

Short Communication

First records of two species of groupers, *Cephalopholis nigripinnis* and *Epinephelus retouti* (Perciformes: Epinephelidae) from India, with a note on Epinephelids from Andaman and Nicobar Islands

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Abstract

Two grouper species, Blackfin grouper, *Cephalopholis nigripinnis* (Valenciennes, 1828), and Red-tipped Grouper, *Epinephelus retouti* (Bleeker, 1868) were reported for the first time from the waters around Andaman and Nicobar Islands, India. Their descriptions, ecology of habitat and distributional range has been provided. A list of 54 species of groupers (Family: Epinephelidae) known from Andaman and Nicobar Islands till date is also provided with conservation status and information on their first record.

Keywords: Andaman Islands, *Cephalopholis nigripinnis*, *Epinephelus retouti*, Groupers, New record

Introduction

The groupers of the family Epinephelidae, earlier placed as a subfamily in Serranidae, are mostly reef dwellers and commercially important as food fish, game fish and aquarium curio as well. The family comprises more than 160 species in 16 genera in the world (Craig *et al.*, 2011; Zhuang *et al.*, 2013; Tucker *et al.*, 2016). Juveniles of these fishes inhabit tidal pools and coastal waters; whereas adults live at depths of 10– 150 m. Owing to their size and value, the epinephelids attracted ichthyologist's eye since the fish faunal study began in Andamans. Day (1871) has recorded ten groupers from Andamans. By now, 54 species in 7 genera belonging to the family Epinephelidae have been recorded from the waters around Andaman and Nicobar Islands. Rajan *et al.* (2013) listed 47 species of epinephelids, but missed out *Epinephelus summana*, recorded by Day (1871), *Epinephelus morrhua*, listed by Rao (2009) and *Cephalopholis polyspila*, reported by Allen & Erdmann (2012). Further, Sachithanandam and Mohan (2014), Rajan (2015) and Rajan *et al.* (2016)

reported four more species of the family Epinephelidae, viz., *Cephalopholis aurantia*, *Epinephelus epistictus*, *E. heniochus* and *E. tukula*, from Andamans. The present paper reports new record of two more grouper species, *Cephalopholis nigripinnis* and *Epinephelus retouti*, for the first time from Andaman and Nicobar Islands.

Material and Methods

Among the new record of grouper fishes, *Cephalopholis nigripinnis* was recorded during underwater observations in the coral reef ecosystem at Havelock Island, South Andaman using SCUBA gears at the site of southern part of Rosamund shoal slope (12° 03.450' N, 92°57.757' E) at a depth range 3m to 15m, that gradually slopes to 30m on the North- East side with sandy bottom, and ridges of rock. The site mainly has *Porites* coral and strong currents running south east to North-West direction, which brings sediment from the channel between peel and Havelock. The North-West to South-East direction current brings in clears water from the west side of the ridge. Eastern side

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covered with wipe coral and gorgonians ranging from 5m to 20m. *Epinephelus retouti* was collected during fish market survey at Junglighat, South Andaman and noted diagnostic characters. The photographs collected on the site of observation are presented here.

Cephalopholis nigripinnis (Valenciennes, 1828)
(Blackfin grouper)

1828. *Serranus nigripinnis* Valenciennes, *Histoire naturelle des poissons*, 2: 339 (Type locality: probably Indian Ocean).

2012. *Cephalopholis nigripinnis* Allen and Erdmann, *Reef fishes of the East Indies*: 264.



Diagnostic Characters: D IX, 14-16; A III, 8-9; P 17-18; LL pored 54-68; LSS 88-108. Body depth 2.7-3.1 in SL; pectoral fin length 1.8-2.2 in head length. Interorbital area convex. Preopercle rounded and finely serrate, lower edge fleshy; subopercle and interopercle usually smooth; maxilla reaching beyond posterior edge of eye. Scales Ctenoid on body and abdomen. Caudal fin rounded. Body red in color anteriorly, grading to dark brown on posterior part; posterior edge of operculum with a prominent brown ear spot.

Habitat: This small grouper found in solitary in shallow water, mainly found in outer coral-rich areas.

Distribution: Indian Ocean: From East coast of Africa (Kenya to South Africa) to Indonesia (Java and Sumatra); Comoros Island, Mascarene Island, Maldives, Sri Lanka, Chagos Island.

Remarks: *C. nigripinnis* (Valenciennes) was earlier thought to be a junior of *C. Urodeta* (Schneider 1801) (Heemstra and Randall, 1993). However, recently it is recognised as a valid species based on molecular studies (Craig and Hastings, 2007; Craig *et al.*, 2011). The later is distinguished in having a pair of diagonal white bands

on caudal fin which is absent in the former. The present report forms its first record from India and Andaman Islands as well.

Epinephelus retouti Bleeker, 1868
(Redtipped grouper)

1868. *Epinephelus retouti* Bleeker, *Versl. Akad. Amsterdam*, ser. 2, 2: 336. (Type locality: Reunion).



Diagnostic Characters: D IX, 16-17; A III, 8; P 19-20; LL pored 62-74; LSS 121-140; Gill rakers 7-8 + 14-16; Pyloric caeca 39-45. Snout length 3.5 to 3.9 times in head length. Ctenoid scales on body except anterodorsally, on thorax and abdomen; numerous auxiliary scales present on body; maxilla naked; caudal fin truncate to slightly rounded; pelvic fins not reaching anus. Adults dull yellowish orange to brownish red overall, usually with 5 faint dark bars on body; head mottled light red and orangish brown; lips light red; dorsal fin olivaceous to brown, the outer triangular part of each interspinous membrane deep red; remaining fins light orange red except upper caudal fin olivaceous to brown similar as the dorsal fin.

Habitat: Mainly found in depths more than 70-200 m, but the young ones can be observed in 15-40 m depth.

Distribution: Widely distributed in the tropical and subtropical Indo-Pacific region, but with scattered distribution around oceanic islands.

Remarks: *E. retouti* is closely related to *E. fasciatus*, *E. rivulatus* and *E. irroratus* in meristic, morphometric and colour pattern. In both *E. fasciatus* and *E. rivulatus*, snout length is shorter (4.0 to 5.1 in head length), while in *E. irroratus*, no dark bars on body and second dorsal spine elongated in adults. Among these four species, only *E. fasciatus* was recorded from Andamans earlier (Day 1875), which further differs from *E. retouti* in having tips of the interspinous dorsal-fin membranes are black, the

soft dorsal fin and upper caudal-fin rays are not darker than the rest of these fins, caudal-fin margin is convex or moderately rounded (Heemstra and Randall, 1993). The present report forms its first record from India and Andaman Islands as well.

Results and Discussion

Grouper species are usually identified by their colour pattern, morphological characters and size of the fins, the shape and relative size of the head and various parts of the head and body; and the number of fin rays, scales, gillrakers body shape and with pyloric caeca as an additional tool for identification of species. Till date, only 54 species in seven genera, namely *Aethaloperca* (1 sp.), *Anypserodon* (1 sp.), *Cephalopholis* (12 spp.), *Cromileptes* (1 sp.), *Epinephelus* (33 spp.), *Plectropomus* (4 spp.), *Variola* (2 spp.), represent in the waters around Andaman and Nicobar Islands (Table 1). Table 1 details the list of the Epinephelids currently known from Andaman and Nicobar Islands, their first report

from the region, synonymous names as reported and conservation status.

Day (1871) reported only 10 species of Epinephelids (earlier in Serranidae) as a pioneer worker on ichthyofaunal study of Andaman and Nicobar Islands and added 8 more species in his subsequent work (Day, 1875). After 98 years, Menon and Talwar (1973) recorded *Epinephelus coeruleopunctatus* from Great Nicobar Island. Talwar (1990) enlisted seven more species in the checklist of fishes from Bay Islands, which became the baseline information for study of fish fauna of this group of Islands. Rao *et al.* (1992) provided information on six more species of Epinephelidae (in Serranidae). Krishnan and Mishra (1994) and Dhandapani and Mishra (1998) recorded *Epinephelus quoyanus* and *Cephalopholis sonnerati* respectively. Rao *et al.* (2000) included six more species, while Rajan (2002) added 4 species to the list. Further, Rajan (2003) recorded *Epinephelus radiatus* and Rao (2003) reported *Epinephelus sexfasciatus* and *Plectropomus laevis*. Later, *Epinephelus morrhua* was listed by Rao (2009)

Table 1. Epinephelidae (Groupers) in Andaman waters (species listed by Rajan *et al.* (2013) are marked with (*) asterisk)

Sl.No.	Species	First record from Andamans	Conservation status
1.	<i>Aethaloperca rogae</i> (Forsskal, 1775)*	Rao <i>et al.</i> 1992: 47	Data Deficient
2.	<i>Anypserodon leucogrammicus</i> (Valenciennes, 1828)*	Rao <i>et al.</i> 2000: 125	Least Concern
3.	<i>Cephalopholis argus</i> Schneider, 1801*	Day 1871: 678	Least Concern
4.	<i>Cephalopholis aurantia</i> Valenciennes, 1828	Sachithanandam & Mohan, 2014: 2233	Data Deficient
5.	<i>Cephalopholis boenak</i> (Bloch, 1790)*	Day 1875: 26	Least Concern
6.	<i>Cephalopholis cyanostigma</i> (Valenciennes, 1828)*	Rao <i>et al.</i> 1992: 48	Least Concern
7.	<i>Cephalopholis formosa</i> (Shaw & Nodder, 1812)*	Talwar 1990: 76; Rao <i>et al.</i> 2000: 128	Least Concern
8.	<i>Cephalopholis leopardus</i> (Lacepede, 1802)*	Day 1871: 678 as <i>Serranus homfrayi</i> ; Day 1875: 25	Least Concern
9.	<i>Cephalopholis microprion</i> (Bleeker, 1852)*	Rao <i>et al.</i> 1992: 48	Least Concern
10.	<i>Cephalopholis miniata</i> (Forsskal, 1775)*	Day 1871: 679 as <i>Serranus cyanostigmatoides</i> ; Day 1875: 24	Least Concern
11.	<i>Cephalopholis nigripinnis</i> (Valenciennes, 1828)	Present study ; Rao <i>et al.</i> 1992: 48 as <i>Cephalopholis urodeta</i>	Data Deficient
12.	<i>Cephalopholis polyspila</i> Randall & Satapoomin, 2000	Allen & Erdmann 2012: 265	Least Concern
13.	<i>Cephalopholis sexmaculata</i> (Ruppell, 1830)*	Ramakrishna <i>et al.</i> , 2010: 12, 63	Least Concern
14.	<i>Cephalopholis sonnerati</i> (Valenciennes, 1828)*	Dhandapani & Mishra 1998: 141	Least Concern
15.	<i>Cromileptes altivelis</i> (Valenciennes, 1829)*	Day 1875: 9	Vulnerable
16.	<i>Epinephelus areolatus</i> (Forsskal, 1775)*	Day 1871: 678 as <i>Serranus glaucus</i> ; Day 1875: 11 as <i>Serranus angularis</i> ; Day 1875: 12	Least Concern
17.	<i>Epinephelus bleekeri</i> (Vaillant 1878)*	Talwar 1990: 76; Rajan 2001: 49	Near Threatened
18.	<i>Epinephelus chlorostigma</i> (Valenciennes, 1828)*	Talwar 1990: 76; Rajan 2001: 51	Least Concern
19.	<i>Epinephelus oeruleopunctatus</i> (Bloch, 1790)*	Menon & Talwar 1973: 42	Least Concern

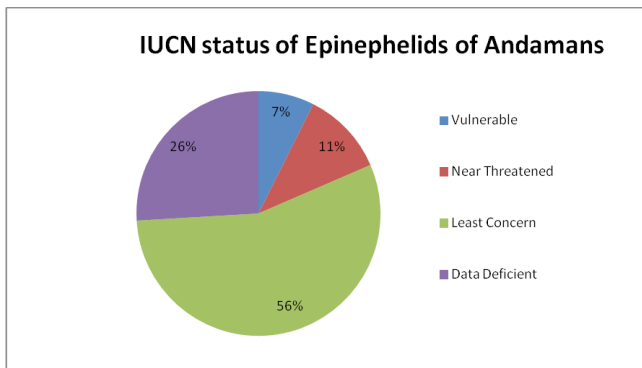
20.	<i>Epinephelus coioides</i> (Hamilton, 1822)*	Day 1871: 678 as <i>Serranus suillus</i> ; Rao <i>et al.</i> 2000: 133	Near Threatened
21.	<i>Epinephelus corallicola</i> (Valenciennes, 1828)*	Rajan 2002: 51	Data Deficient
22.	<i>Epinephelus epistictus</i> (Temminck and Schlegel, 1842)	Rajan, 2015: 321	Data Deficient
23.	<i>Epinephelus erythrurus</i> (Valenciennes, 1828)*	Rao <i>et al.</i> 1992: 49	Data Deficient
24.	<i>Epinephelus heniochus</i> Fowler 1904	Rajan 2015: 322	Data Deficient
25.	<i>Epinephelus fasciatus</i> (Forsskal, 1775)*	Day 1875: 15	Least Concern
26.	<i>Epinephelus faveatus</i> (Valenciennes, 1828)*	Day 1871: 678 as <i>Serranus bontoo</i>	Data Deficient
27.	<i>Epinephelus flavocaeruleus</i> (Lacepede, 1801)*	Day 1875: 15	Least Concern
28.	<i>Epinephelus fuscoguttatus</i> (Forsskal, 1775)*	Day 1875: 11	Near Threatened
29.	<i>Epinephelus hexagonatus</i> (Forster, 1801)*	Day 1871: 678	Least Concern
30.	<i>Epinephelus lanceolatus</i> (Bloch, 1790)*	Day 1871: 514	Vulnerable
31.	<i>Epinephelus ongispinis</i> (Kner, 1864)*	Day 1875: 11, 14 as <i>Serranus maculatus</i> ; Talwar 1990: 76 as <i>Epinephelus fario</i> ; Dhandapani & Mishra 1993: 59	Least Concern
32.	<i>Epinephelus macrospilos</i> (Bleeker, 1855)*	Rao <i>et al.</i> 2000: 136	Least Concern
33.	<i>Epinephelus malabaricus</i> (Bloch & Schneider, 1801)*	Day 1875: 20 as <i>Serranus salmoides</i>	Near Threatened
34.	<i>Epinephelus melanostigma</i> Schultz, 1953*	Rao <i>et al.</i> 2000: 137	Data Deficient
35.	<i>Epinephelus merra</i> Bloch, 1793*	Day 1875: 13	Least Concern
36.	<i>Epinephelus miliaris</i> (Valenciennes, 1830)*	Talwar 1990: 77; Rajan 2001: 61	Least Concern
37.	<i>Epinephelus morrhua</i> (Valenciennes 1833)	Rao 2009: 341; Ramakrishna <i>et al.</i> 2010: 64	Least Concern
38.	<i>Epinephelus ongus</i> (Bloch, 1790)*	Day 1871: 678 as <i>Serranus summana</i> ; Rao <i>et al.</i> 2000: 138	Least Concern
39.	<i>Epinephelus polyphkadion</i> (Bleeker, 1849)*	Day 1871: 678 as <i>Serranus dispar</i>	Near Threatened
40.	<i>Epinephelus polystigma</i> (Bleker, 1853)*	Rajan 2002: 63	Data Deficient
41.	<i>Epinephelus quoyanus</i> (Valenciennes, 1830)*	Krishnan & Mishra 1994: 280	Least Concern
42.	<i>Epinephelus radiatus</i> (Day, 1868)*	Rajan 2003: 121	Least Concern
43.	<i>Epinephelus retouti</i> Bleeker 1868	Present study	Data Deficient
44.	<i>Epinephelus sexfasciatus</i> (Valenciennes, 1828)*	Rao 2003: 170	Data Deficient
45.	<i>Epinephelus spilotoceps</i> Schultz, 1953*	Rao <i>et al.</i> 2000: 139	Least Concern
46.	<i>Epinephelus tauvina</i> (Forsskal, 1775)*	Talwar 1990: 77; Rajan 2001: 65	Data Deficient
47.	<i>Epinephelus tukula</i> Morgans, 1959	Rajan <i>et al.</i> 2016: 50	Least Concern
48.	<i>Epinephelus undulosus</i> (Quoy & Gaimard, 1824)*	Rao <i>et al.</i> 2000: 139	Data Deficient
49.	<i>Plectropomus areolatus</i> (Ruppell, 1830)*	Rajan 2002: 65	Vulnerable
50.	<i>Plectropomus laevis</i> (Lacepede, 1802)*	Rao 2003: 173	Vulnerable
51.	<i>Plectropomus maculatus</i> (Bloch, 1790)*	Talwar 1990: 77; Rao <i>et al.</i> 2000: 140	Least Concern
52.	<i>Plectropomus pessuliferus</i> (Fowler, 1904)*	Rao <i>et al.</i> 1992: 49	Near Threatened
53.	<i>Variola albimarginata</i> Baissac, 1952*	Rajan 2002: 67	Least Concern
54.	<i>Variola louti</i> (Forsskal, 1775)*	Talwar 1990: 77; Rao <i>et al.</i> 2000: 141	Least Concern

and *Cephalopholis sexmaculata*, by Ramakrishna *et al.* (2010). Allen and Erdmann (2012) reported *Cephalopholis polyspila* and Sachithanandam and Mohan (2014) recorded *Cephalopholis aurantia* from Andamans. In the recent past, *Epinephelus epistictus* and *Epinephelus heniochus* has been reported from Andaman and Nicobar Islands (Rajan, 2015). Another species, *Epinephelus tukula*, was recently reported by Rajan *et al.* (2016).

However, *Cephalopholis urodeta* reported by Rao *et al.* (1992) does not explain to have any diagonal pale/white

band on caudal fin and so, seemingly a misidentification of *Cephalopholis nigripinnis*, reported in this present paper. Hence, *Cephalopholis urodeta*, *sensu stricto*, has never recorded from Andamans. *Epinephelus summana* was only recorded by Day (1871) and the same was reflected in his subsequent work, and in the checklists of Talwar (1990), Rao (2009) and Ramakrishna *et al.* (2010). Moreover, *Epinephelus ongus* was erroneously identified as *Epinephelus summana*, a closely related species and restricted to Red Sea (Heemstra and Randall, 1993).

Therefore, in the present list of the fishes of the family Epinephelidae from Andaman and Nicobar Islands, these two species, *Cephalopholis urodeta* and *Epinephelus summana*, are omitted. The present paper reports *Cephalopholis nigripinnis* and *Epinephelus retouti* as new records to India and Andamans as well. Thus, at present, 54 species belonging to the family Epinephelidae are known to inhabit the waters around Andaman and Nicobar Islands.



Little information is available on the conservation status of groupers of Andamans. However, the monitoring and research studies have revealed dramatic declines in groupers. These are mostly captured as food fish, in recreational game fishing and also traded as aquarium curios. Groupers are particularly easy to catch and their spawning aggregations make them very vulnerable to

over fishing; they have been fished out of most shallow reefs. Four species (7.4% of known Epinephelids from Andamans), *Cromileptes altivelis*, *Epinephelus lanceolatus*, *Plectropomus laevis* and *Plectropomus areolatus*, are classified as Vulnerable according to IUCN Red List (IUCN 2017), while six more species (11.1%), *Epinephelus bleekeri*, *E. coioides*, *E. fuscoguttatus*, *E. malabaricus*, *E. polystigma* and *Plectropomus spessuliferus*, are assessed as Near Threatened. As per IUCN (2017), 30 species are assessed Least Concern (55.6%) and 14 species (25.9%) as Data Deficient among the Epinephelids known from Andaman and Nicobar Islands. Therefore, when 18.5% of the epinephelids known from Andamans are placed in threatened category, conservation status of about 26% is not clearly known. The only bony fish - the giant grouper, *Epinephelus lanceolatus*, is protected under Indian Wildlife (Protection) Act 1972 (placed in Schedule-I). The population of this species is having a scattered distribution in few areas only and thus, it is very rare in these islands.

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References

- Allen, G.R. and Erdmann, M.V. 2012. *Reef fishes of the East Indies*. Tropical Reef Research, Perth, Australia, Volume I-III: 1292 pp.
- Craig, M.T and Hastings, P.A. 2007. A molecular phylogeny of the groupers of the subfamily Epinephelinae (Serranidae) with a revised classification of the Epinephelini. *Ichthyol. Res.*, **54**: 1-17.
- Craig, M.T., Sadovy de Mitcheson, Y. and Heemstra, P.C. 2011. *Groupers of the world: A Field and Market Guide*. Grahamstown: CRC Press, NISC (Pty) Ltd. 424pp.
- Day, F. 1871. On the fishes of the Andaman and Nicobar Islands. *Proc. Zool. Soc. London*, **1870**: 677-705.
- Day, F., 1875. *The fishes of India, being a Natural History of the fishes known to inhabit the seas and freshwater of India, Burma and Ceylon*. William Dawson, London. Part 1, **1875**: 1-168, 1-40 pls.
- Dhandapani, P. and Mishra, S.S. 1998. Fish resources of the Great Nicobar Island and their potentiality for sustainable utilisation. *Symp. Proc. Island Ecosystem and Sustainable Development. Andaman Sci. Assoc.*: 139-146.
- Heemstra, P.C. and Randall, J.E., 1993. FAO species catalogue. Vol. 16. Groupers of the world (Family Serranidae, Subfamily Epinephelinae). An annotated and illustrated catalogue of the grouper, rockcod, hind, coral grouper and lyretail species known to date. *FAO Fisheries Synopsis*, **125**(16): 1-382. FAO, Rome.
- IUCN 2017. The IUCN Red List of Threatened Species. Version 2017-2. <<http://www.iucnredlist.org>>. Downloaded on 15 November 2017.
- Krishnan, S. and Mishra, S.S. 1994. On a collection of fish from Middle and South Andaman group of Islands. *Rec. zool. Surv. India*, **94**(2-4): 265-306.

- Menon, A.G.K. and Talwar, P.K. 1973. Fishes of the Great Nicobar Expedition, 1966, with a description of a new gobioid fish of the family Kraemeriidae. *Rec. zool. Surv. India*, **66**(1-4): 35-61.
- Rajan, P.T. 2002. *A field guide to Grouper and Snapper fishes of Andaman and Nicobar Islands*. Z.S.I., Port Blair, 103 pp.
- Rajan, P.T. 2003. *A field Guide to Marine Food Fishes of Andaman and Nicobar Islands*. Z.S.I., Kolkata, 260 pp.
- Rajan, P.T. 2015. New record of two Species of Epinephelus (Perciformes: Serranidae: Epinephelinae) from Andaman Islands, India. *Rec. zool. Surv. India*, **115**(4): 321-323.
- Rajan, P.T., Vikas, N., Mishra, S.S., Rajan, R. and Sivaperuman, C. 2016. *Reef Fishes of Andaman and Nicobar Islands*. Zool. Surv. India, Kolkata: 167 pp.
- Rajan, P.T., Sreeraj, C.R. and Immanuel, T. 2013. Fishes of Andaman and Nicobar Islands: A Checklist. *J. Andaman Sci. Assoc.*, **18**(1): 47-87.
- Ramakrishna, Immanuel, T., Sreeraj, C.R., Raghunathan, C., Raghuraman, R., Rajan, P.T. and Yogesh Kumar, J.S. 2010. An account of additions to the Ichthyofauna of Andaman and Nicobar Islands. *Rec. zool. Surv. India, Occ. Paper*, No. **326**: 1-140.
- Rao, D.V., 2003. *Guide to Reef Fishes of Andaman and Nicobar Islands*. Zool. Surv. India, Kolkata, 555 pp.
- Rao, D.V., 2009. Checklist of fishes of Andaman and Nicobar Islands, Bay of Bengal. *Environ. Ecol.*, **27**(1a): 334-353.
- Rao, D.V., Kamla Devi and Rajan, P.T. 2000. An account of Ichthyofauna of Andaman & Nicobar Islands, Bay of Bengal. *Rec. zool. Surv. India, Occ. Paper*, No. **178**: 434 pp.
- Rao, D.V., Rajan, P.T. and Kamla Devi, 1992. New records of groupers (Family: Serranidae) and cardinal fishes (Family: Apogonidae) from Andaman & Nicobar Islands. *J. Andaman Sci. Assoc.*, **8**(1): 47-52.
- Sachithanandam, V. and Mohan, P.M. 2014. New distribution record of *Cephalopholis aurantia* Valenciennes, 1828 (Pisces: Serranidae) golden hind to Indian waters from Andaman and Nicobar Islands. *Indian Journal of Geo-Marine sciences*, **43**(12): 2233-2235.
- Talwar, P.K. 1990. Fishes of the Andaman and Nicobar Islands: A Synoptic analysis. *J. Andaman Sci. Assoc.*, **6**(2): 71-102.
- Tucker, S.J., Kurniasih, E.M. and Craig, M.T. 2016. A new species of grouper (*Epinephelus*; Epinephelidae) from the Indo-Pacific. *Copeia*, **104**(3): 658-662. <https://doi.org/10.1643/CI-16-398>
- Zhuang, X., Qu, M., Zhang, X., Ding, S. 2013. A comprehensive description and evolutionary analysis of 22 grouper (Perciformes, Epinephelidae) mitochondrial genomes with emphasis on two novel genome organizations. *PLoS ONE*, **8**(8): e73561. doi:10.1371/journal.pone.0073561