



Description of a new species of rabbitfish (Perciformes: Siganidae) from southern India, Sri Lanka and the Maldives

DAVID J. WOODLAND^{1,3} & R. CHARLES ANDERSON²

¹Zoology, School of Environmental and Rural Science, University of New England, New South Wales 2351, Australia.

E-mail: dwoodla2@une.edu.au

²Manta Marine Pvt Ltd, PO Box 2074, Malé, Republic of Maldives. E-mail: anderson@dhivehinet.net.mv

³Corresponding author

Abstract

Siganus insomnis **sp. nov.** is described from the Maldives, Sri Lanka and southern India. It most closely resembles *S. lineatus* (Valenciennes) from the Western Pacific but differs in coloration, principally in that most if not all of the bronze bands on its mid and upper sides continue horizontally and unbroken through to the nape and opercular slit. By contrast, in *S. lineatus*, typically the anterior area below the spinous dorsal fin down to the mid-sides is irregularly marked with golden bronze spots, commas, or a maze of contorted lines. *S. guttatus* (Bloch) is the third member of this group of sibling species; its sides are covered with orange to bronze-gold spots. It is distributed throughout S.E. Asia, i.e., it occupies a geographic position between the areas inhabited by *S. lineatus* and *S. insomnis*. Thus the gene pools of *S. lineatus* and *S. insomnis* are quarantined from one another by distance and the intervening presence of *S. guttatus* in S.E. Asia. The geographical separation of the populations of *S. lineatus* and *S. insomnis* from one another is reinforced by the absence of suitable, coralline habitats for these species in the western half of the Bay of Bengal.

Key words: Siganidae, rabbitfish, *Siganus insomnis* **sp. nov.**, *Siganus lineatus*, *Siganus guttatus*, systematics, biology

Introduction

The extant species of Siganidae are morphologically a very uniform group of fishes. For example, they all have dorsal fins with 13 spines and 10 rays and anal fins with 7 spines and 9 rays. On the other hand, they may be grouped into 3 clades: deep bodied species, slender bodied species, and streamlined, spindle-shaped species. At a lower level of classification, colour patterns are most useful for distinguishing between the more closely related species. Using these criteria Woodland (1990) identified 27 species. He recognized as different a number of sibling species, mostly pairs of species, united by similarities in colour and form but distinguishable from one another by details of coloration. For example, *Siganus guttatus* (Bloch 1787) and *S. lineatus* (Valenciennes 1835) both have a very large yellow spot below the last few rays of the dorsal fin; but the sides of the former species are spotted while the sides of the latter are variously marked with a mixture of bands and spots, the bands often anastomosing or being replaced by spots antero-dorsally (Figs. 1, 2).

All the sibling species recognized by Woodland (1990) had either parapatric or allopatric distributions. Exceptionally, his *S. lineatus* also had a disjunct distribution: a widespread Western Pacific population east of Wallacea, and another in the area around southern India. He noted that specimens from Sri Lanka and southern India were marked differently from those from the Pacific: the bands on the sides breaking up into spots below the leading dorsal-fin spines with the spots continuing onto the nape in Pacific specimens but not in specimens from the area around south India. That observation was based on a sample of just four preserved specimens from southern India and Sri Lanka, and two underwater photos of fish taken in Sri Lanka: one by J.E. Randall (Woodland 1990, pl. XI, F), another by R.C. Steene (in Allen & Steene, 1987, pl. 126–4, as *S. guttatus*). The latter photo was subsequently reproduced in Burgess *et al.* 1988, Kuitert & Debelius, 2001 (as *Siganus c.f. lineatus*, “undescribed species”), and Allen *et al.*, 2003. Our second author published an underwater photo of this species

from the Maldives, also commenting on the difference in colour pattern from Western Pacific specimens and identifying it as *Siganus ? lineatus* (Anderson 2005). Since then more specimens and photos of specimens, especially from the Maldives obtained by the second author have provided sufficient evidence to support our view that the populations around the southern Indian area deserve to be recognized as a separate species, which we name here as *S. insomnis*. The populations of *S. lineatus* and *S. insomnis* are physically separated from one another by the Bay of Bengal and the area in S E Asia occupied by *S. guttatus* (Fig 8). If any gene flow between these species occurs it would likely be between the parapatric species *S. lineatus* and *S. guttatus*, rather than between *S. lineatus* and *S. insomnis*.

Two molecular studies provide qualified support for our decision to recognize the population of *S. lineatus* from the southern India area as a distinct species. Interpreting the results from cytochrome *b* gene fragments from 15 siganid species, Lemer *et al.* (2007) found that their *S. guttatus* haplogroup (n = 11 specimens) was distant from their *S. lineatus* Indo-West Pacific haplogroup (n = 19) by $d = 0.010\text{--}0.020$ while the latter was separated from the Maldives *S. lineatus* haplotype by $d = 0.024\text{--}0.027$. In fact, the single Maldives specimen resolved as an "outgroup" of a combined *S. guttatus* and Western Pacific *S. lineatus* haplogroup. In a related study on 20 siganid species, Borsa *et al.* (2007) using cytochrome *b* and rRNA fragments obtained from tissues from many of the same specimens used in the study above plus some additional specimens, found that the Maldives specimen of *S. lineatus* was "clearly distinct from all five other *S. lineatus* haplotypes sampled across the West Pacific". The *S. lineatus* haplotype from the Maldives in both these studies was a piece of tissue from our holotype of *S. insomnis* (BPBM 40390).

Material and methods

Methods of counting, measuring, terminology and presentation follow Woodland (1990). Institutional codes are as follows: AMS—Australian Museum, Sydney; BPBM – B.P. Bishop Museum, Honolulu. Comparisons with similar species are based on specimens listed in Woodland (1990).

Siganus insomnis sp. nov.

Bronze-lined rabbitfish. Local names: ori, (thammas at Addu Atoll), Maldives; oora (Tamil), leella (Sinhalese), Sri Lanka. These local names may also be used to refer to other species of *Siganus*.

Synonymy

Siganus javus (non Linnaeus 1766); Jones & Kumaran, 1980: 547 (fig. 466; Laccadive Arch., Minicoy).

Siganus lineatus (non Valenciennes 1835); Woodland, 1984 (*partim*): Sigan 7 (colour pl. and fig. are of the Western Pacific *S. lineatus*, not *S. insomnis*); Burgess *et al.*, 1988: pl. 512 (colour photo, Sri Lanka, Hikkaduwa); Woodland, 1990 (*partim*): 90 (pl. XI, F, colour photo, Sri Lanka, Trincomalee; Central Fish market, Colombo; S. India); Randall & Anderson, 1993: 39 (Maldives); De Bruin *et al.*, 1995 (*partim*): 334 (pl. XXXII, 220 and fig. are of the Western Pacific *S. lineatus*); M.R.S. 1997 (*partim*): 308 (fig. is of the Western Pacific *S. lineatus*); Allen *et al.*, 2003: 56 (colour photo, Sri Lanka, Hikkaduwa).

Siganus guttatus (non Bloch 1787); Allen & Steene, 1987: 215 (colour photo, pl. 126–4, Sri Lanka, Hikkaduwa).

Siganus sp. "Sri Lankan Rabbitfish"; Kuitert, 1998: 230 (colour photo, Sri Lanka).

Siganus c.f. lineatus "undescribed species"; Kuitert & Debelius, 2001: 164 (colour photo, Sri Lanka, Hikkaduwa).

Siganus ? lineatus; Anderson, 2005: 108 (colour photo, Maldives).

Holotype. BPBM 40390, 226 mm SL, Maldives, Addu Atoll, Feydhoo I., 1 m, R.C. Anderson, 2 August 2005.

Paratypes. BPBM 40389, 5: 228–276 mm SL, Maldives, Addu Atoll, R.C. Anderson, May 2000; AMS I. 22402-001, 2: 126.2–134.7 mm SL, Sri Lanka, Colombo, Central Fish Market, D.J. Woodland, 11 June 1977.

Diagnosis. A deep-bodied species of *Siganus* which differs from all other siganids in that the whole of the sides of the body with the possible exception of the belly and a narrow strip adjacent to the base of the spinous dorsal fin (where a row of bronze spots may occur) are decorated with horizontal, parallel bronze bands extending the full length of the sides from nape and opercular slit back to and below the large yellow spot below the base of the soft dorsal fin. The majority of these lines on the sides are complete (i.e., uninterrupted) along their length.

Comparisons with sibling species. *Siganus insomnis* differs from its sibling species *S. lineatus* (Valenciennes) in that the great majority of the bronze bands on the mid and upper sides continue without interruption as they travel the length of the sides (Figs 3, 5, 6, 7). In *S. lineatus* the golden bronze bands on the mid and upper sides are replaced by a mixture of bronze spots, commas, and meandering lines in an area anterior to a line running from the base of the middle of the dorsal fin down to the base of the pectoral fin (Fig. 2). The third sibling species, *S. guttatus*, has gold to orange spots over the whole of the sides (Fig. 1).

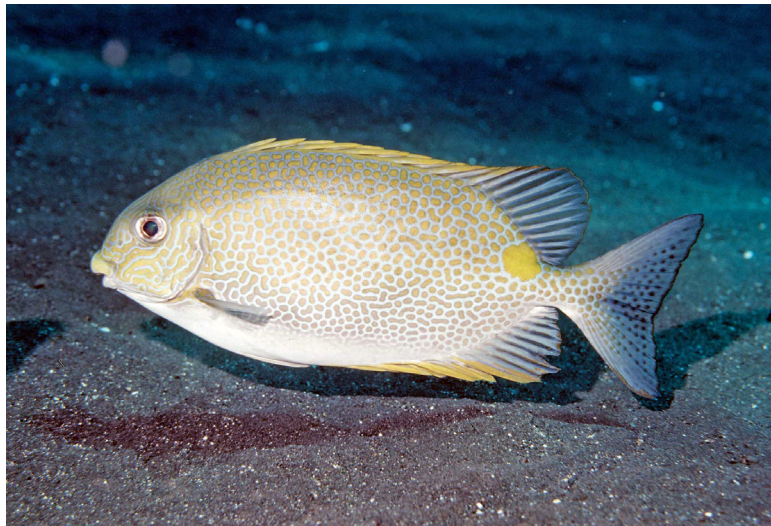


FIGURE 1. *Siganus guttatus*, large adult, ca. 30 cm SL, Tulamben, Bali, Indonesia. (Photo: R.C. Anderson)



FIGURE 2. *Siganus lineatus*, subadult, ca. 20 cm SL, Lizard I., Great Barrier Reef, Australia. (Photo: J.E. Randall)

Description. (Based on 8 specimens, 126–276 mm SL; data for the holotype given first, followed where different by data for paratypes in parentheses). D XIII, 10; A VII, 9; V I, 3, I; P 16. Scale rows, counted almost vertically, between lateral line and the bases of the 2nd to 4th dorsal-fin spine 18 (16–26). Gill rakers on 1st arch: anterior side 4 + 20 (5 + 20), posterior side 22 (22) (gills missing from the 5 paratypes from Maldives). Greatest body depth 2.1 (2.0–2.1); head 4.0 (3.3–4.0); base 2nd dorsal spine to base 1st pelvic fin spine 2.4 (2.1–2.5); base last dorsal spine to base last anal spine 2.6 (2.2–2.7); base 6th dorsal ray to base 5th anal ray 4.6 (4.5–4.9); 1st pelvic fin spine 7.0 (6.6–8.0); longest pectoral ray 5.3 (4.1–5.7) (smaller values for smaller fish); mid caudal ray 6.3 (4.9–7.2) (smaller values for smaller fish)—all in SL. Orbit 3.0 (2.5–3.2); (smaller values for smaller fish); interorbital width 2.8 (3.0–3.3); snout 2.2 (2.1–2.8); preorbital 3.2 (3.2–4.5) (smaller values for smaller fish); cheek depth 2.8 (3.0–3.3), all in length of head.

Spines stout, pungent—very pungent in juveniles. Longest dorsal spine 6th (5th–7th, but these often subequal), 1.05 (1.04–1.09) times last dorsal spine. Longest dorsal ray 2nd, 3rd subequal (2nd or 3rd), 1.4 (1.2–1.5) times longest dorsal spine. Longest anal spine the last, 1.1 (1.1–1.3) times longest dorsal spine. Longest anal ray 1st (1st, rarely 2nd), 1.3 (1.2–1.4) times longest anal spine. Caudal fin emarginate in small juveniles but becoming more forked with increasing size; even in very large fish caudal not strongly forked, outer caudal ray 1.7 (1.5–1.8) times mid caudal ray (smaller values for smaller fish).

Preopercular angle 98° (91° – 100°). Anterior nostril encircled by a very low rim, sometimes with a small peak posteriorly. Cheeks almost completely covered with strong, overlapping scales, 11 (12 or 13) vertical rows below midpoint of orbit to preopercle margin. Midline of thorax scaled, except for the two bony ridges extending forward from the bases of the outer pelvic fin spines.



FIGURE 3. *Siganus insomnis*, Holotype, BPBM 40390, 228 mm SL, Feydhoo I., Addu Atoll, Maldives. (Photo: R.C. Anderson)



FIGURE 4. *Siganus insomnis*, preserved holotype, BPBM 40390, 228 mm SL, Feydhoo I., Addu Atoll, Maldives. (Photo: D.J. Woodland)



FIGURE 5. *Siganus insomnis*, subadults, ca. 15–20 cm SL, Horubadhoo I. (= Royal I.), Baa Atoll, Maldives. (Photo: Dieter Grage)



FIGURE 6. *Siganus insomnis*, large adults, ca. 35 cm SL, Komandoo I., Lhavyani Atoll, Maldives. (Photo: Dieter Grage)



FIGURE 7. *Siganus insomnis*, adults, ca. 30 cm SL, Third Reef off Negombo, Sri Lanka. (Photo: Susan Anderson)

Colour in life. Sides of body blue, belly silvery; bronze or golden bronze, horizontal, parallel bands along length of sides; bands on upper sides sometimes interrupted but mostly continuing unbroken up to the nape; bands on mid and lower sides usually uninterrupted along whole length of sides, extending from the large yellow spot below base of soft dorsal fin and caudal peduncle through to nape and opercular slit; bands on belly variously interrupted, wavy or straight, but sometimes replaced by one to three rows of bronze spots above base of anal fin which spots extend on to the caudal peduncle and across the caudal fin. Bronze bands on upper sides extending on to nape where they terminate abruptly to create a small maze. Sometimes one or two rows of spots on sides adjacent to base of dorsal fin. Head, including interorbital zone, bronze; a blue line from behind orbit, diagonally across cheek to premaxilla; another from below eye to corner of mouth; another tracking along the margin of operculum; another from orbit to posterior nostril and then on to anterior nostril; a few blue spots on snout. Spines of dorsal and anal fins bronze to golden; soft rays of dorsal and anal fins pale blue; membrane of soft dorsal fin dark blue, often with a bronze spot at base of each ray; membrane of anal fin bronze; pectoral fin rays bluish, membrane hyaline; pelvic fin spines silvery; trailing edges of dorsal, anal and especially caudal fin bronze. Bronze spots on distal half of caudal fin arranged in columns, appearing as four to five bars when fin not expanded.

Colour after preservation. (1) of the holotype (Fig. 4) and paratypes from the Maldives, large dark brown spot (yellow in life) below base soft dorsal fin; spots on the caudal fin and peduncle dark brown and prominent; elsewhere on sides of body, a series of parallel horizontal brown lines, 1–2 mm wide, separated by paler areas, 4–5 mm wide; on mid sides, these lines run from in advance of the caudal peduncle through to the opercular slit; on upper sides traces of similar parallel lines below base of fourth dorsal fin spine to last dorsal fin spine; in all, 11–13 unbroken lines on sides above the level of the base of the pectoral fin, in the smaller specimens, lines terminating on the nape without becoming convoluted, but in the two largest specimens these lines becoming convoluted in the area anterior to the base of the fifth dorsal fin spine through on to nape; a row of match-head size brown spots on base of all membranous cells of soft dorsal and soft anal fins, otherwise all fins except caudal unmarked; head light brown with prominent brown line from posterior margin of eye to premaxillary, other lines on head less prominent than in life; (2) of the smaller paratypes from Sri Lanka, eight and traces of a ninth horizontal brown band extending from caudal region to nape and opercular slit, a short tenth one below base of spinous dorsal fin; only a few dark spots visible on caudal fin and peduncle.

Biology. *Siganus insomnis* is a very common species around the coasts of Sri Lanka. Adults live in schools, frequenting coral and sandstone reefs and also seagrass beds; juveniles live in large estuaries such as Negombo Lagoon (5km x 3km) (De Bruin *et al.* 1995). In India, this species is reported (as *S. lineatus*) from Vembanad Kayal, a brackish lake, over 200 km long, that runs parallel to the coast of Kerala State (Kurup & Samuel, 1985). It is also recorded further south in India from the Gulf of Mannar, where there are extensive coral reef areas (Varghese *et al.* 2011). It would seem estuaries are an important habitat for juveniles and sub-adults, with older fish moving to coral reefs. Previously published comments on the distribution of this species in the Maldives need to be clarified: it is **not only found in the northern atolls** (Kuitert & Debelius 2001), **nor is it only common in the south of the Maldives** (M.R.S. 1997). *S. insomnis* is here recorded from several atolls; it is particularly common in Faadhippolhu (= Lhaviyana) in the northern part of the Maldives, and in the southern part of the Maldives from Kolhumadula (= Thaa) and Addu (= Seenu) Atolls.

Like most siganids, *S. insomnis* feeds by scraping algae from rock and coral substrates and browsing on seaweeds and sea grasses. However, like many siganids it will no doubt supplement its diet with small items of animal tissue. An analysis of gut contents from specimens ranging in size from 2–27 cm SL, collected by trap and seine, from lagoons and coastal areas of Sri Lanka showed that there they fed on diatoms, green, blue-green, red and brown algae and a seagrass (Chitravadivelu & Sivapalan, 1984). Comparing percentages of gut fullness between day and night catches, these authors also found that this species appeared to have a preference for feeding during the night. Because it was mostly seen to be inactive during the day, our second author also concluded that this species appeared to be nocturnal (Anderson, 2005). In the Maldives, the fish is caught either with gill nets or with a fine line and a small hook baited with bread dough. It can be caught both by day and night. Nocturnal activity is a curious behaviour for a browsing herbivore; but it is supported by observations on its two sibling species. According to a Philippine fisherman, of the dozen or so siganid species in the Cebu area (which does not include *S. lineatus*) only *S. guttatus* entered set nets or traps at night (Woodland 1990). Our second author concluded from underwater observations in Indonesia that *S. guttatus* should be active at night “because it spent much of the daytime loitering near coral outcrops or on sandy patches” (Anderson 2000). Previously, Drew (1971)

had reported that at Palau *S. lineatus* was active at night. In a study specifically designed to investigate this phenomenon, Fox and Bellwood (2011) found that those *S. lineatus* that inhabited a boulder shoreline site at Lizard Island, Great Barrier Reef, fed during the day and slept at night, while those living on the nearby coral reef zone foraged only at night and remained stationary beside favoured coral bommies during the day.

Etymology. We chose the specific epithet *insomnis* (Latin, sleep-less) to allude to the nocturnal activity of this fish. It is an adjective agreeing in gender with *Siganus* (masculine).

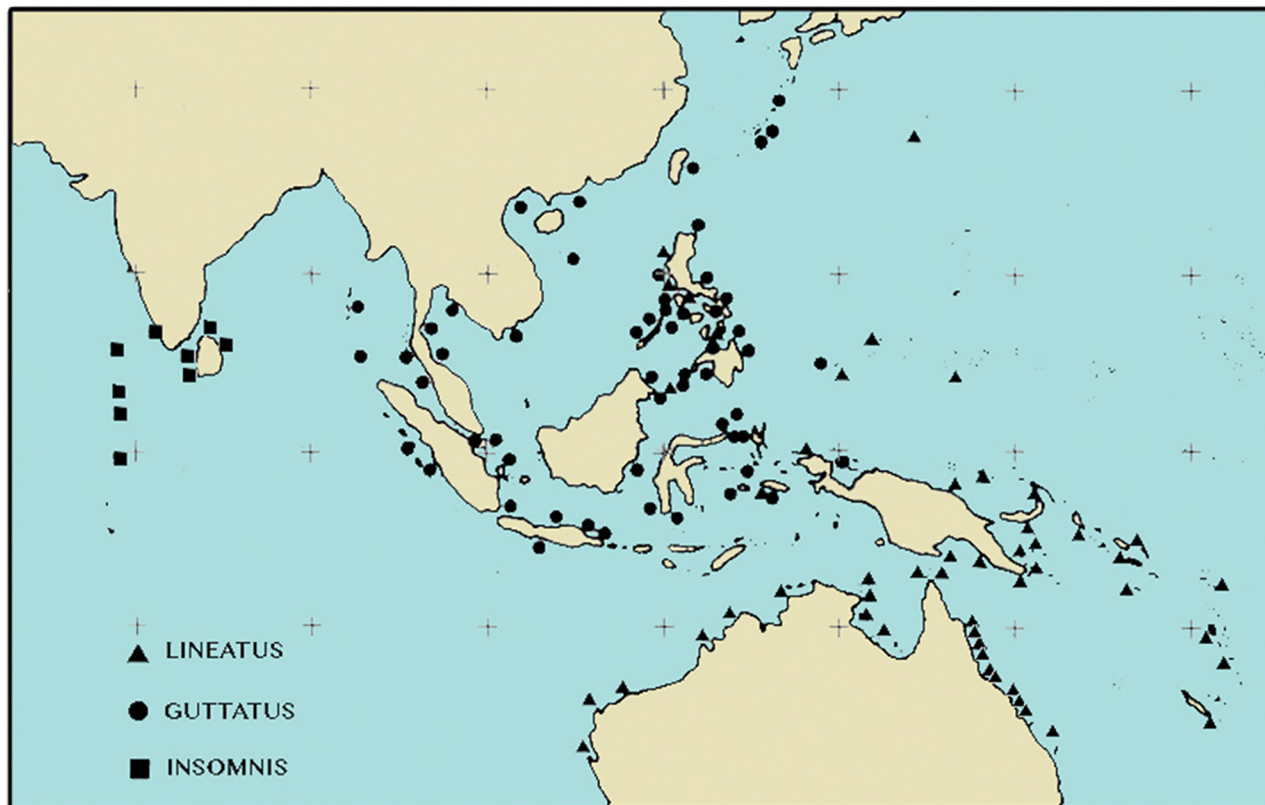


FIGURE 8. Distribution records for *Siganus insomnis* n.sp., *Siganus guttatus* (Bloch), and *Siganus lineatus* (Valenciennes). Records for *S.guttatus* and *S.lineatus* from Woodland (1990), Borsa *et al.*(2007) and Kuriwa *et al.* (2007).

Acknowledgements

We thank Dieter Grage and Susan Anderson for providing photographs of the new species and their permission to reproduce some of them in this publication. We also thank A. Suzumoto and L.O'Hara (BPBM) and M. McGrouther (AMS) for the loan of specimens, and Melanie Smith and Susan Woodland for preparing figures. We thank Ahmed Hafiz, B. Dayarathne and staff of Mirissa Water Sports for assistance in determining local names. Jack Randall provided photographs and suggested that the authors might join forces to publish this description of the new species. Tony Gill and Rudie Kuitert made some helpful suggestions which have improved the paper. We thank the University of New England and the Marine Research Centre, Ministry of Fisheries and Agriculture, Republic of the Maldives for their support.

References

- Allen, G.R. & Steene, R.C. (1987) *Reef Fishes of the Indian Ocean. Book 10, Pacific Marine Fishes*. TFH Publications, Neptune City, New Jersey, 240 pp.
- Allen, G.R., Steene, R.C., Humann, P. & DeLoach, N. (2003). *Reef Fish Identification: Tropical Pacific*. New World Publications, Jacksonville, Florida, 480 pp.

- Anderson, R.C. (2000) *An Underwater Guide to Indonesia*. Times Editions, Singapore, 160 pp.
- Anderson, R.C. (2005) *Reef Fishes of the Maldives*. Manta Marine Pvt Ltd, Malé, Maldives, 130 pp.
- Borsa, P., Lemer, S. & Aurelle, D. (2007) Patterns of lineage diversification in rabbitfishes. *Molecular Phylogenetics and Evolution*, 44, 427–435.
<http://dx.doi.org/10.1016/j.ympev.2007.01.015>
- Burgess, W.E., Axelrod, H.R. & Hunziker III, R.E. (1988) *Dr. Burgess's Atlas of Marine Aquarium Fishes*. TFH Publications, Neptune City, New Jersey, 736 pp.
- Chitravadivelu, K. & Sivapalan, A. (1984) Food and feeding of *Siganus lineatus* from waters around northern Sri Lanka. *Journal of the National Science Council of Sri Lanka*, 12, 129–139.
- De Bruin, G.H.P., Russell, B.C. & Bogusch, A. (1995) *FAO Species Identification Field Guide for Fishery Purposes. The Marine Fishery Resources of Sri Lanka*. Food and Agriculture Organization of the United Nations, Rome, 400 pp + 32 pls.
- Drew, A. (1971) Preliminary report on ksebuul and meyas, two fish of Palau Islands. Unpublished Report, Micronesian Mariculture Demonstration Center Library, Palau, 20 pp.
- Fox, R.J. & Bellwood, D.R. (2011) Unconstrained by the clock? Plasticity of diel activity rhythm in a tropical reef fish, *Siganus lineatus*. *Functional Ecology*, 25, 1096–1105.
<http://dx.doi.org/10.1111/j.1365-2435.2011.01874.x>
- Jones, S. & Kumaran, M. (1980) *Fishes of the Laccadive Archipelago*. Nature Conservation and Aquatic Sciences Service, Trivandrum, 761 pp.
- Kuiter, R.H. (1998) *Photo Guide to Fishes of the Maldives*. Atoll Editions, Apollo Bay, Australia, 257 pp.
- Kuiter, R.H. & Debelius, H. (2001) *Surgeonfishes, Rabbitfishes and their Relatives: A Comprehensive Guide to Acanthuroidei*. TMC Publishing, Chorleywood, U.K., 208 pp.
- Kuriwa, K., Hanzawa, N., Yoshino, T., Kimura, S. & Nishida, M. (2007) Phylogenetic relationships and natural hybridization in rabbitfishes (Teleostei: Siganidae) inferred from mitochondrial and nuclear DNA analyses. *Molecular Phylogenetics and Evolution*, 45, 69–80.
<http://dx.doi.org/10.1016/j.ympev.2007.04.018>
- Kurup, B.M. & Samuel, C.T. (1985) Re-description of the little known rabbitfish *Siganus lineatus* (Cuvier and Valenciennes), (Pisces: Siganidae) with notes on siganid fishes of the Vembanad Lake. *Fishery Technology*, 22, 62–65.
- Lemer, S., Aurelle, D., Vigliola, L., Durand, J.-D. & Borsa, P. (2007) Cytochrome *b* barcoding, molecular systematics and geographic differentiation in rabbitfishes (Siganidae). *Comptes Rendus Biologies*, 330, 86–94.
<http://dx.doi.org/10.1016/j.crvi.2006.09.002>
- M.R.S. (1997) *Fishes of the Maldives*. Marine Research Section, Ministry of Fisheries and Agriculture, Republic of Maldives, 408 pp.
- Randall, J.E. & Anderson, R.C. (1993) Annotated checklist of the epipelagic and shore fishes of the Maldivian Islands. *Ichthyological Bulletin of the J.L.B. Smith Institute of Ichthyology*, 59, 1–48.
- Varghese, M., Manisseri, M.K., Ramamurthy, N., Geetha, P.M., Thomas, V.J. & Gandhi, A. (2011) Coral reef fishes of the Gulf of Mannar, S.E. of India. *Fishing Chimes*, 31 (1), 38–40.
- Woodland, D.J. (1984) Family Siganidae. In: Fischer, W. & Bianchi, G. (Eds.) *FAO Species Identification Sheets for Fishery Purposes. Western Indian Ocean (Fishing Area 51)*. Vol. 4. Food and Agriculture Organization of the United Nations, Rome, looseleaf, 30 pp.
- Woodland, D.J. (1990) Revision of the fish family Siganidae with descriptions of two new species and comments on distribution and biology. *Indo-Pacific Fishes*, 19, 1–136.