

Occurrence and characteristics of the brown-spotted spine foot, *Siganus stellatus* (Forsskal, 1775) from Gulf of Mannar, Southeast coast of India.

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The present paper reports the occurrence of the fish, brown-spotted spinefoot, *Siganus stellatus* (Forsskal, 1775) from Gulf of Mannar waters, caught from the bottom set gillnet locally called as 'maya valai' normally deployed in reefs and over a rocky substratum. A description of the observed specimen and their morphometric differences from their congeners is provided.

[**Keywords:** Siganidae, reef fish, spine foot and Gulf of Mannar]

Introduction

Siganids, commonly recognized as rabbitfishes belong to a single genus *Siganus*, which comprises 29 described species worldwide^{1,2}. Among the recorded species around 15 species have been reported from Indian waters^{3,4,5}. Among the 15 reported species around 4 species were recorded from Gulf of Mannar waters (*S. javus*, *S. canaliculatus*, *S. lineatus* and, *S. spinus*)^{4,5}. In recent decades, the occurrence of the same species in different geographical boundaries has raised new challenges^{6,7,8}. Siganid species are currently identified mainly by means of colour and morphology characteristics such as snout shape, colour patterns, body depth and caudal fin shape^{9,10}. The fishes coming under the family Siganidae are found to occur both in brackish and marine waters, which suggest that they have a wide distributional range that includes tropical, Indo-Pacific and even the Eastern Mediterranean^{9,11,12,13}. The fishes belonging to the family Siganidae is considered as

an important food fish in India. Around 25 - 30% of the total reef fish landings from coral reef trap fishery are comprised of siganid fishes¹⁴, whereas these fishes constitute a minor fraction in fishing gears like bottom set gill net, trammel net, country trawl and bottom trawl nets.

An earlier occurrence of *S. stellatus* in Indian waters includes reports from the Lakshadweep Islands¹⁵, southern India¹⁶ and also off the waters of the Andaman Islands^{16,17,18} which suggest it is a little known species. However, no occurrence has so far been reported from Gulf of Mannar waters. The present study adds to the existing information on the range and distribution of *S. stellatus* from Indian waters, by adding recording observations from specimens collected from the Indian side of the Gulf of Mannar. The occurrence of *S. stellatus* from the Gulf of Mannar waters of the Srilankan coast^{19,20,21} already alludes to its occurrence in the Indian Gulf of Mannar as well and the present study confirms the occurrence of this

species in waters of the Gulf of Mannar, under the jurisdiction of both countries.

Materials and Methods

Three individuals of *S. stellatus* were collected from the continental shelf region of the external waters of the Keelakarai group of islands, Gulf of Mannar, the south-east coast of India (Fig.1). The fishermen from the locality abutting the Keelakarai group of islands deploy their fishing nets (*mayavalai*) in this particular region within the region of the Indian jurisdiction of the Gulf of Mannar (N 09° 08' 406'' E 079° 18' 988''; N 09° 07' 860'' E 079° 21' 558'' and N 09° 07' 172'' E 079° 23' 180''), to target commercially important reef associated fish groups (snapper-emperor-grouper complex) considered as the keystone species in the reef ecosystem^{22,23,24}, which also fetch a high price in the local markets.

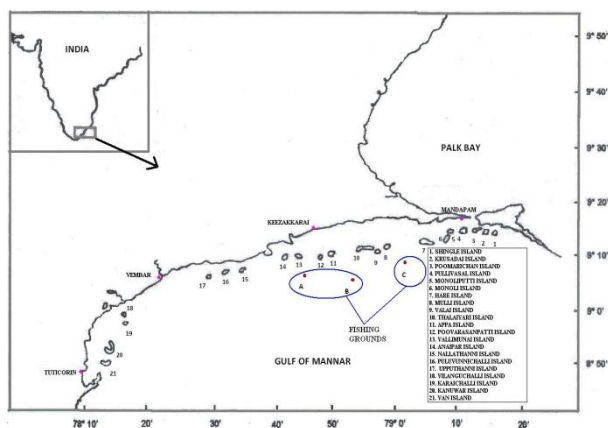


Fig. 1. Map showing the fishing grounds of the *S. stellatus* in Gulf of Mannar.

The low wave action, a shallow depth regime, and the rocky substratum make for a very specific fishing ground. Fishermen deploy a peculiar type of gill net locally called as “*Maya valai*” (a type of demersal net) with a mesh size ranging from 40 – 50 mm, with light blue monofilament netting at a depth of 1 to 4 meter. This type of fishing is carried out in the evening (19:00hrs) or early morning hours (02:00 hrs) with the soaking period of the fishing nets varies from 2-3 hours. The collected specimen from the fish landing centers were immediately photographed to record its body color and then preserved in a suitable solvent until further investigation. Morphometric and meristic analyses were carried out as per standard protocols²⁵.

Identification was carried out using FAO species catalog for the family Siganidae²⁶.



Fig. 2. *S. stellatus* (fresh specimen) from the Gulf of Mannar.



Fig. 3. *S. stellatus* (formalin preserved) from the Gulf of Mannar.

Results and discussion

Siganid fishes are the most dominant species in the alage rich areas of the Gulf of Mannar region and considered as an ecologically important species. Earlier literature reveals that two subspecies of *S. stellatus* exists viz. *S. s. stellatus* and *S. s. laqueus* differentiated by their pale green and yellow background colors respectively². In the present observation, the collected three specimens had a greenish background with chocolate brown spots all over the body with a dark black spot observed just below the dorsal fin origin. Trailing edges of dorsal, anal fins, the perimeter of caudal fin and the outer edge of the caudal peduncle was markedly paler than the rest (Fig. 3). The present examination along with earlier observations suggests that the collected specimens are *Siganus stellatus*. The body of the present specimens is laterally compressed, oval in shape, deep or slender, covered with small scales and strong scales covering the cheeks. The small mouth consists of a single row of close-set teeth in each jaw. The dorsal fin had a forward projecting spine, which was followed by 13 strong spines all of which were

venomous, and 10 soft rays which were arranged in varying inclinations on the nape (Table I). On the other hand, the pelvic fins had two strong spines separated by 3 soft rays, whereas the anal fin had 7 strong spines and 9 soft rays. The proportional measurement of the morphometric characters of the specimens in this study revealed a very small head body proportion which appears typical of this species. Similarly, it has smaller proportional percentages for the caudal peduncle, pelvic fin base, and pectoral fin base lengths. However, the proportional percentage witnessed for the moderately big eye and longer dorsal fin bases for the observed specimens are depicted in Table 2.

Table 1. Meristic characters of three specimens of *Siganus stellatus* from the Gulf of Mannar.

Meristic Characters	Specimen 1	Specimen 2	Specimen 3
Dorsal spines	XIII	XIII	XIII
Dorsal soft rays	10	10	10
Anal spines	VII	VII	VII
Anal soft rays	9	9	9
Pelvic spines	II	II	II
Pelvic soft rays	3	3	3
Pectoral soft rays	17	17	17

Table 2. Proportional measurements (in %) of morphometric characters of three specimens of *S. stellatus* of Gulf of Mannar

Morphometric Characters	Measurements Mm			Ratios (%)		
	Specimen 1	Specimen 2	Specimen 3	Specimen 1	Specimen 2	Specimen 3
Total length (TL)	320	285	286	---	---	---
Standard length (SL)	245	215	215	76.6 % of TL	75.4 % of TL	75.2 % of TL
Fork length (FL)	288	255	254	90.0 % of TL	89.5 % of TL	88.8 % of TL
Caudal fin length (CL)	75	72	72	23.4 % of TL	25.3 % of TL	25.2 % of TL
Caudal peduncle length (CPL)	30	20	20	9.4 % of TL	7.0 % of TL	7.0 % of TL
Dorsal fin base (DB)	209	182	181	65.3 % of TL	65.3 % of TL	63.3 % of TL
Anal fin base (AB)	115	130	130	35.9 % of TL	35.9 % of TL	45.5 % of TL
Pelvic fin length (VL)	40	40	40	12.5 % of TL	14.0 % of TL	14.0 % of TL
Pelvic fin base (VB)	10	10	10	3.1 % of TL	3.5 % of TL	3.5 % of TL
Pectoral fin length (PL)	53	50	51	16.6 % of TL	17.5 % of TL	17.8 % of TL
Pectoral fin base (PB)	20	20	20	6.3 % of TL	7.0 % of TL	7.0 % of TL
Head length (HL)	59	60	60	18.4 % of TL	21.1 % of TL	21.0 % of TL
Snout length (SNL)	30	27	27	50.8 % of HL	45.0 % of HL	45.0 % of HL
Eye diameter (ED)	14	14	14	23.7 % of HL	23.3 % of HL	23.3 % of HL
Body depth (BD)	120	114	114	37.5 % of TL	40.0 % of TL	39.9 % of TL
Head depth (HD)	95	83	82	79.2 % of BD	72.8 % of BD	71.9 % of BD
Caudal peduncle depth (CPD)	21	20	20	17.5 % of BD	17.5 % of BD	17.5 % of BD

Peculiar characters of siganids viz., laterally compressed, oval, deep and slender body type have been confirmed mathematically by the proportional ratio of its morphometric characters (Table 2). *S. stellatus* with a maximum length of 400 mm and the average length of 350 mm has so far been recorded in the western Pacific region^{20,27}. The length of the present specimens under study varied between 285-320 mm, with an average length of 297 mm (n=3) (Table II & Fig.3) which falls well under the size

range observed in the earlier literature. Other Siganids in the present fishing practice viz. *S. javus*, (max. length: 270mm), *S. canaliculatus* (max. length: 188 mm) and *S. lineatus* (max. length: 235 mm) were also caught from this area, and were comparatively smaller than *S. stellatus*. The spine foot, *S. stellatus* is well known in the reef-associated habitats and is found at the depth of 1 m in reefs of the Red Sea and the Caribbean²⁸. The present observations suggest that the species

although found in the reef and rocky substratum regions can occur in different depth regimes. Further explorations and *in-situ* studies on reef fish assemblages in Gulf of Mannar regions might indicate reasons for the distributional range, spatially but also along the water column.

The present study confirms the findings of earlier investigations that *S. stellatus* is found to occur both on the east and west coast of India, but detailed surveys and studies are needed along the east coast of India to know its distributional range, particularly to understand the movement or dependence, if any, of these highly preferred domestic food fish species on the shared transboundary waters of the two nations. As per the literature pertaining to Zoological Survey of India around 15 species of siganid fishes have been recorded from Indian waters viz., *S. vermiculatus*, *S. vulpinus*, *S. canaliculatus*, *S. guttatus*, *S. lineatus*, *S. spinus*, *S. stellatus*, *S. virgatus*, *S. magnificus*, *S. labyrinthodes*, *S. fuscescens*, *S. corallinus*, *S. argenteus*, *S. puelloides* and *S. javus*^{29,30,31}, which is against the 29 species recorded world wide². The siganid fishes reported from the Gulf of Mannar region includes 4 species viz., *S. canaliculatus*, *S. lineatus*, *S. spinus* and *S. javus*^{4,5}, of which *S. javus* and *S. canaliculatus* form the considerable fishery in mechanized and artisanal sectors. The local distribution of Siganid fishes are related to their ecological function such as algal browsers, croppers, mixed-feeders and spongivores³². Around 7 species of siganid fishes has been recorded from the nearby Srilankan waters, the species recorded are *S. virgatus*, *S. vermiculatus*, *S. canaliculatus*, *S. lineatus*, *S. spinus*, *S. stellatus* and *S. javus* which suggest that the study species is distributed in the Srilankan part of the Gulf of Mannar²¹. Our study and survey of existing literature point to the need for further in-depth studies on reef fish diversity in nationally shared waters such as the Gulf of Mannar to know the fish diversity.

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References

1. Randall, J. E., and Kulbicki, M., *Siganus woodlandi*, new species of rabbitfish (Siganidae) from New Caledonia. *Cybium*, 29(2005), 185-189.
2. Froese, R., and D. Pauly., Fish Base. World Wide Web electronic publication. www.fishbase.org. (12 / 2017) version.
3. Sriramachandramoorthy, V., *Marine Ornamental Fishes of India*, (Proceeding of the seminar on fisheries-A multi billion dollar Industry, Madras) 1995, p. 23-35.
4. Varghese, M., Manisseri, M. K., Ramamurthy, N., Geetha, P. M., Thomas, V. J. and Gandhi, A., Coral Reef fishes of Gulf of Mannar, Southeast coast of India. *Fish. Chimes.*, 31(2011), 38-40.
5. Murugan, A. and Namboothri, N., *Finfishes of the Gulf of Mannar Biosphere reserve: A field identification guide*. (Dakshin foundation) 2012, pp. 222.
6. Powers, D. A., Lauerman, T., Crawford, D., and DiMichele, L., Genetic mechanisms for adapting to a changing environment. *Ann. Rev. of Gen.*, 25(1991), 629-659.
7. Knowlton, N., Sibling species in the sea. *Ann. Rev. of Ecol. and Syst.*, 24(1993), 189-216.
8. Miya, C. M., and Nishida, M. Speciation in the open ocean. *Nature*, 389(1997), 803-804.
9. Woodland, D.J., Revision of the fish family Siganidae with description of two new species and comments on distribution and biology. *Indo-Pac Fish.*, 19 (1990), 1-136.
10. Borsa, P., Lemer, S. and Aurelle, D., Patterns of lineage diversification in rabbitfishes. *Mol. Phylogenet. Evol.*, 44 (1994), 53-56.
11. Jones, L. L. C. A Review of the Rabbitfishes. *Freshwat. Mar. Aquar.*, 4(1981), 42- 67.
12. Collins, L.A. and Nelson, S.G., Effect of temperature on oxygen consumption, growth, and development of embryos and yolk sac larvae of *Siganus randalli* (Pisces: Siganidae). *Mar. Biol.* 117 (1993), 195-2014.
13. Nelson, S.G. and Wilkins, S., Growth and respiration of embryos and larvae of the rabbit fish *Siganus randalli* (Pisces: Siganidae). *J. Fish Biol.* 44 (1994), 513-525.
14. Murugan, A. and Durgekar, R., Status of fisheries in Tamil Nadu, India: A snapshot of present and long-term trends. In: *Beyond the Tsunami: social, ecological and policy analyses of coastal and marine systems on the mainland coast of India*, edited by K. Shanker, N. Namboothiri. (Post-tsunami Environment Initiative Report submitted to the United Nations Development Programme. UNDP/UNTRIS, Chennai and ATREE, Bangalore, India) 2008, p. 118-178.
15. Kumaran, M. and Lalmohan, R. S., Resources of ornamental fishes. In: *Marine Living Resources of the Union territory of Lakshadweep, an indicative survey with suggestions for development*. *Bull. Cent. Mar. Fish. Res. Inst.* 43(1989), 46-64.
16. Kapoor, D., Dayal, R. and Ponniah, A. G., Fish biodiversity of India, *Nat. Bur. of Fish Gen. Res.*, Lucknow, India, (2002), pp. 775.
17. Dorairaj, K., *Study on the marine fauna from the Marine National Park, Wandoor, South Andaman*. Report submitted to the State Council of Science and Technology, A & N administration, CARI, Port Blair. 1994, pp. 166.
18. Rajan, P. T., Sreeraj, C. R., and Immanuel, T., Fish fauna of coral reef, mangrove, freshwater, offshore and seagrass

- beds of Andaman and Nicobar Islands, Zoological Survey of India, Andaman and Nicobar Regional center, Haddo, Port Blair. 2011.
19. Citravadivelu, K., Food, and feeding of *Siganus lineatus* from waters around northern Srilanka. *J. Nat. Sci. count. Srilanka*, 1984, 1-2.
 20. Woodland, D.J., Siganidae. In: *Smiths' sea fishes*, edited by Smith, M. M., and Heemstra, P. C., (Springer - Verlag, Berlin) 1986, 824-825.
 21. De Bruin, G. H. P., Russell, B. C., and Bogusch, A., FAO species identification field guide for fishery purposes. The Marine fishery resources of Sri Lanka. FAO, Rome. 1995, pp. 400.
 22. Parrish, J. D., The trophic biology of snappers and groupers. In: *Tropical Snappers and Groupers: Biology and Fisheries Management*, edited by Ralston S. and Polovina J. J. (West view Press, Boulder) 1987, pp. 405-463.
 23. Coleman, F. C., Koenig, C. C., Eklund, A. M., and Grimes, C. B., Management and conservation of temperate reef fishes in the snapper-grouper complex of the Southeastern United States. *Amer. Fish. Soc. Sym.*, 23(1999), 233-242.
 24. Murugan, A., Vinod, K., Saravanan, K.R., Anbalagan, T., Saravanan, R., Sanaye, S.V., Mojjada, S.K., Rajagopal, S. and Balasubramanian, T., Diversity, occurrence and socio economic aspects of snappers and job fish (Family : Lutjanidae) fisheries from Gulf of Mannar region, south east coast of India, *Indian J. Mar. Sci.*, 43 (2014), 618-633.
 25. Hubbs, C. L., and Lagler, K. F. Fishes of Isle Royale, Lake Superior, Michigan. *Michigan Acad. of Sci. Arts and Lett.* 33(1949), 73-133.
 26. Woodland D. J. FAO Species Identification catalog sheets *Siganidae*. 1983, p. 1-2.
 27. Woodland, D. J. Siganidae, Spinefoots, rabbitfishes. In *FAO Identification Guide for Fishery Purpose* edited by K. E. Carpenter and V. Niem., The Western Central Pacific. 1997, pp. 3627-3650.
 28. Lieske, E. and Collins, R. M., Coral reef fishes of Indo-Pacific & Caribbean including the Red Sea. Pocket Guide, 1994, p. 15.
 29. Rajan, P. T., A field guide to Marine Food Fishes of Andaman and Nicobar Islands, Published by Zoological Survey of India, 2003, pp. 1-260.
 30. Ramakrishna, Titus Immanuel, Sreeraj, C. R., Raghunathan, C., Raghuraman, R., Rajan, P. T. and Yogesh Kumar, S., An account of additions to the Ichthyofauna of Andaman and Nicobar Islands. *Rec. Zool. Surv. India, Occ.* 326(2010), pp. 1-140.
 31. Zoological Survey of India., *Fauna of Tamil Nadu, State Fauna Series*, 17(2011), 1-418.
 32. Hoey, A.S., Brandl, S.J. and Bellwood, D.R., Diet and cross – shelf distribution of rabbit fishes (f. Siganidae) on the northern Great Barrier Reef : implication for ecosystem function. *Coral Reef*, 23 (2013), 973-984.