>. It was reported in the North Western Pacific regions due to human introduction, and now this species is reported as an established species from the Australia and New Zealand waters<sup>13,16</sup>. Most of the morphological features of *O. oratoria* described by Ah Yong<sup>13</sup> in the New Zealand waters are agreed with the identified specimens. The collected specimen of *O. oratoria* is differentiated from closely related species *O. fabricii* by the presence of submedian carinal spine in the 4<sup>th</sup> abdominal segmentation (Plate 2h). The rostral plate of *O. oratoria* is trapezoidal in shape<sup>13</sup>, but the present specimen shows a flat rounded margin at the anterior margin (Plate 1c) and the propodus of the raptorial claw having two spines in the inferodistal margin. The total length of *O. oratoria* ranged from 68.2 – 106.3 mm, which is much smaller than the earlier reported length of 54 – 183 mm<sup>17</sup> and 129 – 155 mm<sup>13</sup> in Indo-Western Pacific and New Zealand waters, respectively.

*Oratosquillina gravieri* is commonly known as Vietnamese squillid mantis shrimp, distributed in the regions of Vietnam, Philippines, Australia, New Caledonia and Taiwan<sup>12</sup>. The morphological characters of *O. gravieri* described in the Taiwan waters are agreed with the characters presented in the reported specimen. The present specimen was well differentiated from the similar species of *O. perpensa*<sup>12,19,20</sup> based on the shape of the rostral plate (Plate 4c). Rostral plate rectangular and elongated in shape and anterolateral spine in the carapace not extending beyond the base of the rostral plate. The observed specimen had eight movable spines in the outer margin in the uropodal exopod (Plate 4i) and it was reported as 7 – 9 movable spines in the specimen from New Zealand waters<sup>13</sup>. The reported specimen of *O. gravieri* has a total length of 71.9 mm and the same was reported as 110 mm in Western Central Pacific<sup>16</sup> and 112 mm in Philippines<sup>20</sup>.

The mantis shrimps are mainly exploited for their edible and ornamental values. Some studies indicated that these shrimps are considered as pollution indicators due to changes in their population based on the influence of heavy metals, petroleum and agrochemical runoff in the aquatic systems<sup>21,22</sup>. The mantis shrimps were rich in macro and micro minerals<sup>23</sup> and proved that these shrimps were nutritionally equal with any other fish foods<sup>24</sup>. Currently, they are utilized for the preparation of poultry feed, fish meal and manure<sup>25</sup>. Since this resource is exploited considerably in the bycatch it can be used as an alternative nutritional source to overcome malnutrition in the coastal regions of Tamil Nadu.

Studies on the mantis shrimps diversity are very scanty in the Indian region. The present study on the occurrence of these two squillids has increased the faunal resources in the Indian region. Further, in-depth studies are needed to understand and revise the faunal diversity of mantis shrimps and to judiciously exploit these resources for human use effectively.

#### Acknowledgements

The first author express his deep sense of gratitude to the Vice-Chancellor, Tamil Nadu Dr. J. Jayalalithaa Fisheries University, Nagapattinam for permitting to carry out the Ph.D. research work. He also extremely thankful to the Dean, Fisheries College and Research Institute, Thoothukudi and the Dean, Dr. MGR Fisheries College and Research Institute, Thalainayeru for providing facilities and constant support during the study period.

#### Ethical statement

The mantis shrimp species were collected as dead specimens from the trawlers bycatch of Nagapattinam region and no animals were killed or stressed during the study period with duly following the present Indian animal welfare laws. The provisions of the Government of India's Wildlife Protection Act (1972) are not applicable, since the mantis shrimps are not categorized under the endangered list.

#### Conflict of Interest

The authors of this paper declare no competing or conflicts of interest.

#### Author Contributions

SS & AS contributed to the collection and taxonomic identification, SS contributed to conceptualize the idea, draft the manuscript and revise it based on the corrections. PJ contributed to refine

the article, overall guidance to execute the work and provided valuable inputs for results and conclusion. BS, NJ & ASN contributed to review and comment on the article critically.

## References

- 1 CMFRI, *CMFRI Annual Report: 2018-19*, (Central Marine Fisheries Research Institute, Cochin, India), 2019, pp. 60-67.
- 2 Kumar A B & Deepthi G R, Trawling and by-catch: Implications on marine ecosystem, *Curr Sci*, 90 (8) (2006) 922-931.
- 3 Antony P J, Dhanya S, Lyla P S, Kurup B M & Khan S A, Ecological role of stomatopods (mantis shrimps) and potential impacts of trawling in a marine ecosystem of the Southeast coast of India, *Ecol Model*, 221 (21) (2010) 2604-2614.
- 4 Sukumaran K K, *Squilla (Mantis shrimp) fishery of Karnataka state, R & D Series for Mar Fish Res Man*, 18 (1987) 1-3.
- 5 Kemp S, An account of the Crustacea Stomatopoda of the Indo-Pacific region based on the collection in the Indian Museum, *Mem Indian Mus*, 4 (1) (1913) 1-217.
- 6 Shanbhogue S L, *Studies on stomatopod crustacea from the seas around India*, In: *Recent Advances in Marine Biology*, (Today and Tomorrow Printers and Publishers, New Delhi), 1985, pp. 515-567.
- 7 Sukumaran K K, Study on the fishery and biology of the mantis shrimp *Oratosquilla nepa* (latreille) of South Kanara coast during 1979-83, *Ind J Fish*, 34 (3) (1987) 292-305.
- 8 Losse G F & Merrett N R, The occurrence of *Oratosquilla investigatoris* (Crustacea: Stomatopoda) in the pelagic zone of the Gulf of Aden and the equatorial western Indian Ocean, *Mar Biol*, 10 (3) (1971) 244-253.
- 9 Ah Yong S T & Kumar A B, First records of seven species of mantis shrimp from India (Crustacea: Stomatopoda), *Zootaxa*, 4370 (4) (2018) 381-394.
- 10 Manning R B, Notes on some Australian and New Zealand stomatopod Crustacea, with an account of the species collected by the Fisheries Investigation Ship Endeavour, *Rec Aust Mus*, 27 (4) (1966) 79-137.
- 11 Carpenter K E & Niem V H, *FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific. Cephalopods, crustaceans, holothurians and sharks*, (Food Agricultural Organization, Rome), 2 (1998) 687-1396.
- 12 Ah Yong S T, Chan T Y & Liao Y C, *A catalog of the mantis shrimps (Stomatopoda) of Taiwan*, (National Taiwan Ocean University, Keelung), 2008, pp. 1-191.
- 13 Ah Yong S T, *The marine fauna of New Zealand: mantis shrimps (Crustacea: Stomatopoda)*, (NIWA), 125 (2012) pp. 113.
- 14 Rath S & Mishra S S, On the Occurrence of a Giant Squilla, *Harpiosquilla raphidae* (Crustacea: Malacostraca: Stomatopoda) in Chilika Lagoon, Odisha, *Rec Zool Surv India*, 113 (1) (2013) 235-237.
- 15 Trivedi J N, Ah Yong S T, Vachhrajani K D & Kumar A B, An annotated checklist of the mantis shrimps of India (Crustacea: Stomatopoda), *Zootaxa*, 4768 (2) (2020) 221-238.
- 16 Ah Yong S T, Revision of the Australian Stomatopod Crustacea, *Rec Aust Mus Suppl*, 26 (2001) 1-326.
- 17 Manning R B, Keys to the species of *Oratosquilla* (Crustacea, Stomatopoda), with descriptions of two new species, *Smithson Contrib Zool*, (1971) 1-16.
- 18 Wikipedia contributors (eds.), *Oratosquilla oratoria*, In: *Wikipedia, The Free Encyclopedia*, accessed at [https://en.wikipedia.org/w/index.php?title=Oratosquilla\\_oratoria&oldid=1078747748](https://en.wikipedia.org/w/index.php?title=Oratosquilla_oratoria&oldid=1078747748)
- 19 Manning R B, Further observations on *Oratosquilla*, with accounts of two new genera and nine new species (Crustacea: Stomatopoda: Squillidae), *Smithson Contrib Zool*, 272 (1978) 1-44.
- 20 Moosa M K, Stomatopod Crustacea, Résultats du Campagnes Musorstom I & II Philippines, 2, *Memoires du Muséum national d'Histoire naturelle (Paris)*, series A, *Zoologie*, 13 (1986) 367-414.
- 21 DBW, OZ REEF Marine Park: Reference Material, Mantis Shrimp, accessed at [http://ozreef.org/reference/mantis\\_shrimp.html](http://ozreef.org/reference/mantis_shrimp.html) version (04/2001)
- 22 Heitler W J, Fraser K & Ferrero E A, Escape behaviour in the stomatopod crustacean *Squilla mantis*, and the evolution of the caridoid escape reaction, *J Exp Biol*, 203 (2) (2000) 183-192.
- 23 Wardianto Y, Santoso J & Mashar A, Biochemical Composition in Two Populations of the Mantis Shrimp, *Harpiosquilla raphidea* (Fabricius 1798) (Stomatopoda, Crustacea) (Komposisi Biokimia dari Dua Populasi Udang Mantis, *Harpiosquilla raphidea* (Fabricius 1798) (Stomatopoda, Crustacea), *Ilmu Kelaut*, 17 (1) (2012) 49-58.
- 24 Rao Y P, Prasad R D & Sirisha R I, Species composition of order Stomatopoda (Crustacea) and some biochemical aspects of two stomatopod species at Visakhapatnam, East Coast of India, *Int J Curr Res*, 5 (12) (2013) 4108-4112.
- 25 Pillai S L, Kizhakudan S J, Radhakrishnan E V & Thirumilu P S S, Crustacean bycatch from trawl fishery along north Tamil Nadu coast, *Ind J Fish*, 61 (2) (2014) 7-13.