

Research Article

Cite this article: Ragul S, Parmar HL, Mahadevan G, Fricke R (2024). First record of two cardinalfishes (Teleostei: Apogonidae) from northwestern India. *Journal of the Marine Biological Association of the United Kingdom* **104**, e117, 1–6. <https://doi.org/10.1017/S0025315424001061>

Received: 15 May 2024
Revised: 16 October 2024
Accepted: 23 October 2024

Keywords:

Apogonidae; Arabian Sea; Cardinalfish; distribution; new record

Corresponding author:

Gopalan Mahadevan;
Email: marinemahadevan@gmail.com

First record of two cardinalfishes (Teleostei: Apogonidae) from northwestern India

Sivakumar Ragul¹ , H. L. Parmar¹, Gopalan Mahadevan²  and Ronald Fricke³

¹Department of Fisheries Resource Management, College of Fisheries Science, Kamdhenu University, Veraval, Gujarat, India; ²Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai, Tamil Nadu, India and ³Staatliches Museum für Naturkunde in Stuttgart, Stuttgart, Germany

Abstract

The current study represents the first records of elusive cardinalfish, *Apogon fugax* Gon *et al.*, 2020 and twinbar cardinalfish, *Apogonichthyoides sialis* (Jordan and Thompson, 1914) from the Gujarat coast, northwestern India. During February 2024, regular fishing surveys were conducted to document a bycatch species assemblage. In the course of this study, a total three specimens of *A. fugax* and a single specimen of *A. sialis* were procured from Veraval Fishing Harbour, Gujarat, India. *Apogon fugax* is reported for the first time from Indian waters, while *A. sialis* is recorded for the first time from northwestern India. Herein, detailed meristic counts, morphometric measurements and the distribution of the species are described.

Introduction

Cardinalfishes are ray-finned fishes belonging to the family Apogonidae Günther, 1859, order Kurtiformes (Fricke *et al.*, 2024), found in the Atlantic, Indian, and Pacific Oceans; they are chiefly marine, but some species are found in brackish water and a few enter freshwater habitats (Johnson and Gill, 1998). Cardinalfishes are generally small fish, with most species in the range of 5 to 20 cm in standard length, and often brightly coloured (Johnson and Gill, 1998). Among other characters, they are distinguished by their large mouths which are adapted for mouth-breeding of the eggs, and the division of the dorsal fin into two separate fins. Most species live in tropical or subtropical waters, where they inhabit coral or rocky reefs and lagoon habitats (Mabuchi *et al.*, 2014).

This family consists of 381 valid species in 40 genera (Fricke *et al.*, 2024). In India, a total of 65 valid species belonging to 17 genera have been reported from various coastal regions and most of them have been reported from the Andaman and Nicobar Islands, Lakshadweep archipelagic, and the eastern and southwestern coasts of India (Saravanan *et al.*, 2017; Kumar *et al.*, 2019).

The fishes of this family have a high ecological importance owing to their trophic role, especially in reef ecosystems (Marnane, 2001). Despite their ecological significance, only a few studies have been performed to explore the diversity and distribution of apogonids of the northwestern coast of India. Therefore, in the present trawl bycatch study along the coast of Veraval, the presence of two new records of cardinalfishes could be confirmed; these species are reported and described herein.

Materials and methods

In February 2024, regular fishing surveys were conducted at Veraval Fishing Harbour (20° 54'27"N 70°23'02"E) off Gujarat, northwestern coast of India, to document the bycatch species assemblage. Specimens of cardinalfishes belonging to the genus *Apogon* and *Apogonichthyoides* were collected from the multiday trawler bycatch landed at Veraval Fishing Harbour. The collected specimens were brought to the laboratory, and then photographed. Species-level identification was based on the keys of Gon (2000), Gon *et al.* (2020), and Fraser *et al.* (2022). Morphometric measurements were taken using a Mitutoyo 150 mm Vernier caliper (nearest 0.1 mm), following the method of Hubbs and Lagler (1958). The specimens were preserved in 10% formalin for further studies. The material was deposited in the fish collection at the Department of Fisheries Resource Management, College of Fisheries Science, Kamdhenu University, Veraval (KU/COFS/MUS) for future reference.

Results

Systematic position
Order Kurtiformes
Family Apogonidae Günther, 1859
Subfamily Apogoninae Günther, 1859
Genus *Apogon* Lacepède, 1801
Apogon fugax Gon *et al.*, 2020



Elusive cardinalfish
(Figure 1A, B; Table 1)

Type locality: Off Jizan, Saudi Arabia, southern Red Sea.

Apogon fugax: Gon *et al.*, 2020: 485–504, fig 1 & table 3; Moazzam and Osmany, 2023: 50, fig 4.

Material examined. KU/COFS/MUS/010225–7, 3 ex., 46.7–58.0 mm SL (Figure 1A, B), Northwest Indian Ocean, northwestern coast of India, off Gujarat, Veraval Fishing Harbour, 20°54'27"N 70°23'02"E, collected by S. Ragul, 13 February 2024.

Description. First dorsal-fin spines VI; second dorsal-fin elements I,9; anal-fin elements II,8; pelvic-fin elements I,5; pectoral-fin rays 12/12; caudal-fin rays 10/10; lateral-line scales 23–24 + 3; predorsal scales 5–6; gill rakers on 1st arch 4 + 10–11. For detailed comparison of meristic and morphometrics see Table 1.

Body relatively elongate, somewhat deeper anteriorly, laterally compressed; body depth at pelvic-fin base 28.6–33.1% of SL; head length 38.7–42.8% of SL. Body scales ctenoid; a single large scale situated between first dorsal fin and lateral line; distance between snout and origin of first dorsal fin 41.3–42.8% of SL, between snout and origin of anal fin 60.5–62.0% of SL, and between snout and origin of pelvic fins 35.3–38.9% of SL. Caudal peduncle slender, compressed, its length 24.6–27.5% of SL, its width of 6.4–6.8% of SL, its depth 13.7–14.9% of SL.

Head profile between snout and first dorsal fin straight; nape somewhat elevated, width of head at posterior preopercular margin 13.9–14.1% of SL. Opercular margin weakly ossified. Opercle without serrations. Posterior margin of preopercle with serrae (not serrated spines). (Figure 1B). Snout elevated, its length 6.6–7.7% of SL. Eyes large, eye diameter 10.7–12.0% of SL. Mouth terminal, maxilla extending at least to below posterior margin of pupil; upper-jaw length 20.6–22.4% of SL (Figure 1B). Jaws with several rows of small villiform teeth. Tongue with a short prominent lobe.

First dorsal fin triangular, with second spine longest (16.7–17.2% of SL), first spine shortest (8.6–8.7% of SL), and third spine intermediate (14.7–16.8% of SL). Second dorsal-fin base (13.7–13.9% of SL) longer than the first dorsal-fin base (12.2–13.0% of SL). Pectoral fin elongate, pectoral-fin length 29.3–29.9% of SL; pelvic fins short, 22.4–24.6% of SL; pelvic-fin spine length 14.5–14.6% of SL. Anal-fin base similar to second dorsal-fin base, anal-fin base length 13.7–13.9% of SL. Caudal fin narrow, elongate, distally forked, its length 29.4–32.1% of SL (Table 1).

Colouration (fresh specimen) (Figure 1A, B). Body reddish orange. First dorsal-fin membrane with a patch of distinct black dots. Fins otherwise orange; distal part of caudal fin, bases of second dorsal fin, pelvic and anal fins translucent.

Coloration (preserved specimen). Body paler than in fresh condition, black dots more prominent; paired and unpaired fins pale yellowish.

Distribution and habitat. *Apogon fugax* is known from the southern Red Sea, northern Indian Ocean (Pakistan, India, Myanmar), and the southeastern Indian Ocean (Western Australia). It was collected at depths of 54–166 m (Gon *et al.*, 2020). Three adults are here recorded for the first time from the Arabian Sea off Gujarat, northwestern India (Figure 2), at depths of 70–110 m (SR, pers. comm., based on information of the fishing crew).

Systematic position

Order Kurtiformes

Family Apogonidae Günther, 1859

Genus *Apogonichthyoides* Smith, 1949

Apogonichthyoides sialis (Jordan and Thompson, 1914)

Twinbar cardinalfish

(Figure 3; Table 1)

Type locality: Suruga Bay, Pacific coast of Honshu, Japan

Material examined. KU/COFS/MUS/010229, 1 ex, 60.0 mm SL (Figure 3), Northwest Indian Ocean, northwestern coast of India, off Gujarat, Veraval Fishing Harbour, 20°54'27"N 70°23'02"E, collected by S. Ragul, 13 February 2024.

Diagnosis. First dorsal-fin spines VII; second dorsal-fin elements I,9; anal-fin elements II,8, pelvic-fin elements I,5; pectoral-fin rays 15/15; caudal rays 9/10; lateral-line scales 24 + 3; gill rakers on 1st arch 5 + 13. For detailed comparison of meristic and morphometrics see Table 1.

Body relatively deep; depth at first dorsal-fin origin 40.5% of SL. Head with a steep nape, head length 41.3% of SL, head width at posterior preopercular margin 16.1% of SL. Snout relatively short, snout length 9.1% of SL, shorter than eye diameter that equals 11.8% of SL. Mouth large, terminal, maxilla reaching to a vertical through mid-eye. Both jaws with several rows of small villiform teeth. Caudal peduncle length of 25.1% of SL, its depth 16.3% of SL.

Colouration (fresh specimen) (Figure 3). Body greyish black. A distinct black blotch on both lateral sides of the caudal peduncle. Body with two dark vertical bars, the first below first dorsal-fin origin, the second somewhat behind the second dorsal-fin origin. Fins black, except pectoral fins, caudal-fin margin, base of second dorsal fin, tips of pelvic and anal fins translucent.

Coloration (preserved specimen). Body paler than in fresh condition, black blotch and bars more prominent. Fins black to greyish.

Distribution. *Apogonichthyoides sialis* is distributed in the Indo-West Pacific from Pakistan, India, Bangladesh (Habib *et al.*, 2021) and Myanmar, east to the Philippines, north to Japan (Figure 4); and has also been reported from the United Arab Emirates (Ludt *et al.*, 2020) as *Apogonichthyoides* cf. *nigripinnis*. In India this species has previously been reported from the southeastern coast (Gon, 2000); the southwestern coast at Cochin, Kerala (Manjebraayakath *et al.*, 2012) and the northeastern coast at Visakhapatnam (Silambarasan *et al.*, 2022); here it is recorded from Gujarat, northwestern coast of India (Figure 4).



Figure 1. *Apogon fugax* (KU/COFS/MUS/010225) from northwestern India: (A) lateral view and (B) head. Scales (A-B) = 5 mm.

Table 1. Morphometric and meristic data of *Apogon fugax* and *Apogonichthyoides sialis* from Gujarat, India, compared with previous data

Parameters	<i>Apogon fugax</i>		<i>Apogonichthyoides sialis</i>	
	Gon <i>et al.</i> (2020)	Present study	Manjebraayakath <i>et al.</i> (2012)	Present study
	<i>n</i> = 5	<i>n</i> = 3	<i>n</i> = 5	<i>n</i> = 1
Total length (mm)	–	63.1–73.2	115.2–133.6	87.1
Standard length (mm)	42.5–59.6	46.7–58.0	89.4–102.8	60.0
Measurements in % of SL				
Head length	41.9–45.4	38.7–42.8	41.9–45.3	41.3
Head width	–	13.9–14.1	–	16.1
Eye diameter	11.4–13.4	10.7–12.0	11–12.5	11.8
Snout length	7.5–8.9	6.6–7.7	10–10.7	9.1
Interorbital width	7.4–7.9	6.6–7.5	9.4–10.3	9.1
Maxillary width	5.6–6.0	5.5–5.9	–	5.0
Body depth	30.7–34.1	28.6–33.1	41.4–44.4	40.5
Body width	17.9–19.6	15.8–17.3	17–17.9	16.5
First dorsal-fin first spine	8.6–10.5	8.6–8.7	2.1–4.4	4.8
First dorsal-fin second spine	16.5–17.9	16.7–17.2	7.1–9.3	9.1
First dorsal-fin third spine	15.8–17.1	14.7–16.8	22.3–22.6	21.5
Spine of second dorsal fin	13.8–14.6	12.8–14.6	18.7–20.4	20.1
First anal-fin spine	2.9–3.1	3.2–3.4	3.4–5.1	4.0
Second anal-fin spine	12.6–12.7	12.8–12.9	15.6–16.7	16.6
Length of anal fin ray	23.2–24.2	23.2–23.5	24.2–29.8	25.8
Predorsal length	41.4–43.1	41.3–42.8	44.6–48.3	43.3
Preanal length	61.8–64.0	60.5–62.0	–	62.0
Prepelvic length	37.2–40.1	35.3–38.9	39.2–42.3	40.8
Pelvic-fin to anal-fin origin	25.0–29.4	28.9–31.2	–	24.8
Length of first dorsal-fin base	–	12.2–13.0	17.4–20.1	17.5
Length of second dorsal-fin base	–	13.7–13.9	15.5–17	14.8
Length of second dorsal fin ray	25.5–25.6	23.2–23.5	21.9–31.3	31.5
Length of anal-fin base	–	13.7–13.9	14.8–16	14.1
Pectoral-fin length	29.2–30.3	29.3–29.9	25.8–28.3	25.0
Pelvic-fin length	23.1–24.0	22.4–24.6	25–31.5	25.1
Pelvic-fin spine length	14.2–15.1	14.5–14.6	15.6–18	18.5
Caudal peduncle length	25.9–28.2	24.6–27.5	19.5–24.8	25.1
Caudal peduncle depth	13.4–14.0	13.7–14.9	16.1–17.5	16.3
Caudal-fin length	31.4–35.5	29.4–32.1	–	30.3
Counts				
First dorsal-fin spines	VI	VI	VII	VII
Second dorsal-fin elements	I, 9	I, 9	I, 9	I, 9
Anal-fin elements	II, 8	II, 8	II, 8	II, 8
Pectoral-fin rays	12/12	12/12	15–16	14/14
Pelvic-fin rays	I, 5	I, 5	I, 5	I, 5
Caudal-fin rays	–	10/10	–	9/10
Predorsal scales	6–7	5–6	4	4
Lateral-line scales	24 + 3	23–24 + 3	23–24 + 2–4	24 + 3
Gill rakers on 1st arch	4–5 + 10–11	4 + 10–11	5 + 14	5 + 13

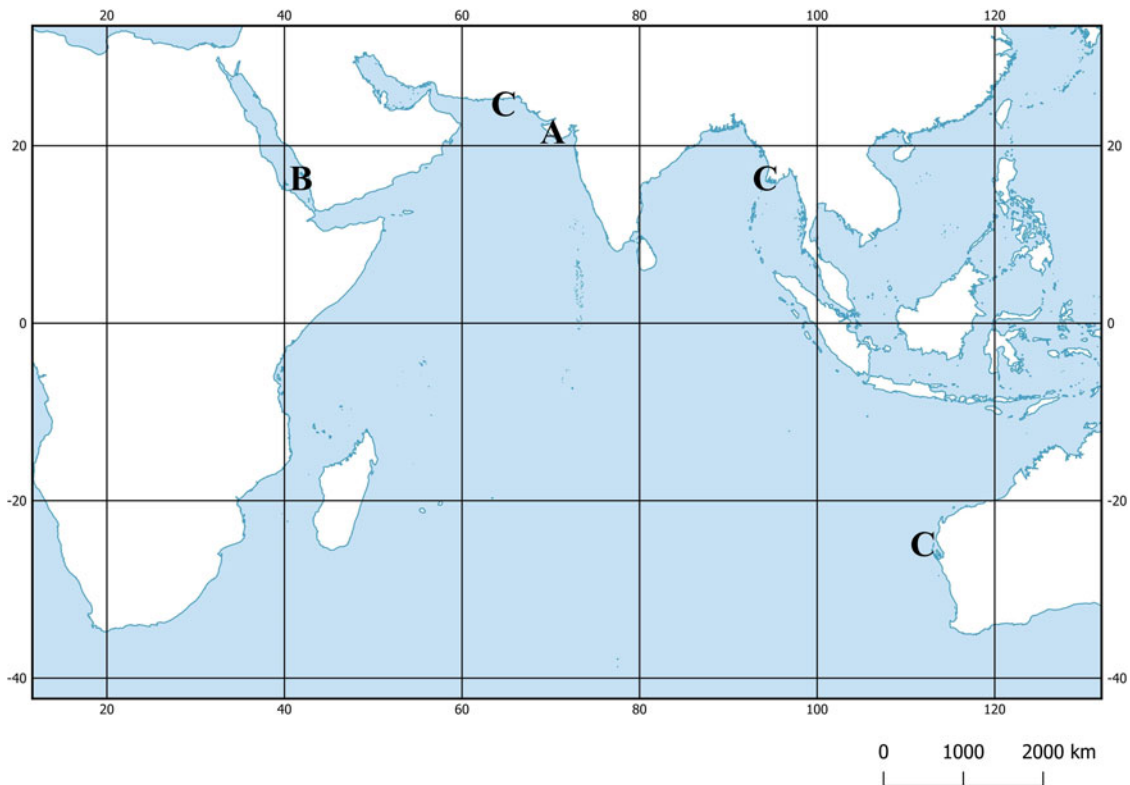


Figure 2. Geographical distribution of *Apogon fugax* in the Indian Ocean, showing (A) new record from Gujarat, (B) type locality, and (C) other records.



Figure 3. Lateral view of *Apogonichthyoides sialis* (KU/COFS/MUS/010229) from northwestern India. Scale = 10 mm.

Discussion

A comparison of *Apogon fugax* with other closely related apogonid species showed that it differs significantly from all of them in many morphometric and meristic characters: smaller size, larger head, preopercle with serrae in one vertical row, numbers of dorsal, anal and pectoral-fin rays. In addition to the above differences, *A. fugax* differs from *Apogon deetsie* Randall, 1998 by having a plain colouration without a distinct band on the body (vs a black bar on the caudal peduncle present in *A. deetsie*). *Apogon fugax* differs from *Apogon rubrifuscus* Greenfield and

Randall, 2004, *Apogon caudicinctus* Randall and Smith, 1988 and *Apogon dianthus* Fraser and Randall, 2002 in having fewer gill rakers on the first arch, 4 + 10–11 (vs 4 + 13 in *A. caudicinctus*; 4–5 + 14–18 in *A. dianthus*; 5 + 15 in *A. rubrifuscus*).

Apogonichthyoides sialis is most similar to *Apogonichthyoides pseudotaeniatus* (Gon, 1986), but differs in having a lower number of lower gill rakers on the first arch 13 (vs 14 in *A. pseudotaeniatus*), the length of the second spine of the first dorsal fin 20.1% of SL (vs 15–19% in *A. pseudotaeniatus*), and the pelvic spine length 18.5% of SL (vs 16–17% in *A. pseudotaeniatus*).

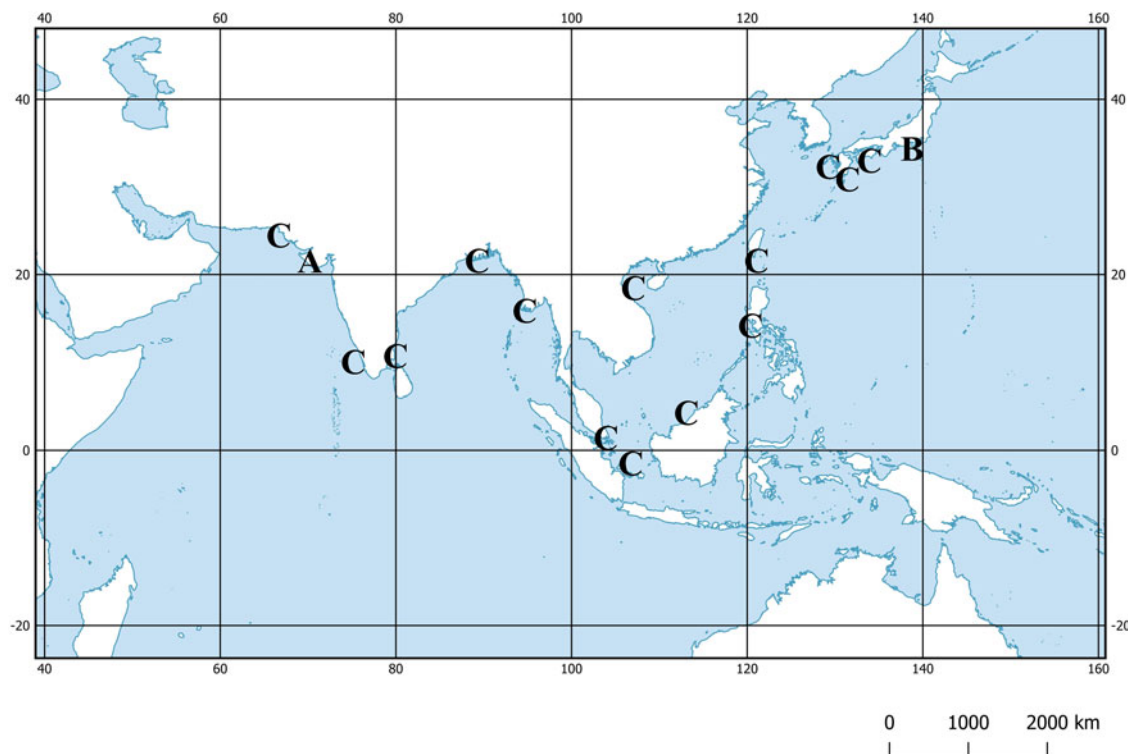


Figure 4. Geographical distribution of *Apogonichthyoides sialis* in the Indo-West Pacific, showing (A) new record from Gujarat, (B) type locality, and (C) other records.

Conclusion

The present specimens of *Apogon fugax* and *Apogonichthyoides sialis* were collected in association with the other apogonid fishes, namely *A. pseudotaeniatus* (Gon, 1986), *Jaydia ellioti* (Day, 1875), *J. lineata* (Temminck and Schlegel, 1843), *J. queketti* (Gilchrist 1903), *J. striata* (Smith and Radcliffe, 1912), *J. striatodes* (Gon, 1997), and *Ostorhinchus fasciatus* (Shaw, 1790). The present report of *A. fugax* from off Gujarat confirms the first documentation from Indian waters. Records of *A. fugax* are sparse, but they seem to indicate an anti-equatorial distribution pattern in the northern and southeastern Indian Ocean, with a wide gap in the equatorial regions.

Acknowledgements. The authors are grateful to the Principal, College of Fisheries Science, Kamdhenu University, for providing facilities enabling this work. The authors wish to extend their sincere gratitude to the anonymous reviewers and the editor, Dr Jim Ellis for their valuable comments and suggestions to improve the manuscript.

Financial support. This research received no specific grant from any funding agency, commercial or not-for-profit sectors.

Data Availability Statement. All relevant dataset supporting the conclusions of this article is included within the article.

Author contributions. S.R. and G.M. wrote the first version of the manuscript. S.R. carried out field sampling and collected the specimens. All authors contributed to the draft, provided critical feedback and helped shape the research. All authors read and approved the final manuscript.

Competing interest. None.

Ethical standards. Not applicable.

References

Fraser TH, Gon O and Kraai M (2022) Family apogonidae, cardinalfishes. In Heemstra PC, Heemstra E, Ebert DA, Holleman W and Randall JE (eds),

Coastal Fishes of the Western Indian Ocean, vol. 3. Makhanda, South Africa: South African Institute for Aquatic Biodiversity, pp. 167–223, Pls. 52–68.

Fricke R, Eschmeyer WN and Fong JD (2024) Eschmeyer's catalog of fishes: genera/species by family/subfamily, updated 11 May 2024. Available at <http://researcharchive.calacademy.org/research/ichthyology/catalog/SpeciesByFamily.asp>. Electronic version (accessed 13 May 2024).

Gon O (2000) The taxonomic status of the cardinalfish species *Apogon niger*, *A. nigripinnis*, *A. pharaonis*, *A. sialis*, and related species (Perciformes: Apogonidae). *Special Publications, J.L.B. Smith Institute of Ichthyology, Rhodes University* 65, 1–20.

Gon O, Bogorodsky SV, Mal AO and Alpermann TJ (2020) A new species of cardinalfish genus *Apogon* (Teleostei, Apogonidae) from the southern Red Sea and Indian Ocean with comments on phylogenetic relationships within the Apogonini. *Zootaxa* 4896, 485–504.

Habib KA, Islam MJ, Nahar N, Neogi AK and Fraser TH (2021) Three new records of Cardinalfish (Apogonidae) from the Northern Bay of Bengal, Bangladesh. *Journal of Ichthyology* 61, 505–513.

Hubbs CL and Lagler KF (1958) *Fishes of the Great Lakes Region*. University of Michigan Press, Ann Arbor, 545 pp.

Johnson GD and Gill AC (1998) Paxton JR and Eschmeyer WN (eds), *Encyclopedia of Fishes*. San Diego: Academic Press, p. 183. ISBN 0-12-547665-5.

Jordan DS and Thompson WF (1914) Record of the fishes obtained in Japan in 1911. *Memoirs of the Carnegie Museum* 6, 205–313.

Kumar R, Dineshbabu AP, Jaiswar AK, Shenoy L, Kumar AP, Rahangdale S, Vase V and Damodaran D (2019) New distributional records for cardinalfishes (Perciformes/Apogonidae) from north east Arabian Sea, western Indian Ocean. *Thalassas: An International Journal of Marine Sciences* 35, 341–346.

Ludt WB, Jabado RW, Al Hameli SM, Freeman L, Teruyama G, Chakrabarty P and Al Dhaheri SS (2020) Establishing a reference collection and DNA barcoding the coastal fishes of the United Arab Emirates. *Journal of the Ocean Science Foundation*, 35, 54–64.

Mabuchi K, Fraser TH, Song H, Azuma Y and Nishida M (2014) Revision of the systematics of the cardinalfishes (Percomorpha: Apogonidae) based on molecular analyses and comparative reevaluation of morphological characters. *Zootaxa* 3846, 151–203.

Manjebraayakath H, Akhilesh KV and Pillai NGK (2012) Report of *Apogonichthyoides sialis* (Perciformes: Apogonidae) from the west coast of India. *Marine Biodiversity Records* 5, e15, pp. 1–3.

- Marnane MJ** (2001) The trophic role of cardinalfishes (family Apogonidae) on coral reefs. Dissertation, James Cook University, pp. 1–135.
- Moazzam M and Osmany HB** (2023) Review of cardinal fishes of family Apogonidae of Pakistan. *International Journal of Biology and Biotechnology* **20**, 47–80.
- Saravanan R, Purushottama GB and Rohit P** (2017) Diversity and distribution of cardinalfishes in Indian coastal waters with an occurrence report of spot fin cardinalfish *Apogon queketti* from central southwest coast of India. 4th Indian Biodiversity Congress, Puducherry, India.
- Silambarasan K, Kar AB, Prasad GV, Pattnayak SK and Ramalingam L** (2022) New records of six fish Species from reef off Visakhapatnam Coastal Waters, Northeast Coast of India. *Thalassas* **38**, 401–409. <https://doi.org/10.1007/s41208-021-00353-w>