J. Indian Soc. Coastal Agric. Res. 41(1): 41-52 (2023) https://doi.org/10.54894/JISCAR.41.1.2023.131591

New Records of Mantis Shrimps (Crustacea: Stomatopoda) from the Gujarat Waters, India

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Received: 21.12.2022 Accepted: 10.04.2023

Mantis shrimps are the most significant predators in the shallow waters and intertidal regions of tropical and subtropical marine ecosystems and they are integral components of the food chain. Additionally, mantis shrimps are sensitive to environmental pollutants and indicate poor environmental conditions through their ecological behaviour. As a fisheries species, they hold immense socio-economic importance for several countries. In this study, we document three species of stomatopods found in the waters of Gujarat, India. Notably, *Manningia arabica* (Manning, 1990), which is rare and endemic to the Arabian Sea, is reported for the first time in Indian waters. Furthermore, *Alimopsis supplex* (Wood-Mason, 1875) and *Oratosquillina quinquedentata* (Brooks, 1886) are also documented for the first time in the waters of Gujarat. The study includes taxonomic descriptions, habitat characteristics, and geographical distribution information for each of these species.

(***Key words:*** *Arabian sea, Endemic, First record, Gulf of Kachchh, Stomatopoda*)

Stomatopods are benthic marine carnivores, and aggressive predators with the most complex behaviour. Having tri-flagellate antennules, mighty spearing or smashing raptorial claw, and compound eyes, makes them powerful predators in the ocean (Ahyong and Harling, 2000; Ahyong, 2001, 2012; van der Wal *et al.*, 2017). Stomatopods are distinguished from closely related members of Eumalacostraca by possessing three antennular flagella, amobile rostrum, exopodite gills (Hendrickx and Salgado-Barragán, 1991), three pairs of walking legs and enlarged seconds maxillipeds as raptorial claw (Schram, 1986). They are distributed globally in tropical, subtropical waters and a few in the coldest waters of the sub-Antarctic region. They are found in a wide range of habitats such in the continental shelf, on slope, in intertidal zones, and at bathypelagic depths over 1500 m (Ahyong, 2012; Schram *et al.*, 2013; van der Wal *et al.*, 2017. They mostly prefer to live in 'U'-shaped burrows in sandy or muddy habitats of coastal or deep-water basins (Parivallal and Jayalakshmi, 2020). A total of 495 species of stomatopods belonging to 120 genera in 17 families have been reported worldwide (WoRMS, 2022), among them, approximately 330 species have been recorded from the Indo-West Pacific region (Ahyong, 2012).

The pioneering study of stomatopods fauna was conducted in the Indian water by various researchers such as Wood-Mason (1875, 1895), Wood-Mason and Alcock (1891), Henderson (1893), Thurston (1895), Kemp (1911, 1913, 1915), Kemp and Chopra (1921), Gravely (1927), Chopra (1934), Alikunhi (1952), Manning (1967), Chhapgar and Sane (1967, 1968), Shanbhogue (1969, 1986), Dutt and Ravindranath (1975), Ghosh (1984, 1987, 1991, 1995, 1998), Rao *et al.* (1989), Lyla *et al.* (1997), Holthuis (2000), Ramakrishna *et al.* (2003), Venkataraman *et al.* (2004), Pillai and Thirumilu (2008), Kathirvel (2008), Gopalakrishnan *et al.* (2012), Divipala and Thirumilu (2013), Ahyong (2016), Kumaralingam and Raghunathan (2016), Ahyong and Kumar (2018), Niveditha *et al.* (2019) and Vadher *et al.* (2022).

Trivedi *et al.* (2020) compiled a checklist of 72 species of stomatopods belonging to 35 genera in 10 families from Indian waters. Subsequently, Padate *et al.* (2021) described two species of stomatopods *Gonodactylopsis drepanophora* (de Man, 1902)

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and *Cloridina malaccensis* (Manning, 1968) from India. The present study added one more species *Manningia arabica* (Manning, 1990), to enrich the list of stomatopods fauna of India. Hence, a total of 75 species belonging to 36 genera in 10 families are reported from Indian waters until now. From Gujarat waters, 10 species belonging to nine genera and two families have been documented until now (Dudiya *et al.*, 2022; Vadher *et al.*, 2022). The present study added three more species to the stomatopods lists of Gujarat waters. A total of 13 species belonging to 11 genera and three families of stomatopods fauna are now reported from Gujarat waters. The primary objective of the present study is to describe the two endemic species *M. arabica* and *A. supplex* and confirm the occurrence of *O. quinquedentata* in Indian waters. All the species were described with habitat and distribution with existing diversity of stomatopods of Gujarat waters.

MATERIALS AND METHODS

Sikka reef is a tiny reef area of Marine National Park, Jamnagar, situated on the southern coast of the Gulf of Kachchh, Gujarat, India. The lower intertidal zone of the Sikka reef comprises mixed habitat types, *i.e.*, sandy and muddy, sandy with muddy, sandy-rocky, water pools with gravels, corals and sea anemone beds. A single female specimen of *M. arabica* and a single male specimen of *A. supplex* and *O. quinquedentata* were collected. All the specimens were brought to the laboratory for further taxonomical identification and deposited in the Museum of Fisheries Research Station, Junagadh Agricultural University, Sikka, Gujarat with an accession number. Detailed morphological characters were examined under the microscope (LABOMED LX-500 LED Binocular Microscope). The specimens were identified using the standard literature and identification keys of Brooks (1886), Wood-Mason (1895), Kemp (1913) and Manning (1978, 1990) including communication with relevant crustacean experts. The total length (TL) considered from the tip of the rostral plate to the tip of the submedian spines of the telson and the carapace length (CL), which excludes the rostrum, was measured using the standard vernier calliper.

RESULTS AND DISCUSSION

Systematics

Order: Stomatopoda (Latreille, 1817)

Superfamily: Eurysquilloidea (Manning, 1977)

Family : Eurysquillidae (Manning, 1977)

Genus: *Manningia* (Serène, 1962)

Species: *Manningia arabica* (Manning, 1990) (Fig. 1a-f)

Synonymized names: *Manningia* sp. (McCain, 1984: 101)

Material examined: FRSACS-07, 1 ♀ (CL = 17 mm, TL = 61 mm), (22° 27’ 28.8” N, 69° 48’ 02.6” E) Sikka reef, Gulf of Kachchh, Gujarat: Coll: Sidik Mepani on 17 May, 2022.

Description

The dorsal surface of the carapace and abdomen was smooth, carapace showed a weak gastric groove and reflected marginal carina. The rostrum was pentagonal shaped and the anterolateral angle curved with a minute apical spine anteromedially. The anterior margin of the eye reaches to mid-length of the first segment of the antennular peduncle; the cornea is bilobed. Median and intermediate carinas are absent on thoracic and abdominal segments. Merus of the raptorial claw unarmed, carpus with two sharp dorsal distal lobes, propodus with rows of small sharp teeth on the occlusal margin of dactylus with four uneven small to larger evenly spaced sharp teeth. Abdominal somite 5 lateral processes comprise a sharp spine on the posterodistal portion of the marginal carina and abdominal somite 6 comprises three pairs of marginal spines. The telson is broader than long, submedian carina possesses a pair of movable spines that join at the base, dorsal surface of the telson with median, other three accessory carinae, lateral and intermediate denticles. The outer margin of the proximal segment of the exopod comprises nine movable sharp uneven spines, uropods with an inner longer sharp spine on the outer margin.

Colour: The entire animal is beige with light brown spots except for the raptorial claw. Raptorial claw opaque. Telson with light brown carinae.

Habitat: The present species is observed in the burrows of the sandy zone at the lower intertidal zone of the Sikka reef. Previous studies showed that the habitat was a sandy-rocky area (Manning, 1990).

Distribution in World: Saudi Arabia (McCain, 1984;

Fig. 1. *Manningia arabica Manning, 1990, Female, TL= 61 mm, Sikka reef, FRSACS-07 (a) dorsal view (b) ventral view (c) raptorial claw (d) telson (e) carapace with eyes (f) uropod. Scale: 10 mm*

Manning, 1990).

Distribution in India: Sikka Reef, Gulf of Kachchh, Gujarat, India (Present study).

Remarks

The diagnostic characteristic of the present specimen agreed well with the description of *Manningia arabica* by Manning (1990). Formerly, this species was described as *Mannigia* sp. from Saudi Arabia by McCain in 1984; afterwards, it was re-described as *M. arabica* in 1990 from Saudi Arabia (Manning, 1990). This species is endemic to the Persian Gulf and hereafter, it is described with colour illustrations for the first time from India. *M. arabica* is identical to *Manningia misool* (Ahyong, 1997) in the shape of the rostral plate and dorsal armature of abdominal somite 6, but it differs from *M. misool* in ocular scales shape, anterior intermediate carinae on the telson and lateral carinae of abdominal somite 5. *M. misool* has narrow ocular scales inclined anteriorly, flattened, and not fused while *M. arabica* ocular scale is inclined downward, fused in V-shaped ridges. *Manningia arabica* differentiated from *M. misool* in having anterior intermediate carinae on the telson and additional carinae between intermediate and lateral carinae of abdominal somite 5 (Ahyong, 1997).

Superfamily: Squilloidea (Latreille, 1802)

Family: Squillidae (Latreille, 1802)

Genus: *Alimopsis* (Manning, 1977)

Species: *Alimopsis supplex* (Wood-Mason, 1875) (Fig. 2a-f)

Synonymized names:

Squilla supplex (Wood-Mason, 1875: 232)

Squilla supplex (Wood-Mason, 1895: 4, pl. 2, Fig. 2, pl. 3, Fig. 2)

Squilla supplex (Kemp, 1913: 82, pl. 6, Fig. 69)

Alimopsis supplex (Ghosh, 1995: 182)

Alimopsis supplex (Ghosh, 1998: 425)

Material examined: FRSACS-06, 1 ♂ (CL = 22 mm, TL = 77 mm), (22° 27' 37.1" N, 69° 48' 10.9" E) Sikka Reef, Gulf of Kachchh, Gujarat: Coll: Sidik Mepani on 22 March, 2022.

Description

Dorsal integument is unpitted or smooth. Eyes short, extending to half the length of the antennular peduncle article 1; cornea bilobed, set obliquely on the stalk. Rostrum subtrapezoid, broader than long, lateral margin carinate, apex truncate to form a round shape. Carapace smooth, anterolateral spines sharp not reaching the base of the rostral plate, anterior and posterior bifurcation of median carina obsolete marked. The intermediate and lateral carinae are well-marked. Gastric and cervical grooves are distinct. The dactylus of the raptorial claw possesses five uneven teeth, the first dactylus longer and the second, third, and so on decreasing gradually in length. Propodus with a row of uneven sharp teeth on the occlusal margin, dorsal surface of carpus and merus unarmed. Pereopod 1-3 basal articles unarmed; endopod articles fused. Thoracic somites 5-8 are carinae distinctly marked. Thoracic somite 5 lateral process bilobed, anterior lobe with long sharp spine pointed anteriorly, posterior lobe short rounded laterally. Thoracic somites 6-8 are laterally rounded and single-lobed. Abdominal somites 1-5 possess distinct median carinae. Abdominal carinae possess spines on the following segments: submedian 5-6, intermediate 5-6, lateral 2-6, marginal 1-5. The telson is longer than wide with well-marked carination, median carinae with a sharp strong tooth at the posterior end, lateral margin of the telson has well-developed sharp teeth. The uropodal protopod terminates into a pair of primary sharp spines.

Colour

Fresh living species are lemon yellow with dark spots irregularly scattered on the entire body. The margin of propodus is yellowish. Middle, marginal, and submarginal abdominal somites are dark brown. Eyes are light amber.

Habitat

This species was found in the sandy region of the coral reef at the lower intertidal zone of the Sikka reef. Previous studies showed that the habitat was unknown; specimens were preserved in the Indian museum collections (Wood-Mason, 1875, 1895; Ghosh, 1995, 1998); in one study, it was reported from the stomach of *Polynemus tetradactylus* [Shaw, 1804 (now *Eleutheronema tetradactylum* Shaw, 1804 (Kemp, 1913))].

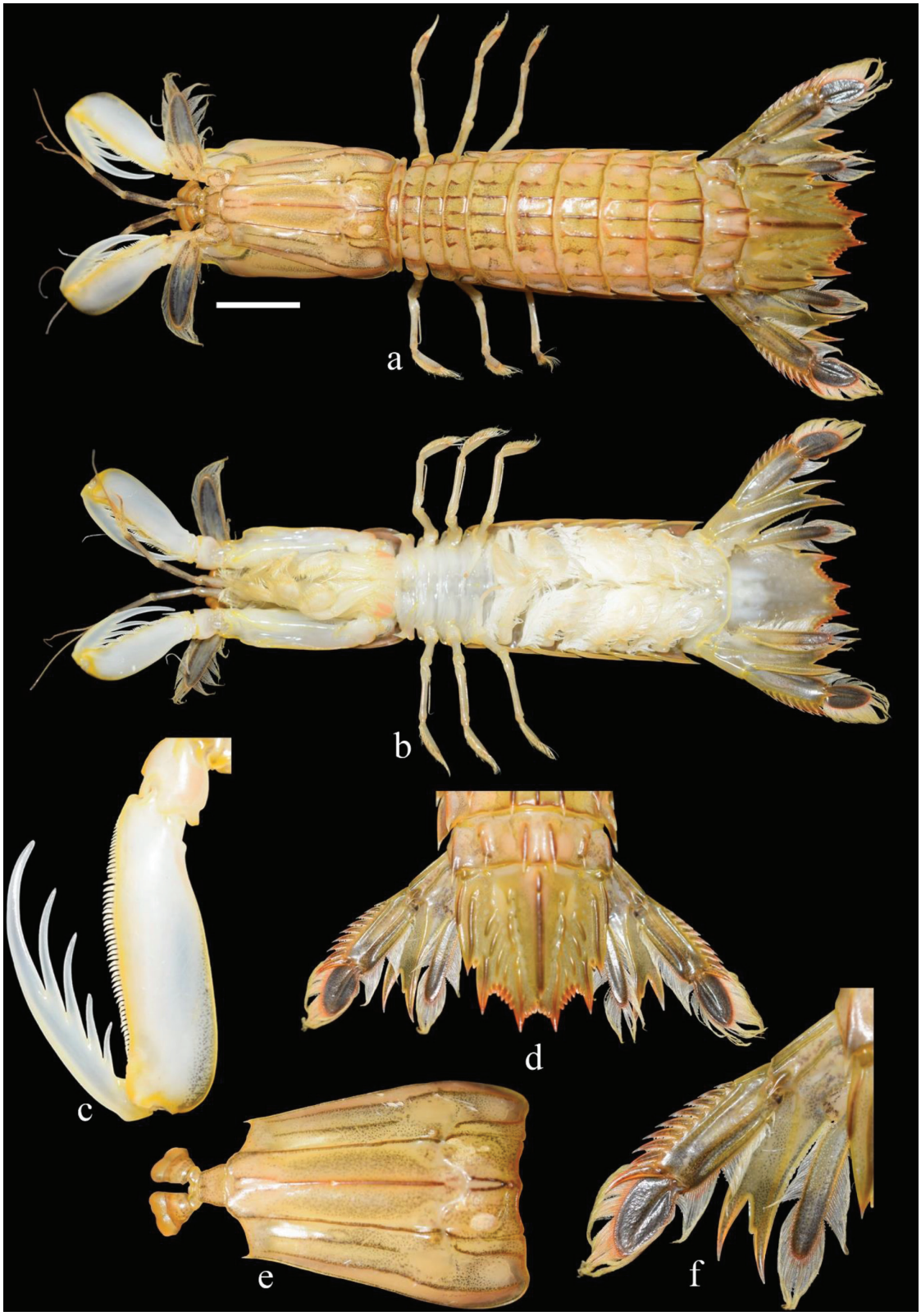

Fig. 2. *Alimopsissupplex (Wood-Mason, 1875), Male, TL= 77 mm, Sikka reef, FRSACS-06 (a) dorsal view (b) ventral view (c) raptorial claw (d) telson (e) carapace with eyes (f) uropod. Scale: 10 mm.*

Distribution in India

Maharashtra (Wood-Mason, 1875, 1895; Kemp, 1913); Tamil Nadu (Kemp, 1913); West Bengal (Ghosh, 1995, 1998). This species is reported from Sikka Reef, Gulf of Kachchh, Gujarat, India (Present study).

Remarks

Taxonomical characteristics of the present specimen examined agree well with the detailed description of Wood-Mason (1895) and Kemp (1913). This species is rare and endemic to the Indian coast. *A. supplex* was previously known from the Indian mainland based on a few published records from Maharashtra, Tamil Nadu and West Bengal. Wood-Mason (1875) reported *Squilla supplex* [now *Alimopsis supplex* (Wood-Mason, 1875)] as a new species from Bombay (present-day Mumbai); later, the original description of the *A. supplex* was given as *S. supplex* with figures and descriptions with other nine species of Squillidae from Bombay (Wood-Mason, 1895). After that, Manning (1977) revised the genus *Squilla* and erected a new genus *Alimopsis*. A single species of *S. supplex* was transferred and recognized as *A. supplex*. The genus *Paralimopsis* (Moosa, 1991) identical to *Alimopsis* (Manning, 1977) by the abdominal superficial carination but differentiated in the following characteristics, *i.e.*, *Alimopsis* possesses mandibular palp whereas it is lacking in *Paralimopsis*. *Paralimopsis* possesses four epipods, whereas it is two in *Alimopsis*, the inner margin of the basal prolongation of uropod of *Paralimopsis* comprises short spines, whereas there is an absence of spines and crenulation in *Alimopsis*. *Alimopsoides tuberculatus* (Moosa, 1991) is identical to *A. supplex* but easily distinguished by the presence of six teeth instead of five on the raptorial dactylus in *A. tuberculatus*. In addition, abdominal somites and telson are covered with tubercles in *A. tuberculatus* while it is smooth in *A. supplex* and have two lobes between the spines of the basal prolongation of the uropod (Moosa, 1991).

Genus: *Oratosquillina* (Manning, 1995)

Species: *Oratosquillina quinquedentata* (Brooks, 1886) (Fig. 3a-f)

Synonymized names:

Squilla quinquedentata (Brooks, 1886: 21, 26, pl. 1, Fig. 3, pl. 2, Fig. 6)

Squilla quinquedentata (Stephenson and McNeill, 1955: 243)

Squilla quinquedentata (Kemp, 1913: 52)

Oratosquilla quinquedentata (Manning, 1978: 23, Fig. 12)

Oratosquilla quinquedentata (Lyla *et al.*, 1997: 13, Fig. 12)

Oratosquilla quinquedentate (Pillai and Thirumilu, 2008: 36)

Oratosquilla quinquedentata (Ghosh, 1987: 310)

Oratosquillina quinquedentata (Ahyong, 2001: 295, Fig. 144)

Oratosquillina quinquedentate (Ahyong and Low, 2013: 597, Fig. 1B.)

Material examined: FRSACS-05, 1 ♂ (CL = 16 mm, TL = 67 mm), (22° 27' 33.7" N, 69° 48' 19.6" E) Sikka reef, Gulf of Kachchh, Gujarat: Coll: Prakash Bambhaniya on 29 December, 2021.

Description

The dorsal surface of the carapace and abdomen were smooth, carapace showed weak median or lateral carinae. Rostrum subquadrate in shape, broader than long, apex flattened. Eyes are small and do not extend to the base of the second segment of the antennular peduncle. The cornea is strongly bilobed, slightly obliquely set on the stalk. Median carinas areabsent on the first five abdominal segments. Raptorial claw oblong, merus with an inferodistal sharp spine, carpus dorsal margin with rows of small sharp teeth; dactylus with five uneven small to larger evenly spaced sharp teeth. Thoracic somites with submedian and intermedia carinae unarmed. Thoracic somite 5 lateral processes comprise a sharp spine and bilobed. Lateral process of thoracic somite 6 is broad and trapezoid, about as long as wide, with its width almost one-half that of the posterior lobe. Lateral process of thoracic somite 7 bilobed and unarmed. Abdominal somite possesses spines as follows: submedian 5-6; intermediate 4-6; lateral 4-6; marginal 1-5. Telson longer than broad, median carinae distinct, lateral margin of each side possess strong sharp teeth and a ventral surface with a strong postanal canal. Submedian, intermediate and lateral primary teeth each with smooth carina. The uropod comprises a row of nine small movable spines on the outer margin of the proximal segment of the exopod.

Colour

The entire body is beige-coloured except for the raptorial claw. Antenna with distal dark band patches. Bilobed eyes with patches of dark brown spots laterally. The raptorial claw is translucent and distal portion of the merus of the claw with light, yellow-coloured patches. Carapace and rostral plate with median, intermediate, lateral carinae and gastric groove with dark brownish lines. Thoracic and abdominal somites with diffused brownish bands on the dorsal surface. Telson is light beige with dark brown spots, and lateral margin sharp teeth are dark red at the posterior end. Uropod is translucent at the basal and proximal segments, distal half of the endopod has light yellowish bands.

Habitat

O. quinquedentata is found in burrows of the sandy bottom at the lower intertidal zone of the Sikka coast.

Distribution in the world

Arafura Sea (Brooks, 1886; Manning, 1978); Australia (Stephenson and McNeill, 1955; Ahyong, 2001; Northern Australia (Ahyong, 2001).

Distribution in India

Maharashtra (Kemp, 1913; Chhapgar and Sane, 1967, 1968; Manning, 1978); Tamil Nadu (Kemp, 1913; Alikunhi, 1952; Shanbhogue, 1969; Lyla *et al.*, 1997; Pillai and Thirumilu, 2008; Pillai *et al.*, 2014; Khan *et al.*, 2017); Odisha (Kemp, 1913; Ghosh, 1987). Presently, in this study, it is reported from the Sikka reef of the Gulf of Kachchh, Gujarat.

Remarks

Taxonomical characters of the present species are identical to the key description of Manning, (1978). *O. quinquedentata* resembles *Oratosquillina nordica* (Ahyongand Chan, 2008), but it is immediately distinguished by the width of the anterior lobe of the lateral process of thoracic somite 6. The anterior lobe of the sixth lateral thoracic somite is as long as wide with its width almost as half of the posterior lobe, broader and trapezoidal whereas in *O. nordica*, the thoracic somite-six is slenderer, digitiform and longer by about twice its width (Ahyong and Chan, 2008). *O. quinquedentata* was found in bycatch/accidental catch from trawl nets/ fishing harbour/fishing nets from various parts of India. Here, we report the occurrence of *O. quinquedentata* from the sandy bottom of the lower intertidal zone of the Sikka Reef. However, Brooks (1886) found it from the bottom having green mud at Arafura Sea.

Formerly, it was identified as an *O. quinquedentata* from the Andaman Sea, Gulf of Thailand, Peninsular Malaysia, Singapore, Indonesia (Anambas I.), China (Guangxi and Guangdong provinces) and Taiwan (Ahyong and Chan, 2008). But Ahyong and Chan (2008) re-examined the collection of *O. quinquedentata* from the various museums and erected a new species of *O. nordica*. Further, they remarked that records of *O. quinquedentata* from various authors of India and Sri Lanka (Kemp, 1913; Odhner, 1923; Manning, 1978; Ghosh, 1987) are doubtful without examining the original species. Ahyong and Chan (2008) stated that the illustration of the mantis shrimp of Manning (1978) from Bombay resembles *O. quinquedentata* in the shape of the lateral processes of thoracic somite six but differed from it by having smaller eyes. On these aspects, the present species have identical taxonomical characteristics like the shape of the lateral processes of thoracic somites six and eyes resemble *O. quinquedentata*. Hence, we confirm the occurrence of *O. quinquedentata* from the Indian coast by examining many samples and confirmation through experts.

The intertidal zone of the Gujarat coast possesses various habitat types from supratidal zones to lower intertidal zones. Sediment accumulated is high at the lower intertidal zone due to currents and the transition zone between land and ocean. The Stomatopods fauna of the Gujarat waters of India consists of 13 species belonging to 11 genera and three families. Stomatopods of Gujarat waters are primarily found in tide pools, under the crevices of dead corals and big boulders, inside the burrows of sandy bottom, coral reef zone of the lower intertidal zone. Stomatopods are often caught in fishing nets and gear. In Indian waters, a total of 75 stomatopod species are known; out of them, 20 species have been described in Indian waters. Three species *viz.*, *Manningia andamanensis* (Ghosh, 1975), *Chorisquilla andamanica* (Manning, 1975) and *Alimopsis supplex* (Wood-Mason, 1875) are endemic to Indian waters. Previously, the family Eurysquillidae (Manning, 1977) and the genus *Manningia* (Serène, 1962) were distributed in the Andaman & Nicobar Islands, but hereafter, both

Fig. 3. *Oratosquillinaquinquedentata (Brooks, 1886), Male, TL= 67 mm, Sikka reef, FRSACS-05 (a) dorsal view (b) ventral view (c) raptorial claw (d) telson (e) carapace with eyes (f) uropod. Scale: 10 mm.*

species have extended their range of distribution to the mainland of India. Here two more genera *Manningia* (Serène, 1962) and *Alimopsis* (Manning, 1977) are recorded for the first time from Gujarat waters.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENT

The authors are thankful to Junagadh Agricultural University, Junagadh for providing the necessary facilities and encouragement. We are thankful to the officials of Marine National Park, Jamnagar, for providing moral support and guidance. The authors are thankful to Professor Shane T. Ahyong (Principal Research Scientist and Manager, Marine Invertebrates Australian Museum Sydney, Australia) and Dr. Tin-Yam Chan (Institute of Marine Biology, National Taiwan Ocean University, Keelung, Taiwan R.O.C.) for his help in suggestions and identification of Stomatopoda.

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