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Lists of Species

A preliminary checklist of the cardinalfishes (Actinopterygii: Gobiiformes: Apogonidae) of Singapore

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Abstract: We record the presence of 35 cardinalfish species from the marine waters of Singapore based on a review of existing literature and examination of museum specimens. Another 13 species previously recorded as occurring in Singapore are considered doubtful records. Five of the 35 species reported here (*Apogon crassiceps*, *Apogonichthyoides timorensis*, *Jaydia lineata*, *Nectamia similis*, and *Siphamia tubifer*) are new records for Singapore, while another four species have not been encountered in more than a century.

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Introduction

The family Apogonidae (cardinalfishes) is a circumtropical group found primarily in marine environments. They are one of the largest groups of reef fishes in the Indo-Pacific, with about two-thirds of the 270 or so species known in the family being found there. Cardinalfishes are easily distinguished by their distinctly separate dorsal fins (with the first consisting of six to eight spines), two anal spines, relatively large eyes and mouth, and preopercle with a ridge preceding the margin. They are primarily nocturnal, and predominantly consist of micropredators or piscivores.

Despite its ubiquity in Indo-Pacific waters, the cardinalfishes of Singapore have been poorly studied, with the only comprehensive checklist being those of Bleeker (1860b), who recorded 30 species, and Fowler (1938), who recorded 32 species. The objective of this study is to reassess the status of Singapore's cardinalfish fauna with the view of producing an annotated checklist that incorporates recent changes to cardinalfish classification.

Material and Methods

The present checklist was compiled from the examination of museum specimens (deposited in the Zoological Reference Collection of the Raffles Museum of Biodiversity Research, National University of Singapore), correspondence with local divers, as well as specimen-based records in the literature. Nomenclature and classifications of the fishes follow Mabuchi *et al.* (2014), with common names following those of Kuiter and Kozawa (2001). All material examined in this study is deposited in the Zoological Reference Collection, Raffles Museum of Biodiversity Research, Singapore (ZRC).

We consider records to be verifiable only if there is physical evidence such as specimen(s), drawing(s) or photograph(s) to substantiate the presence of a cardinalfish speices in Singapore. Records based on specimens not readily identifiable as coming from Singapore, and those based on specimens of unknown provenance are considered separately in Table 1. We also did not use unpublished museum records for which the provenance of the specimens could not be identified (i.e. the specimens could have been purchased from markets or ornamental fish exporters, but not necessarily caught, in Singapore).

Results

We record 35 species of cardinalfishes from Singapore waters, with another 13 species being considered doubtfully occurring (Table 1). Five species are recorded from Singapore for the first time: *Apogon crassiceps*, *Apogonichthyoides timorensis*, *Jaydia lineata*, *Nectamia similis*, and *Siphamia tubifer*. The degree of uncertainty surrounding the occurrence and identity of some of the cardinalfish species treated here renders further survey and study of Singapore's cardinalfish fauna necessary.

Annotated checklist of the cardinalfishes of Singapore

1. ***Apogon crassiceps*** Garman, 1903.
Dusky Red Cardinalfish
Figure 1

Material examined: ZRC 29504 (n=1); ZRC 40666(n=2); Pulau Hantu.

Remarks: *Apogon crassiceps* was described as having two scales between the lateral line and the first dorsal fin. Our specimen exhbits one large scale and one smaller scale between the lateral line and first dorsal fin, a character found in most members of the *A. coccineus* species complex (to which *A. crassiceps* belongs; Greenfield and Schaefer, 2001; Greenfield and Randall, 2004). This species is known from the eastern Andaman Sea to the Line and Tuamotu islands, and from Australia to Japan and the Ogasawara Islands (Allen and Erdmann 2012), and represents a new record for Singapore.

Table 1. Dubious records of cardinalfishes from Singapore.

SCIENTIFIC NAME	COMMON NAME	REMARKS
Apogonichthyoides taeniatus (Cuvier, 1828)	Two-belt Cardinalfish	Known only from the Red Sea and western Indian Ocean (Gon and Randall 2003); record by Steindachner (1870) is likely misidentification of either *A. cantoris* or *A. timorensis*
Jaydia poeciloptera (Kuhl & van Hasselt, 1828)	Pearly-finned Cardinalfish	Not encountered in Singapore waters since Károli (1882); likely misidentification of *J. lineata*
Jaydia novaeguineae (Valenciennes, 1832)	New Guinea Cardinalfish	Not encountered in Singapore waters since Bleeker (1860b); likely misidentification of *J. lineata* (see Gon 1996)
Ostorhinchus apogonides (Bleeker, 1856)	Plain Cardinalfish	Not encountered in Singapore waters since Károli (1882)
Ostorhinchus aureus (Lacepède, 1802)	Ring-tail Cardinalfish	Record based on photograph of specimen purportedly from Singapore in Debelius (2001), who did not indicate Singapore as a locality from which photographs in the book were taken
Ostorhinchus chrysotaenia (Bleeker, 1851)	High-fin Cardinalfish	Record by Khoo and Tay (1990) not substantiated by photographs or specimens; likely misidentification of *O. cavitensis*
Ostorhinchus cyanosoma (Bleeker, 1853)	Orange-lined Cardinalfish	Record by Low and Chou (1994) not substantiated by photographs or specimens; likely misidentification of *O. cavitensis*
Ostorhinchus hoevenii (Bleeker, 1854)	Flag-fin Cardinalfish	Weber and de Beaufort's (1929) record not based on material
Ostorhinchus moluccensis (Valenciennes, 1832)	Moluccan Cardinalfish	Not encountered in Singapore waters since Bleeker (1860a)
Ostorhinchus sealei (Fowler, 1918)	Cheek-bar Cardinalfish	Record by Low and Chou (1992) not substantiated by photographs or specimens;
Ostorhinchus thermalis (Cuvier, 1829)	Masked Cardinalfish	Weber and de Beaufort's (1929) record not based on material
Pristiapogon fraenatus (Valenciennes, 1832)	Tapered-line Cardinalfish	Species recorded as *Apogon melanorhynchos* by Bleeker (1858); none of extant Bleeker specimens of *A. melanorhynchos* agree with the illustration of *Amia melanorhynchos* in Bleeker (1875–76: Pl. 343, Fig. 1), which is that of *P. fraenatus* (see Fraser & Lachner, 1985); record considered dubious due to uncertainty in identity and lack of corroborating material
Rhabdamia gracilis (Bleeker, 1856)	Slender Cardinalfish	Not encountered in Singapore waters since Károli (1882)

2. ***Apogonichthyoides melas*** (Bleeker, 1848).
Black Cardinalfish
Figure 2

Apogon melas—Bleeker 1860b: 48; Weber and de Beaufort 1929: 3=09; Herre and Myers 1937: 24.

Amia melas—Fowler 1938: 131.

Apogon niger (*non* Döderlein)—Ng *et al.* 1994: 326.

Material examined: ZRC 29503 (n=1); ZRC 40994 (n=2); Pulau Hantu. ZRC 35362 (n=1); ZRC 53656(n=1); Pulau Semakau. ZRC 38119 (n=1); Labrador Beach. ZRC 53645 (n=1); Marina Bay. ZRC 53648 (n=1); Seletar River mouth. ZRC 7660 (n=1); Punggol.

Remarks: The assignment of this species in *Apogonichthyoides* follows that of Mabuchi *et al.* (2014).

3. ***Apogonichthyoides niger*** (Döderlein in Steindachner & Döderlein, 1883). Black-finned Cardinalfish

Apogon niger—Gon 2000: 3.

Material examined: None. Material from Singapore listed in Gon (2000).

4. ***Apogonichthyoides timorensis*** (Bleeker, 1854).
Timor Cardinalfish
Figure 3

Apogon melas (*non* Bleeker)—Tan *et al.* 2010: 139.

Material examined: ZRC 53595 (n=1); ZRC 53596 (n=1); Marina Bay.

Remarks: This species was previously misidentified as *A. melas* by Tan *et al.* (2010), but *A. timorensis* can be distinguished from *A. melas* in lacking (*vs.* having) the pale-edged black spot at the base of the second dorsal fin (Allen and Erdmann 2012). This is the first record of this species from Singapore.

Figure 1. *Apogon crassiceps*, ZRC 29504, 39.7 mm SL; Pulau Hantu.

Figure 2. *Apogonichthyoides melas*, ZRC 53645, 90.5 mm SL; Marina Bay. Photograph courtesy of Tan Heok Hui.

Figure 3. *Apogonichthyoides timorensis*, ZRC 53596, 92.8 mm SL; Marina Bay. Photograph courtesy of Tan Heok Hui.

5. ***Archamia bleekeri*** (Gunther, 1859).
Bleeker's Cardinalfish
Figure 4

Apogon macropterus (*non* Cuvier)—Bleeker 1860b: 31, 48.
Apogon lineolatus (*non* Cuvier)—Weber and de Beaufort 1929: 347.
Archamia lineolata (*non* Cuvier)—Herre and Myers 1937: 25; Fowler 1938: 133.
Archamia goni—Kuiter and Kozawa 2001: 104.
Archamia macroptera (*non* Cuvier)—Chua 2002: 108.
Archamia bleekeri—Gon and Randall 2003: 19; Allen and Erdmann 2012: 373.

Material examined: ZRC 53655 (n=2); ZRC 53657 (n=4); Marina East. ZRC 53589 (n=1); East Coast Park. ZRC 46479 (n=4); Pulau Ubin: Tanjong Chek Jawa. ZRC 36679–36681 (n=3); ZRC 41760 (n=1); ZRC 46538 (n=1); ZRC 46660 (n=1); ZRC 47805 (n=13); Changi Point beach.

6. ***Cheilodipterus artus*** Smith, 1961.
Indian Arrow-tooth Cardinalfish

Cheilodipterus artus—Gon 1993: 19; Ng 2009: 108; Heng and Lim, 2013: 65, Figs 2, 3.

Material examined: None. Material from Singapore listed in Gon (1993).

Remarks: Some of the records of this species from Singapore may be referable to *C. macrodon* instead (see remarks for that species).

7. ***Cheilodipterus macrodon*** (Lacepède 1801).
Indian Tiger Cardinalfish
Figure 5

Apogon melanurus Bleeker 1860a: 454 (type locality: Singapore); 1860b: 48; Weber and de Beaufort 1929: 349; Russell *et al.* 2010: 95 (possibly synonym of *Cheilodipterus macrodon).*

Figure 4. *Archamia bleekeri*, ZRC 53655, 54.3 mm SL; Marina East. Photograph courtesy of Tan Heok Hui.

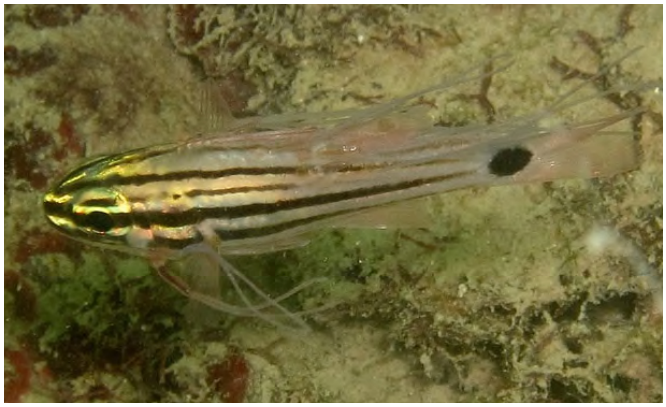

Figure 5. *Cheilodipterus macrodon*, *ca.* 30 mm SL infested with parasitic copepods; Sisters' Islands. Specimen not preserved. Photograph courtesy of Eunice Khoo.

Figure 6. *Cheilodipterus quinquilineatus*, ZRC 30661, 42.8 mm SL; Pulau Hantu.

Cheilodipterus lineatus (*non* Forsskål)—Bleeke 1860b: 47.
Apogon macrodon—Weber and de Beaufort 1929: 363.
Amia melanurus—Fowler 1938: 130.
Cheilodipterus lineatus—Fowler 1938: 134.
Cheilodipterus macrodon—Low and Chou 1992: 141; Ng *et al.* 1994: 326.

Material examined: None. Based on photographs taken in Singapore waters (Figure 5).

Remarks: The identification of this species is tentative, following the records by Bleeker (1860a, 1860b) and photographs of both juveniles and adults taken by divers in Singapore waters. It is possible that the records of this species in Singapore may refer to *C. artus* instead as both it and *C. macrodon* have a very similar color pattern. The only way to reliably distinguish the two is to count the developed gill rakers (11–15 in *C. artus* and 7–10 in *C. macrodon*; Gon 1993) or to observe the morphology of the posterior margin of the preopercle (smooth in *C. artus* and serrate in *C. macrodon*; Gon 1993). However, we were unable to obtain specimens from Singapore to verify if both species are present here. We retain the record of this species on the basis of a photograph illustrating a juvenile specimen (from Sisters' Island; Figure 6) because it possesses a large caudal peduncle spot (the juveniles of *C. artus* have a small caudal peduncle spot; Gon 1993).

8. ***Cheilodipterus quinquelineatus*** (Cuvier *in* Cuvier & Valenciennes, 1828). Five-line Cardinalfish
Figure 6

Cheilodipterus quinquelineatus—Bleeker 1860b: 31, 48; Weber and de Beaufort 1929: 361; Fowler, 1938: 134; Khoo and Tay 1990: 76; Gon 1993: 51; Low and Chou, 1992: 141; Ng *et al.* 1994: 326; Lim and Low 1998: 93; Kwik *et al.* 2010: 127.

Material examined: ZRC 38012 (n=1); Terumbu Pempang Tengah. ZRC 30661 (n=1); Pulau Hantu.

9. ***Cheilodipterus singapurensis*** (Bleeker, 1860). Singapore Cardinalfish
Figure 7

Cheilodipterus singapurensis Bleeker 1860a: 452 (type locality: Singapore); 1860b: 48; Weber and de Beaufort 1929: 360; Fowler 1938: 134; Gon 1993: 54; Russell *et al.* 2010: 95; Allen and Erdmann 2012: 378; Kwik 2012: 95.
Chilodipterus [*sic*] *singapurensis*—Tan *et al.* 2010: 139.

Material examined: ZRC 53592 (n=1); Singapore Straits near Sentosa. ZRC 53597 (n=1); ZRC 53644 (n=1); Marina Bay.

10. ***Fibramia amboinensis*** (Bleeker, 1853).
Ambon Cardinalfish
Figure 8

Apogon amboinensis—Bleeker 1860b: 31, 48; Károli 1882: 152; Weber and de Beaufort 1929: 340; Herre and Myers 1937: 24; Tweedie 1936: 25.

Amia amboinensis—Bleeker 1871–76: 90; Fowler 1931: 445; 1938: 128, 261.

Material examined: ZRC 53619 (n=4); Sungei Tengeh.

Remarks: This species is very similar to *F. lateralis*, but can be distinguished in having a short, dark lateral streak along the dorsal part of the flanks that the other species lacks. Some of the previous records of this species from Singapore may refer to *F. lateralis* instead, but we are unable to verify this.

11. ***Fibramia lateralis*** (Valenciennes, 1832).
Coastal Cardinalfish
Figure 9

Apogon ceramensis—Bleeker 1858: 242; 1860b: 48; Károli 1882: 152; Weber and de Beaufort 1929: 338.

Amia ceramensis—Bleeker 1871–76: 91; 1875–76: Pl. 336, Fig. 1

Amia laterale—Fowler 1938: 130 (Serangoon)

Apogon lateralis—Chua 2002: 108; Ng 2009: 108.

Material examined: ZRC 53684 (n=3); Raffles Marina. ZRC 2373 (n=23); Sungei Poyan. ZRC 2374 (n=6); Sungei Berih. ZRC 781 (n=52); Sungei Tengeh. ZRC 51087 (n=3); Sarimbun fence. ZRC 2372 (n=5); Sungei Kangkar. ZRC 26429–26433 (n=5); Sungei Sawa. ZRC 26160–26199 (n=40); Sungei Kranji. ZRC 2375 (n=7); Sungei Peng Siang. ZRC 30657–30658 (n=2); ZRC 32582–32588 (n=7); Pulau Hantu. ZRC 53147 (n=1); Pulau Semakau. ZRC 2371(n=1); Pulau Brani. ZRC 27157 (n=1); ZRC 27180 (n=1); Pulau Sakijang Bendera (St. John's Island). ZRC 7197–7203 (n=7); Punggol. ZRC 10525–10528 (n=4); Sungei Punggol. ZRC 1752 (n=54); Sungei Changi. ZRC 46517 (n=6); Pulau Ubin: Tanjong Chek Jawa.

12. ***Fowleria variegata*** (Valenciennes, 1832).
Variegated Cardinalfish
Figure 10

Apogonichthys polystigma—Bleeker 1860b: 31, 48; Fowler 1938: 133.

Apogonichthys auritus (*non* Valenciennes)—Herre and Myers 1937: 25; Tweedie 1940: 70.

Material examined: ZRC 2380 (n=4); ZRC 41008 (n=1); Sultan Shoal. ZRC 37455–37458 (n=4); Pulau Satumu (Raffles Lighthouse). ZRC 30481 (n=1); ZRC 36544 (n=1); Pulau Semakau.

13. ***Jaydia lineata*** (Temminck & Schlegel, 1842).
Ten-bar Cardinalfish
Figure 11

Material examined: ZRC 53454 (n=1); Serangoon Harbour, between Pulau Ubin and Pulau Serangoon.

Remarks: We follow Russell *et al.* (2010) and Mabuchi *et al.* (2014) in considering *Jaydia* as a valid genus on the basis of the following synapomorphies outlined in Gon (1996): (1) preopercular edge and ridge weakly serrated; (2) uroneurals reduced or absent; (3) rounded caudal fin; (4) longest dorsal spine supported by third pterygiophore; (5) presence of light organ; and (6) eighth dorsal-spine pterygiophore separated or only partially fused to ninth pterygiophore. There is also support from molecular data for the monophyly of *Jaydia* (Mabuchi *et al.* 2006, 2014).

The single specimen of *Jaydia* obtained from Serangoon Harbour is identified as *J. lineata* (and not the very similar *J. novaeguineae*) following Gon (1996) on the account of the following characters: 15 pectoral-fin rays (*vs.* 16 in *J. novaeguineae*), 11 gill rakers on the lower limb of the first gill arch (*vs.* 9–10 in *J. novaeguineae*)

Figure 7. *Cheilodipterus singapurensis*, ZRC 53644, 125.7 mm SL; Marina Bay. Photograph courtesy of Tan Heok Hui.

Figure 8. *Fibramia amboinensis*, ZRC 53619, 53.8 mm SL; Sungei Tengeh.

Figure 9. *Fibramia lateralis*, ZRC 53147, 56.1 mm SL; Pulau Semakau.

Figure 10. *Fowleria variegata*, ZRC 30481, 51.9 mm SL; Pulau Semakau.

Figure 11. *Jaydia lineata,* ZRC 53454, 50.1 mm SL; Serangoon Harbour.

and 3 predorsal scales (*vs.* 4 in *J. novaeguineae*). This is a new record for Singapore, representing a considerable southward extension of its range (it is otherwise known only from China and Japan southwards to Taiwan; Gon 1996).

14. ***Jaydia truncata*** (Bleeker, 1854). Flat-tail Cardinalfish

Apogonichthys taeniopterus Bleeker 1860b: 48 (type locality: Singapore); Russell *et al.* 2010: 94 (synonymy with *Apogon truncatus*).

Apogon ellioti (in part)—Weber and de Beaufort 1929: 329.

Apogonichthys ellioti—Fowler 1938: 132.

Material examined: None. Based on Castelnau painting (Russell *et al.* 2010: Figs. 1 and 2).

Figure 12. *Lepidamia kalosoma*, ZRC 53594, 96.2 mm SL; Marina Bay. Photograph courtesy of Tan Heok Hui.

Figure 13. *Nectamia similis*, ZRC 31694, 57.6 mm SL; Pulau Salu.

Figure 14. *Ostorhinchus cavitensis*, ZRC 7204, 68.9 mm SL; Punggol.

Figure 15. *Ostorhinchus cavitensis*, *ca.* 75 mm SL; Pulau Hantu. Specimen not preserved. Photograph courtesy of Eunice Khoo.

Remarks: The description of *A. taeniopterus* was based on two paintings of a specimen collected from Singapore by Castelnau (illustrated in Russell *et al.* 2010: Figs. 1 and 2), which has been identified as *J. truncata* by Russell *et al.* (2010). This species has not been encountered in Singapore waters since it was first recorded by Bleeker (1860b).

15. ***Lepidamia kalosoma*** (Bleeker, 1852).
Pinstripe Cardinalfish
Figure 12

Lepidamia kalosoma—Tan *et al.* 2010: 139.

Material examined: ZRC 52436 (n=1); ZRC 53594 (n=1); Marina Bay.

Remarks: This species was recorded from Singapore for the first time by Tan *et al.* (2010).

16. ***Nectamia savayensis*** (Günther, 1872).
Samoan Cardinalfish

Nectamia savayensis—Fraser 2008: 33.

Material examined: None. Material from Singapore listed in Fraser (2008).

17. ***Nectamia similis*** Fraser, 2008. Ghost Cardinalfish
Figure 13

Apogon bandanensis (*non* Bleeker)—Bleeker 1860b: 31, 48; Weber and de Beaufort 1929: 317; Herre and Myers 1937: 24; Khoo and Tay 1990: 76; Ng *et al.* 1994: 326.

Amia bandanensis (*non* Bleeker)—Fowler 1938: 128.

Material examined: ZRC 31694 (n=1); Pulau Salu.

Remarks: This species has been previously misidentified as *N. bandanensis*, which has a completely different color pattern consisting of two dark saddles with the absence of any pale bars on the body (Fraser 2008). This is the first record of this species from Singapore.

18. ***Ostorhinchus cavitensis*** (Jordan & Seale, 1907).
Cavite Cardinalfish
Figures 14, 15

Apogon cavitensis—Kuiter and Kozawa 2001: 33.

Ostorhinchus cavitensis—Allen and Erdmann 2012: 388; Heng and Lim 2013: 65, Fig. 1.

Material examined: ZRC 31726–31729 (n=4); Pulau Salu. ZRC 40985 (n=2); Terumbu Pempang Tengah. ZRC 7204 (n=1); ZRC 53609 (n=12); Punggol.

Remarks: The presence of this species in Singapore has been known for some time (Russell *et al.* 2010).

19. ***Ostorhinchus chrysopomus*** (Bleeker, 1854).
Cheek-spot Cardinalfish

Apogon chrysopomus—Bleeker 1860b: 48; Kuiter and Kozawa 2001: 31.

Material examined: None.

Remarks: Confirmation of the presence of this species in Singapore is based on an *in situ* photograph of a live individual from Singapore (Kuiter and Kozawa 2001).

20. ***Ostorhinchus compressus*** (Smith & Radcliffe, 1911).
Blue-eyed Cardinalfish
Figure 16

Apogonichthys macrophthalmus Bleeker 1860a: 455

(type locality: Singapore); 1860b: 48; Fowler 1938: 132; Russell *et al.* 2010: 97 (*nomen oblitum*).

Apogon macrophthalmus—Weber and de Beaufort 1929: 350.

Apogon compressus—Herre and Myers 1937: 24; Khoo and Tay 1990: 76; Low and Chou 1992: 141; 1994: 437; Ng *et al.* 1994: 326.

Apogon ?compressus—Chua 2002: 108.

Material examined: ZRC 30522 (n=1); Singapore Straits. ZRC 31641–31643 (n=3); ZRC 31758–31759 (n=2); Pulau Salu.

21. ***Ostorhinchus endekataenia*** (Bleeker, 1852).
Many-striped Cardinalfish
Figure 17

Apogon singapurensis Bleeker 1860a: 454 (type locality: Singapore); 1860b: 48; Weber and de Beaufort 1929: 349; Russell *et al.* 2010: 96 (possibly synonym of *Apogon endekataenia*).

Apogon endekataenia—Bleeker 1860: 31, 48; Weber and de Beaufort 1929: 306; Lim and Low 1998: 7; Kuiter and Kozawa 2001: 20; Kuiter and Tonozuka 2001: 213.

Amia singapurensis—Fowler 1938: 132.

Amia endekataenia—Fowler 1938: 129.

Ostorhinchus endekataenia—Allen & Erdmann 2012: 391.

Ostorhinchus cavitiensis (*non* Jordan and Seale)—Tan 2014: 150, Figs. 1, 2.

Material examined: ZRC 41009 (n=2); Sultan Shoal. ZRC 30523 (n=1); Singapore Straits. ZRC 43368 (n=1); off Kusu Island. ZRC 53654 (n=1); Marina East. ZRC 10530 (n=1); Sungei Punggol. ZRC 53600 (n=7); Punggol.

22. ***Ostorhinchus fasciatus*** (White, 1790).
Australian Striped Cardinalfish

Apogon quadrifasciatus (in part)—Bleeker 1860b: 48.

Apogon fasciatus—Fraser 2005: 13.

Material examined: None. Material from Singapore listed in Fraser (2005).

Figure 16. *Ostorhinchus compressus*, ZRC 31758, 82.3 mm SL; Pulau Salu.

Figure 17. *Ostorhinchus endekataenia*, ZRC 53654, 50.1 mm SL; Marina East. Photograph courtesy of Tan Heok Hui.

Figure 18. *Ostorhinchus margaritophorus*, ZRC 53182, 27.4 mm SL; Pulau Semakau. Photograph courtesy of Tan Heok Hui.

Remarks: The much more commonly encountered *O. pleuron* has often been misidentified as this species (see remarks for *O. pleuron*). It has not been encountered in recent surveys, with the last verified record dating from 1953 (Fraser 2005).

23. ***Ostorhinchus magaritophorus*** (Bleeker, 1854).
Pearly Cardinalfish
Figure 18

Apogon margaritophorus—Bleeker 1860b: 48; Weber and de Beaufort 1929: 199; Herre and Myers 1937: 24; Tham 1973: 224; Lim and Low 1998: 91; Kuiter and Kozawa, 2001: 18; Chua 2002: 108; Tan and Yeo 2003; Ng 2009: 108; Kwik *et al.* 2010: 127.

Amia margaritophora—Fowler 1938: 130 (Pulau Brani, Serangoon).

Material examined: ZRC 53682 (n=6); Raffles Marina. ZRC 30651–30656 (n=6); ZRC 40995 (n=2); Pulau Hantu. ZRC 53182 (n=4); Pulau Semakau. ZRC 38132 (n=5); Labrador Beach. ZRC 41479 (n=1); Pulau Seringat. ZRC 7544–7561 (n=18); Punggol. ZRC 46478 (n=22); Pulau Ubin: Tanjong Chek Jawa. ZRC 47820 (n=8); Changi Point beach.

24. ***Ostorhinchus novemfasciatus*** (Cuvier *in* Cuvier & Valenciennes, 1828). Nine-line Cardinalfish

Apogon novemfasciatus—Kuiter and Kozawa 2001: 28.

Material examined: None. Based on an *in situ* photograph of a live individual from Singapore waters (Kuiter and Kozawa 2001).

25. ***Ostorhinchus pleuron*** (Fraser, 2005).
Rib-bar Cardinalfish
Figure 19

Apogon quadrifasciatus (*non* Cuvier)—Cantor 1849: 985; Steindachner 1870: 559; Károli 1882: 52; Weber and de Beaufort 1929: 300 (in part); Tweedie 1936: 25; Herre and Myers 1937: 24; Lim and Low 1998: 92; Chua 2002: 108; Kwik *et al.* 2010: 127; Tan *et al.* 2010: 139.

Amia quadrifasciata (*non* Cuvier)—Fowler 1938: 131, 261.

Apogon pleuron Fraser 2005: 7.

Ostorhinchus pleuron—Allen and Erdmann 2012: 402.

Material examined: ZRC 49710 (n=1); Johor Straits off Seletar Dam. ZRC 53649 (n=2); mouth of Seletar River. ZRC 7205–7210 (n=6); Punggol. ZRC 40697 (n=1); ZRC 40698 (n=4); ZRC 47804 (n=2); Changi Point beach. ZRC 40298 (n=2); Johor Straits, northwest of Pulau Tekong Kechil.

Remarks: This species has often been misidentified as *O. quadrifasciatus* [itself a synonym of *O. fasciatus* (White, 1790)], but is distinguished from it in having the lower edge of the median dark stripe on the body developing into narrow vertical bars (*vs*. uniform), a pigmented (*vs.* unpigmented) roof of the mouth 15 (*vs.* 16) pectoral-fin rays, and 17–20 (*vs.* 14–17) well developed gill rakers (Fraser 2005).

26. ***Ostorhinchus urostigmus*** (Bleeker, 1874).
Spiny-head Cardinalfish

Amia urostigma Bleeker, 1874: 51 (type locality: Singapore).

Material examined: None.

Remarks: This species has not been recorded from Singapore since its original description.

27. ***Pristicon rhodopterus*** (Bleeker, 1852).
False Three-spot Cardinalfish
Figure 20

Apogon rhodopterus Bleeker 1852: 62 (type locality: Singapore); Bleeker 1860: 48; Herre and Myers 1937: 24; Randall and Fraser 1999: 624.

Apogon trimaculatus (non-Cuvier)—Weber and de Beaufort 1929: 335 (in part); Khoo and Tay 1990: 76; (?)Low and Chou 1992: 141; Ng *et al.* 1994: 326; Lim and Low 1998: 91

Amia rhodoptera—Fowler 1938: 132. (= part of *Apogon trimaculatus*)

Pristicon rhodopterus – Allen and Erdmann 2012: 407

Material examined: ZRC 31635–31640 (n=6); ZRC 31679–31682 (n=4); ZRC 31690–31693 (n=4); ZRC 31702–31712 (n=11); ZRC 31723–31725 (n=3); ZRC 36187–36188 (n=2); Pulau Salu. ZRC 45742 (n=2); off Pulau Satumu (Raffles Lighthouse). ZRC 38139 (n=2); patch reef west of Pulau Hantu. ZRC 29501–29502 (n=2); ZRC 40483 (n=1); Pulau Hantu. ZRC 17666 (n=1); Pulau Retan Laut. ZRC 31689 (n=1); Pulau Bukom. ZRC 40325 (n=1); Pulau Sakijang Bendera (St. John's Island). ZRC 53612 (n=2); off Kusu Island.

Remarks: This species has sometimes been misidentified as *P. trimaculatus*, but can be distinguished from it in lacking (*vs.* having) a dark spot on the opercle (Randall and Fraser, 1999).

28. ***Pristicon trimaculatus*** (Cuvier, 1828).
Three-spot Cardinalfish

Apogon koilomatodon—Bleeker 1860b: 48; Herre & Myers 1937: 24

Apogon trimaculatus=(?)Károli 1882: 152; Weber and de Beaufort 1929: 335 (in part); Herre and Myers 1937: 25; Randall and Fraser 1999: 619.

Amia koilomatodon—Fowler 1938: 130.

Amia trimaculata—Fowler 1938: 132.

Material examined: None. Material from Singapore listed in Randall and Fraser (1999).

Remarks: Material in the ZRC previously identified as this species have been reidentified as *P. rhodopterus* (see remarks for previous species).

29. ***Pseudamia amblyuropterus*** (Bleeker, 1856).
White-jaw Cardinalfish

Cheilodipterus polystigma Bleeker 1860a: 454 (type locality: Singapore); 1860b: 31, 48; Fowler 1938: 134; Russell *et al.* 2010: 94 (synonymy with *Pseudamia amblyuroptera*).

Pseudamia polystigma—Weber and de Beaufort 1929: 370.

Pseudamia amblyuroptera—Randall *et al.* 1985: 9.

Pseudamia amblyuropterus—Allen and Erdmann 2012: 408.

Material examined: None. Based on Castelnau painting (Russell *et al.* 2010: Fig. 3).

Remarks: The description of *C. polystigma* was based on a painting of a specimen collected from Singapore by Castelnau, which has been identified as *P. amblyuropterus* by Russell *et al.* (2010). This species has not been encountered in Singapore waters since it was first recorded by Bleeker (1860a).

Figure 19. *Ostorhinchus pleuron*, *ca.* 70 mm SL; Kelong E5, off the mouth of Sungei Simpang. Specimen not preserved. Photograph courtesy of Tan Heok Hui.

Figure 20. *Pristicon rhodopterus*, ZRC 45742, 90.9 mm SL; Pulau Satumu.

Figure 21. *Siphamia tubifer*, ZRC 53540, 29.1 mm SL; Pulau Hantu.

30. ***Siphamia tubifer*** Weber, 1909.
Two-spot Urchin Cardinalfish
Figure 21

Material examined: ZRC 53540 (n=3); Pulau Hantu.

Remarks: This species is recorded in Singapore for the first time here.

31. ***Sphaeramia nematoptera*** (Bleeker, 1856).
Pyjama Cardinalfish
Figure 22

Sphaeramia nematoptera—Low and Chou 1992: 141; Ng *et al.* 1994: 326; Heng and Lim 2013: 65, Fig. 4; Low 2013: 33, Fig. 6.

Figure 22. *Sphaeramia nematopterus*, *ca.* 90 mm SL. Specimen not preserved. Photograph courtesy of Jeffrey Low.

Figure 23. *Sphaeramia orbicularis*, ZRC 52531, 81.1 mm SL; Raffles Marina.

Material examined: None. Based on photographs taken in local waters (Heng and Lim 2013; Low 2013).

32. ***Sphaeramia orbicularis*** (Kuhl & van Hasselt, 1828).
Polka-dot Cardinalfish
Figure 23

Apogon orbicularis—Bleeker 1860b: 48; Weber and de Beaufort 1929: 333.

Amia orbicularis—Fowler 1938: 131.

Sphaeramia orbicularis—Lim and Low 1998: 93; Kwik *et al.* 2010: 127.

Material examined: ZRC 52531 (n=1); ZRC 53681 (n=7); Raffles Marina. ZRC 30659–30660 (n=3); Pulau Hantu. ZRC 41480 (n=2); Pulau Seringat.

33. ***Taeniamia fucata*** (Cantor, 1849).
Painted Cardinalfish
Figure 24

Apogon macropteroides—Bleeker 1860b: 31, 48.

Material examined: ZRC 29505 (n=1); Pulau Hantu. ZRC 40982 (n=1); Terumbu Selegi.

34. ***Yarica hyalosoma*** (Bleeker, 1852).
Hump-backed Cardinalfish
Figure 25

Apogon hyalosoma—Bleeker 1860b: 48; Weber and de Beaufort 1929: 341; Herre and Myers 1937: 24; Lim and Low 1998: 92; Ng and Sivasothi 1999: 135; Chua 2002: 108; Ng 2009: 108; Kwik *et al.* 2010: 127; Tan *et al.* 2010: 139; Kwik 2012: 95; Ng and Tan 2013: 21.

Amia hyalosoma – Fowler 1938: 130 (Pulo Ubin).

Material examined: ZRC 53683 (n=3); Raffles Marina. ZRC 2377 (n=1); ZRC 31696–31701 (n=6); Sungei Tengeh. ZRC 27278–27280 (n=3); ZRC 27320 (n=1); ZRC 29319–29321(n=3); ZRC 31922 (n=1); ZRC 38339 (n=1); ZRC 41704 (n=3); ZRC 52119 (n=3); Sungei Buloh. ZRC 26399–26428 (n=30); Sungei Sawa. ZRC 779 (n=43); Sungei Peng Siang. ZRC 26146–26159 (n=14); Sungei Kranji. ZRC 21821 (n=1); Sungei Mandai Kechil. ZRC 54065 (n=1); Seletar Wet Gap. ZRC 19631 (n=1); Pulau Ubin. ZRC 48416 (n=5); Pulau Ubin: mouth of Sungei Besar. ZRC 1762 (n=4); Sungei Changi.

Figure 24. *Taeniamia fucata*, ZRC 29505, 53.7 mm SL; Pulau Hantu.

Figure 25. *Yarica hyalosoma*, ZRC 54065, 91.0 mm SL; Seletar Wet Gap. Photograph courtesy of Tan Heok Hui.

35. ***Zoramia leptacantha*** (Bleeker, 1856).
Long-spine Cardinalfish

Apogon arenatus Bleeker 1860a: 455 (type locality: Singapore); 1860b: 48; Weber and de Beaufort 1929: 350; Russell *et al.* 2010: 99.

Amia arenata—Fowler 1938: 128.

Material examined: None. Based on Castelnau painting (Russell *et al*. 2010: Fig. 13).

Remarks: The description of *A. arenatus* was based on a painting of a specimen collected from Singapore by Castelnau, which has been tentatively identified as *Z. leptacantha* by Russell *et al.* (2010). *Zoramia leptacantha* has not been encountered in Singapore waters since the record by Bleeker (1860a).

Discussion

The record of 35 of cardinalfish species from Singapore waters represents about one quarter of the approximately 120 species found in the region (Randall and Lim 2000). This small number is largely a result of poor sampling, although it is worrying that four of the 35 species (11.4%) have not been encountered in Singapore in over a century. The strong association of many cardinalfish species to live coral (Gardiner and Jones 2005) and the vulnerability

of coral reef habitats in Singapore to anthropogenic disturbance (Hoeksema and Koh 2009) does not bode well for the future of the cardinalfish fauna of Singapore.

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