Mar Biodiv (2017) 47:1251–1271
DOI 10.1007/s12526-017-0776-2

SENCKENBERG

RED SEA BIODIVERSITY

Review of *Carangoides* (Perciformes: Carangidae) from the Red Sea, with a new record of Imposter Trevally *Carangoides talamparoides* Bleeker, 1852

Sergey V. Bogorodsky[1,2] · **William F. Smith-Vaniz**[3] · **Ahmad O. Mal**[4] · **Tilman J. Alpermann**[1]

Received: 3 April 2017 / Revised: 28 June 2017 / Accepted: 31 July 2017 / Published online: 17 August 2017

Abstract Ten species of *Carangoides* from the Red Sea are reviewed. Imposter Trevally, *Carangoides talamparoides* Bleeker, is reported from the Red Sea for the first time on the basis of four small specimens and three adults trawled off Jizan, southern Saudi Arabia. Previously known from the Gulf of Oman east to Guam, its distribution range is extended to the Red Sea. *Carangoides talamparoides* superficially resembles *C. malabaricus* and may be easily confused, but it differs generally in lower gill raker counts, 25–31 (vs. 32–38), longer snout, the length 10.0–13.6% fork length in adults (vs. snout shorter, 8.5–10.8% fork length in adults); and premaxilla with slightly concave anterodorsal margin laterally (vs. premaxilla with distinctly concave margin laterally); greenish yellow blotch dorsoposteriorly on orbit membrane (vs. no blotch on orbit membrane); and white tongue (vs. tongue mainly dark). Description is provided for Red Sea specimens of *Carangoides talamparoides* and brief accounts for nine other Red Sea congeners. A key and table are also provided to help distinguish Red Sea *Carangoides* species, and a molecular phylogenetic analysis of the COI barcoding region is presented for all available Red Sea species and other Indo-Pacific species of the genus *Carangoides*.

Keywords Carangid fishes · Species diversity · Red Sea · DNA barcoding

Communicated by M. Sonnewald

Electronic supplementary material The online version of this article (doi:10.1007/s12526-017-0776-2) contains supplementary material, which is available to authorized users.

✉ Sergey V. Bogorodsky
ic187196@yandex.ru

William F. Smith-Vaniz
smithvaniz@gmail.com

Ahmad O. Mal
aomal@kau.edu.sa

Tilman J. Alpermann
tilman.alpermann@senckenberg.de

[1] Senckenberg Research Institute and Natural History Museum Frankfurt, Senckenberganlage 25, 60325 Frankfurt a.M., Germany

[2] Station of Naturalists, Omsk, Russia

[3] Florida Museum of Natural History, University of Florida, Gainesville, FL 32611-7800, USA

[4] Marine Biology Department, Faculty of Marine Sciences, King Abdulaziz University, Jeddah, Saudi Arabia

Introduction

Carangoides Bleeker 1851 is a poorly defined "catch-basket" group of carangid fishes distributed worldwide with most species occurring in the Indo-West Pacific where about 18 species are currently recognized. The genus is characterized by the posterior straight part of a lateral line with a combination of small scales and scutes; long pectoral fins usually reaching a junction between the curved and straight parts of the lateral line; each jaw with an inner band of tiny teeth; total gill rakers 21–37. The history of Red Sea species began with Forsskål (1775) who described three species: *C. bajad*, *C. ferdau*, and *C. fulvoguttatus*. Later, Rüppell (1830) and Klunzinger (1871, 1884) described seven additional species, but only two remain valid, *C. armatus* (Rüppell 1830) and *C. coeruleopinnatus* (Rüppell 1830). Dor (1984) summarized published data and listed eight species: *C. armatus* (as its synonym *C. ciliaris* Rüppell 1830), *C. bajad*, *C. coeruleopinnatus*, *C. ferdau*, *C. fulvoguttatus*, *C. malabaricus* (Bloch and Schneider 1801) (with included synonym *C. impudicus* Klunzinger 1871), and *C. plagiotaenia* Bleeker 1857. Goren and Dor

(1994) listed ten species, but in comparison with Dor's (1984) previous list added *C. chrysophrys* (Cuvier and Valenciennes 1833) and *C. gymnostethus* (Cuvier and Valenciennes 1833), and incorrectly (see above) listed *C. ciliaris* as a valid species. Subsequently, Golani and Bogorodsky (2010) removed *Carangoides gymnostethus* from their checklist of Red Sea fishes. Baranes and Golani (1993) reported the first occurrence of *Carangoides equula* (Temminck and Schlegel 1844) from deep waters of the Gulf of Aqaba. During field work in 2011–2017 in coastal waters of the southern part of Saudi Arabia, specimens of several species of *Carangoides* were collected by hook-and-line or by trawling. Among them, the occurrence of *C. chrysophrys* and *C. malabaricus* is confirmed from the Red Sea, and *C. talamparoides* Bleeker 1852 is reported here for the Red Sea for the first time. Occurrence of *C. gymnostethus* from the Red Sea was not confirmed, in agreement with Golani and Bogorodsky (2010).

Kottelat (2013) noted that *Olistus* Cuvier, 1829, with type species *Scomber malabaricus*, has priority over the name *Carangoides*. We continue to use *Carangoides* for convenience and to avoid premature taxonomic changes following Williams and Venkataramani (1978) and Smith-Vaniz (1999: 2661).

Herein, first formal review of ten Red Sea *Carangoides* is provided with diagnoses and photographs of each species and a key and table of selected characters is also given to help distinguish these species. *Carangoides talamparoides* is reported here as the first record of occurrence for the Red Sea. Barcoding sequences (mitochondrial COI) from the Red Sea specimens collected in this study were generated as a basis for future identification of specimens, larvae and eggs by molecular methods. Moreover, a phylogenetic analysis of these sequences together with available sequences from Indo-Pacific species of *Carangoides* was performed in order to assess intra- and interspecific diversity of Red Sea species of the genus.

Material and methods

Several specimens of *Carangoides armatus*, *C. bajad*, *C. chrysophrys*, *C. malabaricus*, and *C. talamparoides* were collected by hook-and-line or by trawling during biodiversity surveys jointly conducted in Saudi Arabia by King Abdulaziz University, Jeddah, and Senckenberg Research Institute and Natural History Museum Frankfurt (SMF) between 2011 and 2017 in coastal waters of the southern Red Sea (see section "Material examined" for the respective species). Specimens have been deposited in either the King Abdulaziz University Marine Museum, Jeddah (KAUMM), or SMF (number in square brackets after collection number is tissue voucher number). In addition to these, specimens from the following institutions were examined: Muséum National d'Histoire naturelle, Paris (MNHN); Smithsonian Institution National Museum of Natural History, Washington DC (USNM).

Meristic and morphometric methods follow Williams and Venkataramani (1978). The length of specimens is presented as fork length (FL) measured from tip of snout to tip of middle caudal-fin rays. Proportional measurements are rounded to the nearest 0.1 mm for specimens less than 100 mm FL and to 0.5 mm for specimens larger than 100 mm FL; maximum length for species is given as FL. Morphometric data presented are given as ratio to standard length in the text and percentages of standard length in Table 1 for easier comparison with published data. Species accounts are provided alphabetically with description of Red Sea specimens of *C. talamparoides* and brief accounts for other species; synonyms are nominal species described only from the Red Sea.

In order to establish DNA barcodes for the respective species, sequencing of the barcoding portion of the mitochondrial COI gene (Folmer et al. 1994, Hebert et al. 2004) was performed for all *Carangoides* species, for which specimens were collected herein: *Carangoides armatus*, *C. bajad*, *C. chrysophrys*, *C. malabaricus*, and *C. talamparoides*. Genomic DNA was isolated either with a DNeasy tissue kit (Qiagen, Hilden, Germany) or according to the protocol developed by the Canadian Centre for DNA Barcoding (Ivanova et al. 2006) from tissue samples of specimens collected herein that were stored in undiluted analysis grade ethanol at −26 °C. Amplification of a 652 bp sequence of the mtCOI gene was carried out with the universal, M13-tailed primer set COI-3 from Ivanova et al. (2007; partly taken from Ward et al. 2005) according to the PCR protocol in this study or the modified protocol from Geiger et al. (2014). Amplicons were Sanger sequenced from both ends with primers M13F (−21) and M13R (−27) (Messing 1983) and contigs were assembled in Geneious Pro 5.4.4 (Biomatters, Auckland, New Zealand). In order to assess intra- and interspecific diversity of Indo-Pacific species of the genus *Carangoides*, an alignment of COI sequences obtained in this study, sequences of other *Carangoides* spp. available from GenBank and the Barcode of Life Database (BOLD), and a sequence each of *Seriolina nigrofasciata*, *Trachinotus baillonii*, and *Scomberoides tala* as outgroup was constructed in MAFFT v7.017 (Katoh and Standley 2013). A neighbor joining (NJ) phylogenetic tree was then inferred in PAUP* (Swofford 1998) under the K2P model. Before sequences were further analyzed, sequences from localities that were represented by a relatively high number in one of the clades were reduced in order to achieve a more balanced geographical sampling of sequences in each clade. A final NJ tree was then inferred from the resultant alignment by the same method and reliability of branch support was assessed by 200 bootstrap replicates. Intra- and interspecies divergence based on K2P-distances was then inferred with the computer program Species Delimitation (Masters et al. 2011) Computational analyses were conducted via respective software plugins in Geneious Pro. Information on sequences that were used in the final analysis is provided in Appendix 1.

Table 1 Selected characters in Red Sea species of *Carangoides*

Species	Breast squamation	Gill rakers (upper + lower = total)	Dorsal–fin rays	Anal–fin rays	Straight LL scales + scutes[1]
C. armatus	naked ventrally to behind pelvic-fin origin and diagonally to naked base of pectoral fin	10–15 + 20–24 = 31–37	19–22	16–18	5–24 + 11–24
C. bajad	completely scaly or small naked area anteroventrally	7–9 + 18–21 = 25–33	24–26	21–24	14–26 + 20–30
C. chrysophrys	like *armatus*	5–9 + 15–18 = 21–26	18–20	15–17	2–15 + 20–36
C. coeruleopinnatus	usually like *armatus*; rarely naked area of breast and pectoral-fin base interrupted by narrow band of scales	5–8 + 15–19 = 21–27	20–23 (usually 22 or 23)	16–20 (usually 18 or 19)	0–13 + 20–36
C. equula	like *bajad*	7–10 + 18–23 = 27–32	23–25	21–24	0–6 + 22–32
C. ferdau	naked ventrally only to pelvic-fin origin and laterally naked breast and pectoral-fin base interrupted by moderate band of scales	7–10 + 17–20 = 24–29	26–34	21–26 (rarely 25 or 26)	10–30 + 21–37
C. fulvoguttatus	naked ventrally to behind pelvic-fin origin and laterally squamation variable, naked breast with or without a band of scales as in *ferdau*	6–8 + 17–21 = 22–27	25–30	21–26	18–27 + 15–21
C. malabaricus	naked area well behind pelvic-fin origin often to anal fin, laterally naked breast extends to pectoral-fin base and small area above base anteriorly	8–12 + 21–27 = 32–38	20–23	17–19	0–18 + 20–36
C. plagiotaenia	breast completely scaly	8–14 + 18–27 = 34–40	22–24	18–20	20–26 + 11–18
C. talamparoides	like *malabaricus*	6–9 + 19–22 = 25–31	20–23	17–19	2–12 + 20–33

[1] Excluding scales on caudal fin

Results

Identification Key to the Red Sea species of *Carangoides*

1. Breast completely scaly or with a small, median naked area anteroventrally.....2

– Breast partially or completely naked (Fig. 1).....4

2. Second dorsal fin and anal fin with dark submarginal stripe; dorsal profile of snout and nape almost straight; vomerine tooth patch anchor-shaped with distinct posterior extension .....*Carangoides equula*

– Second dorsal fin and anal fin without dark submarginal stripe; dorsal profile of snout and nape moderately curved; vomerine tooth patch triangular, without a posterior extension.....3

3. Body usually uniform (occasionally with a few orange spots); preopercle margin black; anal-fin soft rays 18–20 .....*Carangoides plagiotaenia*

– Body typically with numerous orange spots or completely yellow; preopercle margin pale; anal-fin soft rays 21–24.....*Carangoides bajad*

4. Dorsal-fin soft rays 25–34; anal-fin soft rays 21–26.....5

– Dorsal-fin soft rays 17–23; anal-fin soft rays 15–19.....6

5. Adults often with three or four dark blotches on flanks and usually with small brassy spots dorsally on sides; naked area of breast extends posteriorly well beyond pelvic-fin origin.....*Carangoides fulvoguttatus*

– Typically with six or seven dusky bars on sides and, if present, yellow or orange spots on sides mostly above lateral line; naked area of breast does not extend posteriorly beyond pelvic-fin origin (Fig. 1a).....*Carangoides ferdau*

6. Small naked area present just above pectoral-fin base opposite gill opening (Fig. 1c).....7

– Area above pectoral-fin base opposite gill opening completely scaly (Figs. 1b, d).....8

7. In life, tongue pale gray to white and greenish yellow blotch dorsoposteriorly on orbit membrane; premaxilla with slightly concave anterodorsal margin laterally; snout length 10.0–13.6% FL in adults; lower limb gill rakers 17–22, total gill rakers 25–31.....*Carangoides talamparoides*

– In life, tongue brown to grayish brown and no blotch dorsoposteriorly on orbit membrane; premaxilla with distinctly concave margin laterally; snout length 8.5–10.8% FL in adults; lower

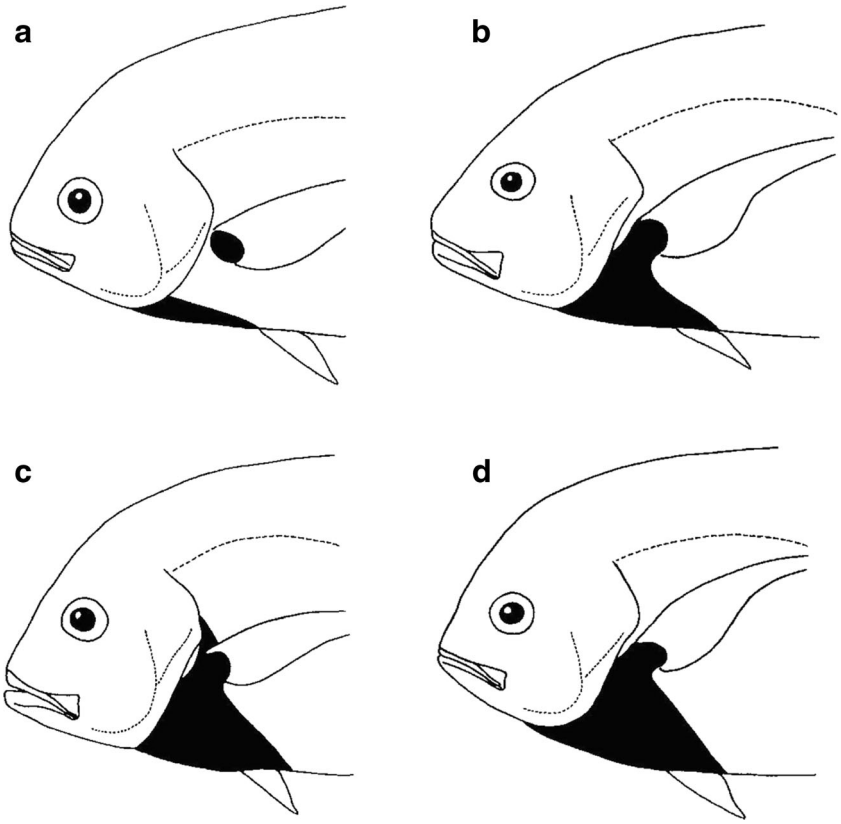


Fig. 1 Diagrammatic drawings of breast squamation (naked areas shown in black) in selected species of *Carangoides*. **(a)** *C. ferdau*; **(b)** *C. chrysophrys*; **(c)** *C. malabaricus*; **(d)** *C. armatus*

limb gill rakers 21–27, total gill rakers 32–38.....*Carangoides malabaricus*

8. Adult males with middle 3–12 dorsal- and anal-fin soft rays filamentous (fewer rays are filamentous in females); lower limb gill rakers 20–24; straight lateral line scutes 11–24.....*Carangoides armatus*

– Adults with middle dorsal- and anal-fin soft not filamentous; lower limb gill rakers 15–19; straight lateral line scutes 20–36.....9

9. Body uniform silvery; dorsal profile of snout gently sloped, and then abruptly vertical above mouth cleft; dorsal-fin soft rays 18–20; anal-fin soft rays 15–17.....*Carangoides chrysophrys*

– Body with small yellow spots; dorsal profile of snout not abruptly vertical above mouth cleft; dorsal-fin soft rays 20–23 (usually 22 or 23); anal-fin soft rays 16–20 (usually 18–19).....*Carangoides coeruleopinnatus*

***Carangoides armatus* (Rüppell, 1830)**

Longfin Trevally

Fig. 2, Table 1

Citula armata Rüppell, 1830: 103 (type locality: Red Sea, Eritrea, Massawa; lectotype: SMF 1601).

Citula ciliaria Rüppell, 1830: 103 (Red Sea, Eritrea, Massawa; original description).

Carangoides ciliarius — Smith 1973: 352 (Red Sea); Dor 1984: 124 (Red Sea); Goren and Dor 1994: 33 (Red Sea).

Caranx citula Cuvier in Cuvier & Valenciennes, 1833: 126.

Olistus ruppelii Cuvier in Cuvier & Valenciennes, 1833: 144 (Red Sea, Eritrea, Massawa; original description).

Caranx armatus — Rüppell 1852: 13 (Red Sea); Klunzinger 1871: 455 (Red Sea); Bamber 1915: 480 (Sudan).

Caranx (*Carangoides*) *armatus* — Klunzinger 1884: 99 (Red Sea); Tortonese 1935: 192 (Egypt).

Carangoides armatus — Smith-Vaniz 1984 (Red Sea); Golani and Bogorodsky 2010: 30 (Red Sea).

Material examined (all from Saudi Arabia, off Jizan): KAUMM 428 [KAU14-563] (1, 92.5 mm); KAUMM 436 (6, 51.0–72.3 mm), 10–12 m, 31 Oct 2014; KAUMM 437 (1, 76.3 mm), 10–12 m, 31 Oct 2014; SMF 35363 [KAU13-650] (1, 122 mm); SMF 35851 [KAU14-346 & 347] (2, 64.6–92.3); SMF 35861 (7, 52.2–76.3 mm), 10–12 m, 31 Oct 2014.

Diagnosis (counts of Red Sea specimens in parentheses). Dorsal-fin rays VIII + I,19–22 (20 or 21); anal-fin rays II + I,16–18 (16 or 17); the straight portion of lateral line with 5–24 scales followed by 11–24 small scutes (9–16 + 18–20); breast entirely naked to pelvic-fin origin and to base of pectoral fin; gill rakers 10–15 + 20–24 = 31–37 (10–12 + 21–22 = 31–34); body deep, its depth 1.9–2.2 in FL; dorsal profile of head steep in adults; band of small teeth in jaws, vomerine tooth patch wedge-shaped, without posterior extension;

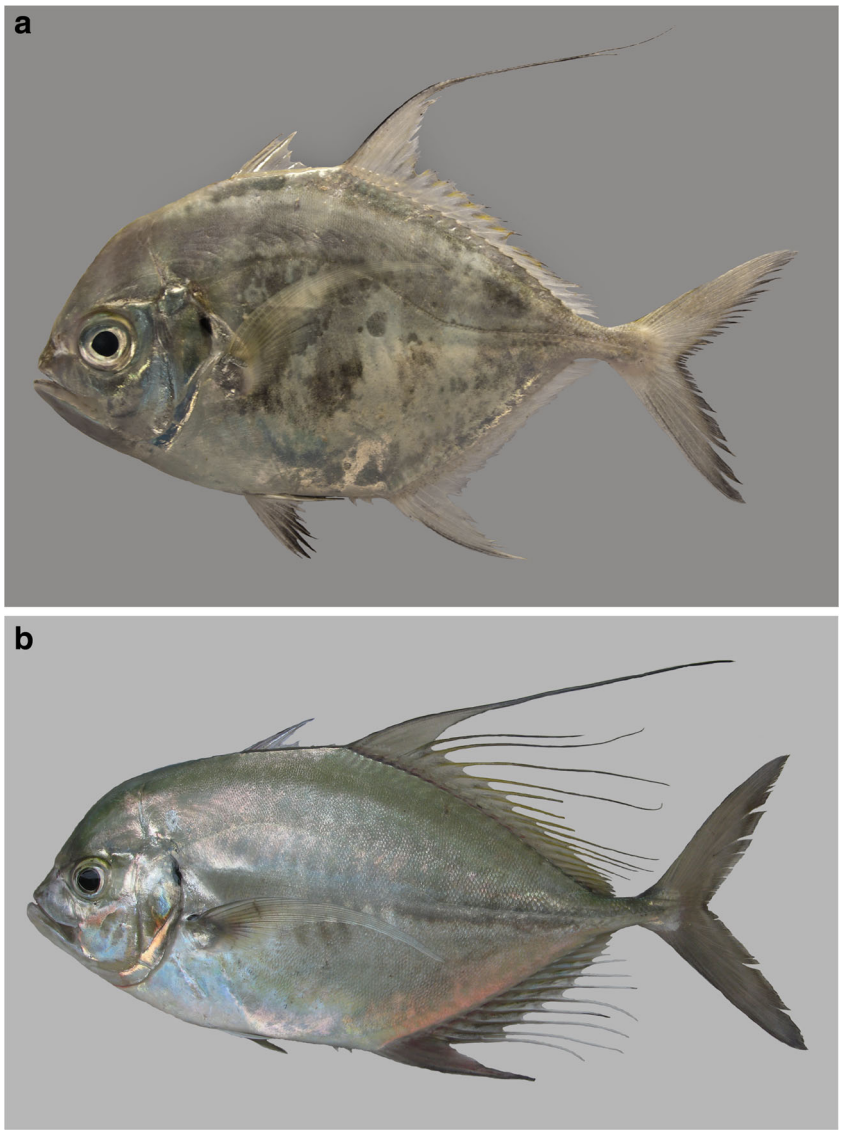


Fig. 2 *Carangoides armatus.* **(a)** subadult, SMF 35363 [KAU13-650], 122.0 mm, off Jizan, Saudi Arabia, Red Sea; **(b)** adult, uncatalogued, 330.0 mm, Iran, Arabian Gulf. Photos by S.V. Bogorodsky (**a**), Z. Sadighzadeh (**b**)

second dorsal and anal fins with prominent anterior lobe, the dorsal lobe much longer than head length, with a long filament; mature males larger than about 21 cm FL with some filamentous central rays in second dorsal and anal fins; pectoral fins long and falcate, reaching junction of curved and straight parts of lateral line.

Coloration. Silvery blue-gray dorsally, shading to silvery on sides, with a small, vertically elongate, black spot posteriorly on operculum at level of upper margin of eye; margins of dorsal-fin filament blackish; posterior margin of caudal fin blackish; juveniles and subadults with five or six broad dusky bars on body and blackish pelvic fins.

Size. Reaches about 50 cm.

Distribution and habitat. Reported from the Red Sea to South Africa and Madagascar east along the southern Asian continent to Thailand, north to Hong Kong and Japan; not reported from the East Indies and Australia. In the Red Sea known north to El Quseir, Egypt, but no records from the Gulf of Aqaba. Inhabits coastal shallow, often turbid, water, reported to 30 m depth.

Remarks. *Carangoides armatus* was redescribed in detail by Williams and Heemstra (1980) and compared with the similar *C. hedlandensis* (Whitley, 1934). It is a moderately rare species in the Red Sea, subadults and juveniles may be collected by trawling, adults usually by hook-and-line. Juveniles and subadults may be confused with the similar in appearance *Ulua mentalis* (Cuvier, 1833) (Figs. 2 and 3), but the latter species differs in having a prominent lower jaw in adults and numerous gill rakers (23–27 + 51–61), partly visible when mouth open. In addition to characters provided in the diagnosis, Red Sea specimens of *C. armatus* are characterized by having a white tongue with tiny teeth and dorsal- and anal fins with a scaly sheath covering about half ray length of entire fin. In contrast, the similar *C. malabaricus* has a

Fig. 3 *Ulua mentalis*, subadult, SMF 35858 [KAU14-548], 122.5 mm, off Jizan, Saudi Arabia, Red Sea. Photo by S.V. Bogorodsky

mainly dark toothed tongue, *C. talamparoides* has white toothed tongue with teeth more developed on median patch, and in both species the scaly sheath only covers the anterior half of each fin at its base.

***Carangoides bajad* (Forsskål, 1775)**

Orangespotted Trevally

Fig. 4, Table 1

Scomber ferdau var. *bajad* Forsskål, 1775: 55 (type locality: Red Sea; syntypes: ZMUC P46437-438).

Caranx auroguttatus Cuvier in Cuvier & Valenciennes, 1833: 71 (Red Sea; original description) — Rüppell 1852: 13 (Red Sea); Clark et al. 1968: 21 (Dahlak Archipelago).

Caranx (*Carangoides*) *auroguttatus* — Klunzinger 1884: 98 (Red Sea).

Carangoides auroguttatus — Ben-Tuvia 1968: 303 (Dahlak Archipelago).

Caranx immaculatus Ehrenberg in Cuvier and Valenciennes 1833: 73.

Caranx fulvoguttatus var. *flava* Klunzinger, 1871: 460 (Red Sea, Egypt, Al-Qusair; original description).

Caranx bajad — Rüppell 1852: 13 (Red Sea).

Carangoides bajad — Ormond 1980: 250 (Red Sea); Randall 1983: 66 (Red Sea, photo); Smith-Vaniz 1984 (Red Sea); Dor 1984: 124 (Red Sea); Goren and Dor 1994: 33 (Red Sea); Khalaf and Disi 1997: 93 (Aqaba, photo); Lieske and Myers 2004: 96 (Mangrove Bay, El Quseir, photo); Khalaf 2004: 39 (Jordan); Golani and Bogorodsky 2010: 30 (Red Sea); Debelius 2011: 195 (Gordon Reef, Sinai, photo).

Material examined: MNHN A.5587 (1, 326 mm SL), syntype of *Caranx auroguttatus*, Red Sea); KAUMM 429 [KAU14-348] (1, 150.0 mm), Saudi Arabia, off Jizan; KAUMM 439 (1, 156.0 mm), Saudi Arabia, off Jizan, 10–12 m, 31 Oct 2014; KAUMM 438 [KAU14-461 & 462] (2, 124.0–137.0 mm), Saudi Arabia, off Jizan; SMF 26 (3, 121–154 mm), Red Sea; SMF 35852 [KAU13-113] (1, 253.0 mm), Saudi Arabia, Al Wajh bank; SMF 35853 [KAU14-141] (1, 199.0 mm), Saudi Arabia, off Jizan; SMF 35862 [KAU14-192] (1, 182.0 mm), Saudi Arabia, off Jizan; SMF 35863 [KAU14-232] (1, 190.0 mm), Saudi Arabia, off Jizan; SMF 35854 [KAU14-560] (1, 150.0 mm), Saudi Arabia, off Jizan; USNM 207273 (1, 254 mm), Eritrea, Dahlak Archipelago; USNM 207644 (3, 173–239), Ethiopia, Isola, Delemme.

Diagnosis. Dorsal-fin rays VIII + I,24–26; anal-fin rays II + I,21–24; straight portion of lateral line with 14–26 scales followed by 20–30 small scutes; breast completely covered by scales or with only a very small naked area anteroventrally; gill rakers 7–9 + 18–21 = 25–33; body depth 2.7–3.1 in FL; dorsal profile of head to above eye nearly straight; bands of small teeth in jaws, on vomer and palatines, vomerine tooth patch triangular, without posterior extension; anterior lobe of second dorsal fin higher than first dorsal fin, shorter than head length; pectoral fins long and falcate, reaching junction of curved and straight parts of lateral line.

Coloration. Brassy dorsally, shading to silvery below, with numerous, conspicuous, yellow-orange spots on side of body, more numerous on lower two-thirds; black spot posteriorly on head; anal fin with light blue margin; capable of rapidly changing color to overall golden yellow (but yellow-orange spots still evident).

Size. Reaches 55 cm.

Distribution and habitat. Distribution is disjunct: one population is restricted to northwestern Indian Ocean from the Red Sea (type locality) to the Arabian Gulf and Pakistan; the other is from Malaysia, Thailand east to Philippines, Papua New Guinea, and Palau, north to Taiwan and southern Japan. Records of *Carangoides bajad* from southern India (Joshi

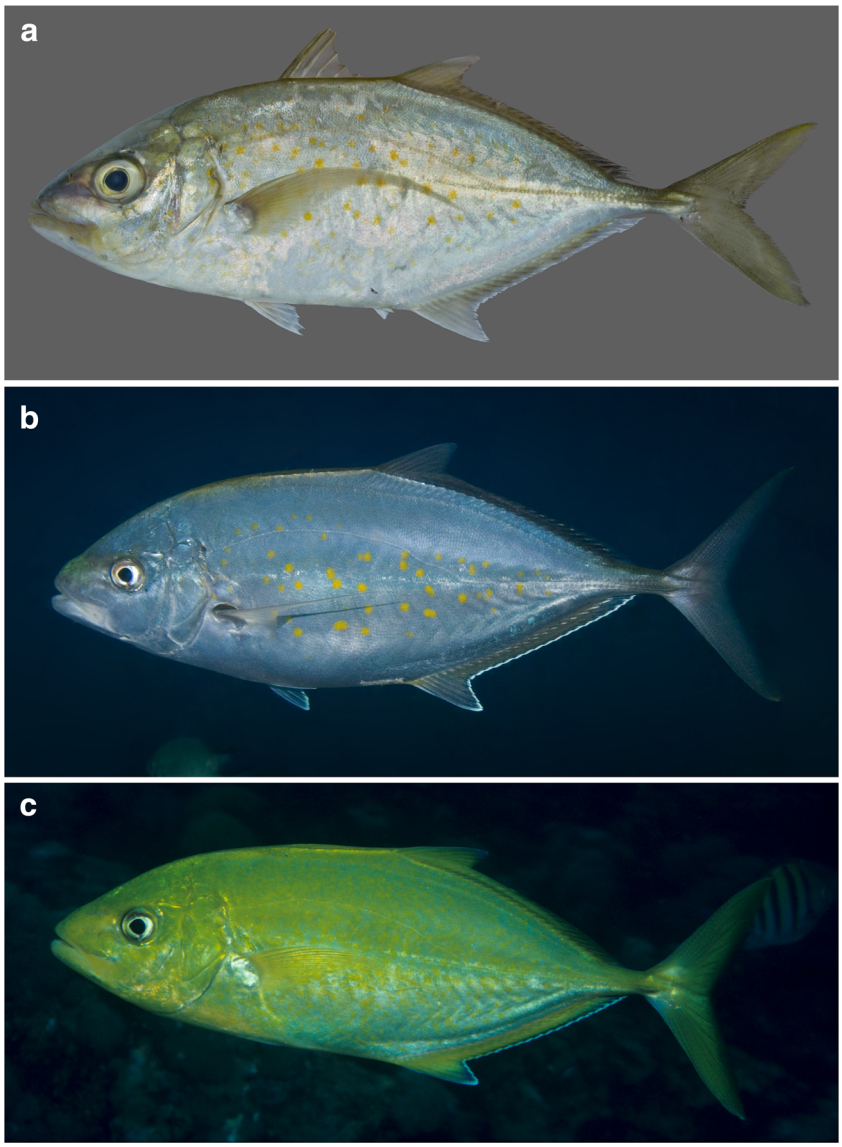


Fig. 4 *Carangoides bajad.* **(a)** SMF 35853 [KAU14-141], 199.0 mm, off Jizan, Saudi Arabia, Red Sea; **(b)** Shams Alam, Egypt, Red Sea; **(c)** Egypt, Red Sea. Photos by S.V. Bogorodsky (a & b), J.E. Randall (**c**)

et al. 2011) are based on misidentifications of *C. fulvoguttatus*. In the Red Sea, *C. bajad* is one of the most common species. It typically inhabits coral-reefs areas where it feeds on fishes; occasionally it is collected by trawling in areas close to islands. Known depth range 1–250 m.

Remarks. Distinctive species, easily distinguished from congeners by a combination of characters: breast usually completely scaly, sides of body covered by numerous small yellow spots and bluish anal-fin margin.

***Carangoides chrysophrys* (Cuvier, 1833)**

Longnose Trevally

Fig. 5, Table 1

Caranx chrysophrys Cuvier in Cuvier & Valenciennes, 1833: 77 (type locality: Seychelles; holotype: MNHN A-0560).

Carangoides chrysophrys — Smith-Vaniz 1984 (Red Sea); Golani and Bogorodsky 2010: 30 (Red Sea).

Caranx chrysophris — Dor 1984: 126 (as a doubtful record).

Carangoides chrysoptera (mistake) — Goren and Dor 1994: 33 (Red Sea).

Material examined: KAUMM 441 (1, 80.6 mm), Saudi Arabia, off Jizan, 10–12 m, 31 Oct 2014; SMF 35855 [KAU12-349] (1, 260.0 mm), Saudi Arabia, Farasan Archipelago, 14 m, 24 Feb 2012.

Diagnosis. Dorsal-fin rays VIII + I,18–20; anal-fin rays II + I,15–17; straight portion of lateral line with 2–15 scales followed by 20–36 small scutes; naked area of breast extends obliquely to base of pectoral fins and distinctly behind origin of pelvic fins; gill rakers 5–9 + 15–18 = 21–26; body depth 2.4–2.8 in FL; dorsal profile of head forming an angle of about 45 degrees to the

Fig. 5 *Carangoides chrysophrys*, SMF 35855 [KAU12-349], 265.0 mm, Farasan Island, Saudi Arabia, Red Sea. Photo by S. Tränkner

horizontal; band of villiform teeth in jaws, vomerine tooth patch ovate; anterior lobe of second dorsal fin a little shorter than head length, but higher than first dorsal fin, filamentous in young; anterior lobe of anal fin prolonged; pectoral fins long and falcate, nearly reaching junction of curved and straight parts of lateral line.

Coloration. Uniformly silvery with blue-green iridescence; a vertically elongate black spot, nearly as large as pupil size, posteriorly on operculum slightly dorsal to mid-level of eye; caudal fin yellowish posteriorly.

Size. Largest specimen about 40 cm.

Distribution and habitat. Occurs from the Red Sea south to South Africa (Algoa Bay) and islands of the Western Indian Ocean east to Australia and the Indo-Malayan region, north to Japan. Uncommon in the Red Sea with no voucher specimens known north of Sudan. It typically lives close to bottom some distance from coral reef areas in depths of 10–90 m, usually between 30 and 60 m.

Remarks. *Carangoides chrysophrys* can be distinguished from *C. malabaricus* and *C. talamparoides* by the combination of lower counts of gill rakers, dorsal- and anal-fin rays (Table 1), in having scaly area above pectoral-fin base (vs. naked) and dorsal and anal-fin lobes prolonged in adults. It also differs from other congeners in having the snout abruptly vertical above the mouth cleft in adults.

***Carangoides coeruleopinnatus* (Rüppell, 1830)**

Coastal Trevally

Fig. 6, Table 1

Caranx coeruleopinnatus Rüppell, 1830: 100 (type locality: Red Sea, Saudi Arabia, Jeddah; lectotype: SMF 2873).

Fig. 6 *Carangoides coeruleopinnatus*, Philippines. Photo by A. Ryanskiy

Caranx (Carangoides) malabaricus (not Bloch & Schneider) — Klunzinger 1884: 99 (Red Sea).

Carangoides caeruleopinnatus — Smith-Vaniz 1984 (Red Sea); Dor 1984: 124 (Red Sea); Goren and Dor 1994: 33 (Red Sea).

Carangoides coeruleopinnatus — Golani and Bogorodsky 2010: 30 (Red Sea).

Material examined: SMF 2873 (1, 336 mm, dry mount) and SMF 1602 (1, 172 mm, dry mount), Jeddah.

Diagnosis. Dorsal-fin rays VIII + I,20–23 (usually 22–23); anal-fin rays II + I,16–20 (usually 18–19); straight portion of lateral line with 0–13 scales followed by 20–36 small scutes; breast naked ventrally to distinctly behind pelvic-fins origin (rarely a narrow band of scales between breast and base of pectoral fins); gill rakers 5–8 + 15–19 = 21–27; body depth 2.3–2.5 in FL; dorsal profile of head distinctly convex; band of small teeth in jaws, vomerine tooth patch ovate; in adults larger than 25 cm FL, anterior lobe of second dorsal fin shorter than head length, higher than first dorsal fin, the lobe filamentous in young; pectoral fins long and falcate, reaching junction of curved and straight parts of lateral line.

Coloration. Silvery blue-green dorsally, shading silvery on sides and ventrally; body with six, indistinct, broad dusky bars and usually with small yellow spots, more numerous dorsally; a small indistinct black spot posteriorly on operculum at level of upper edge of eye; rays of dorsal and anal fins dusky.

Size. Reaches 40 cm.

Distribution and habitat. Ranges from the Red Sea south to Seychelles and South Africa (Durban), east throughout Maldives and coastal continental waters of the Indian Ocean to Fiji and Samoa Islands; in the western Pacific from Australia (Queensland) to Japan; only Guam in Micronesia. Rare in the Red Sea with no records from the Gulf of Aqaba. Reported from depths of 10–100 m but primarily known from deep waters. Rarely seen in areas close to coral reefs.

Remarks. *Carangoides coeruleopinnatus* may be easily confused with the similar *C. ferdau* but differs by yellow spots usually restricted to upper half of body (vs. spots scattered on side of body), and anterior lobe of second dorsal fin shorter than anterior lobe of anal fin, with distinctly curved anterior margin distally (vs. lobes subequal in height and anterior margin only slightly curved distally).

***Carangoides equula* (Temminck & Schlegel, 1844)**

Deepwater Trevally

Fig. 7, Table 1

Caranx equula Temminck & Schlegel, 1844: 111 (type locality: Japan, Kyūshū, Nagasaki Prefecture, Omura Bay; lectotype: RMNH 1311).

Carangoides equula — Baranes and Golani 1993: 307 (Gulf of Aqaba, photo); Khalaf and Disi 1997: 93 (Aqaba, photo); Khalaf 2004: 39 (Jordan, list); Golani and Bogorodsky 2010: 30 (Red Sea).

Material examined: no Red Sea material examined.

Diagnosis. Dorsal-fin rays VIII + I,23–25; anal-fin rays II + I,21–24; straight portion of lateral line with 0–6 scales followed by 22–32 small scutes; breast completely covered by scales or with a very small naked area anteroventrally; gill rakers 7–10 + 18–23 = 27–32; body depth 3.0–3.3 in FL (deeper-bodied in juveniles); dorsal profile of head slightly convex; bands of small teeth in jaws, on vomer and palatines, the vomerine tooth patch anchor-shaped with a narrow median posterior extension; first dorsal fin a little higher than the lobe of second dorsal fin; pectoral fins not reaching junction of curved and straight parts of lateral line; last dorsal- and anal-fin rays about 1.5 times longer than penultimate rays in adults.

Fig. 7 *Carangoides equula*, HUJ 14569, 160.0 mm, Eilat, Gulf of Aqaba, Red Sea. Photo by D. Darom

Coloration. Silvery blue-green dorsally, silvery with iridescence on side and ventrally; a small blackish spot on opercular membrane at level with upper part of eye; membranes of soft dorsal and anal fins with a broad black submarginal bands, the margin whitish.

Size. Attains 50 cm.

Distribution and habitat. Reported from the Red Sea, Somalia, South Africa, Gulf of Oman, northern and Western Australia, South China Sea, Japan (type locality), Sea of Japan, Russia (Balanov and Markevich 2011), New Caledonia, Hawaiian Islands, and Easter Island. Red Sea records are only from deep water of the Gulf of Aqaba. Collected from habitat close to the bottom in depths of 64–350 m (Red Sea records from depth of 200–350 m).

Remarks. Some authors assign *C. equula* to its own genus *Kaiwarinus* Suzuki, 1962. Gushiken (1988) in his phylogenetic analysis placed the species in fusiform carangids based on two putative synapomorphies: well developed premaxillary articular process and interpelvic keel scarcely developed. However, this generic assignment is not recognized by some authors (e.g., Smith-Vaniz 1999). *Carangoides equula* is a distinctive species characterized in having an anchor-shaped vomerine patch with posterior extension and blackish submarginal band in second dorsal and anal fins.

***Carangoides ferdau* (Forsskål, 1775)**

Barred Trevally

Fig. 8, Table 1 *Scomber ferdau* Forsskål, 1775: 55 (type locality: Red Sea, Saudi Arabia, Jeddah; Forsskål specimens: ZMUC P46442).

Caranx ferdau — Rüppell 1852: 13 (Red Sea); Klunzinger 1871: 462 (El Quseir).

Caranx (*Carangoides*) *ferdau* — Klunzinger 1884: 99 (Red Sea).

Carangoides ferdau — Fowler and Steinitz 1956: 275 (Eilat); Smith-Vaniz 1984 (Red Sea); Dor 1984: 125 (Red Sea); Goren and Dor 1994: 33 (Red Sea); Golani and Bogorodsky 2010: 30 (Red Sea); Debelius 2011: 194 (Safaga, Egypt, photo).

Material examined: SMF 1603 (1, 172 mm), "Red Sea"; SMF 35865 [KAU17-124] (1, 240 mm FL), Saudi Arabia, Farasan Archipelago, 5 Feb 2017.

Diagnosis. Dorsal-fin rays VIII + I,26–34; anal-fin rays II + I,21–26 (usually 22–24); straight portion of lateral line much longer than curved, with 10–30 scales followed by 21–37 small scutes; breast naked ventrally to origin of pelvic fins, laterally naked breast and pectoral-fin base interrupted by broad scaly zone; gill rakers 7–10 + 17–20 = 24–29; body depth 2.3–2.8 in FL; dorsal profile of head slightly convex; narrow band of villiform teeth in jaws, disappearing with age, vomerine tooth patch ovate; anterior part of second dorsal and anal fins strongly elevated, the lobes a little shorter than head length but longer than first dorsal fin, the lobes not prolonged into filaments; pectoral fins long and falcate, reaching junction of curved and straight parts of lateral line.

Coloration. Silvery blue-green dorsally, shading to silvery on sides and ventrally, with six or seven dusky bars on upper two-thirds of body nearly as broad as pale interspaces (bars in life faint to strongly marked); scattered, small, yellow spots usually present on upper half of body; posterior margin of caudal fin narrowly black.

Size. Largest specimen 53 cm.

Distribution and habitat. Widespread from the Red Sea and east coast of Africa to Hawaiian Islands and French Polynesia; in the western Pacific from Australia (Great Barrier Reef) to southern Japan. In the Red Sea it known from the entire area. It is usually seen ranging over sand near reefs or often in seagrass beds, sometimes in small groups. Maximum depth reported, 60 m.

Fig. 8 *Carangoides ferdau*, Lahami Bay, Egypt, Red Sea. Photo by S.V. Bogorodsky

Remarks. Both, *C. ferdau* and *C. fulvoguttatus* differ from other species by high count of rays in second dorsal and anal fins (Table 1). In addition, *C. ferdau* is distinctive in having bars and scattered, small, yellow spots on body.

Carangoides fulvoguttatus (Forsskål, 1775)

Yellowspotted Trevally

Fig. 9, Table 1

Scomber fulvoguttatus Forsskål, 1775: 56 (type locality: Red Sea; no types known).

Caranx gaess Lacépède, 1801: 59 (unneeded replacement name).

Caranx bleekeri Klunzinger, 1871: 461 (Red Sea, Egypt, Al-Qusair; original description) — Bamber 1915: 480 (Sudan).

Caranx fulvoguttatus — Rüppell 1852: 13 (Red Sea); Borsieri 1904: 200 (Eritrea); Marshall 1952: 230 (Sanafir I.); Klausewitz 1967: 62 (Sarso Isl); Tortonese 1983: 107 (Jeddah, list).

Caranx (*Carangoides*) *fulvoguttatus* — Klunzinger 1884: 98 (Red Sea).

Carangoides fulvoguttatus — Ormond 1980: 250 (Red Sea); Randall 1983: 67 (Red Sea, photo); Smith-Vaniz 1984 (Red Sea); Dor 1984: 125 (Red Sea); Goren and Dor 1994: 33 (Red Sea); Khalaf and Disi 1997: 93 (Aqaba, photo); Lieske and Myers 2004: 96 (Marsa Shagra, Marsa Alam, photo); Khalaf 2004: 39 (Jordan, list); Golani and Bogorodsky 2010: 30 (Red Sea); Debelius 2011: 196 (Safaga, Egypt, photo).

Material examined: MNHN 1966-171 (1, 144 mm), Red Sea.

Diagnosis. Dorsal-fin rays VIII + I,25–30; anal-fin rays II + I,21–26; straight portion of lateral line with 18–27 scales followed by 15–21 small scutes; breast nearly naked or with a scaly zone separating naked pectoral-fin base from broad scaleless ventral area; gill rakers 6–8 + 17–21 = 22–27; body oblong, the depth 3.2–3.8 in FL; dorsal profile of head to above eye nearly straight in large adults; band of small teeth in jaws, vomerine tooth patch ovate; anterior lobe of second dorsal and anal fins elevated, nearly twice height of longest dorsal spine; pectoral fins long and falcate, nearly or just reaching junction of curved and straight parts of lateral line.

Coloration. Silvery blue-green dorsally, shading to silvery with iridescence on side and ventrally, with five or six broad gray-blue bars (can be turned on or off), sometimes containing small dark blotches posteriorly; upper half of body with scattered, small, brassy or dark yellow spots, varying from a few up to 25; large adults often with

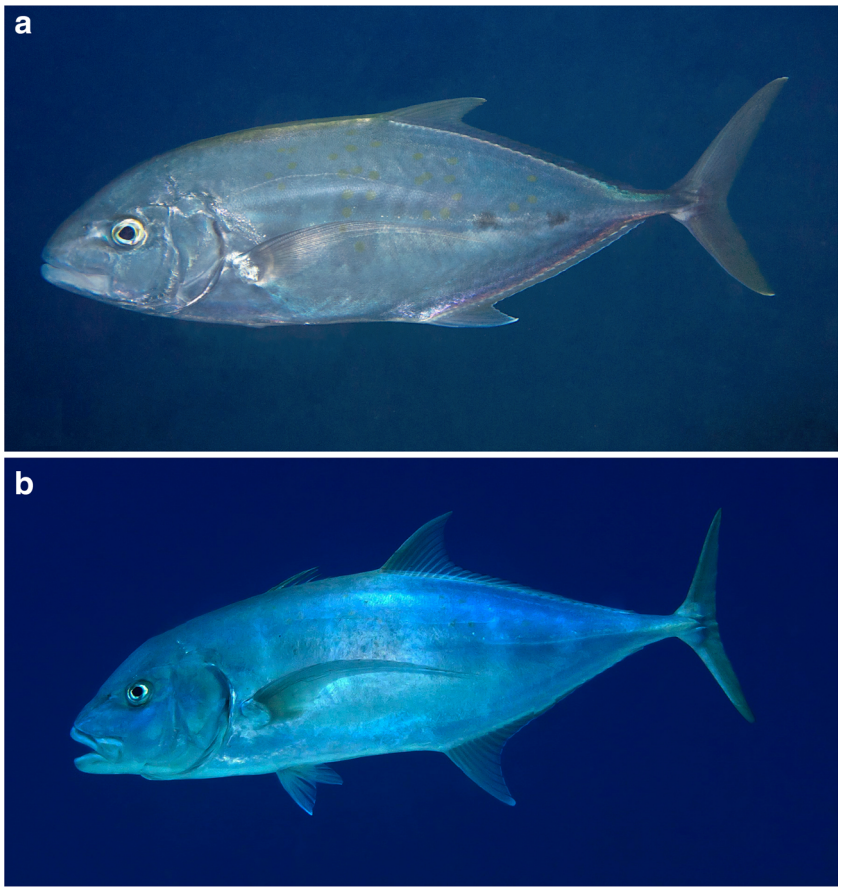


Fig. 9 *Carangoides fulvoguttatus*. **(a)** Dahab, Gulf of Aqaba, Red Sea; **(b)** Hurghada, Egypt, Red Sea. Photos by S.V. Bogorodsky (**a**), A. Golubev (**b**)

three or four midlateral blackish blotches; a small indistinct, vertically elongate, dark spot posteriorly on opercle; caudal fin dusky to yellowish; tip of anal-fin lobe and tips of caudal-fin lobes often white.

Size. A particularly large species for the genus, largest specimen 103 cm.

Distribution and habitat. Widespread in the Indo-West Pacific, from the Red Sea and east coast of Africa east to the Caroline Islands and New Caledonia; in the western Pacific from Australia (New South Wales) to the Ryukyu Islands, Japan. Reported from entire Red Sea but rare elsewhere. It is usually seen along outer-reef slopes, solitary or small schools, reported from depths of 2–100 m.

Remarks. *Carangoides fulvoguttatus* is a distinctive species, but may be confused under water with *C. bajad*, as both may have numerous yellow spots on side of body. However, *C. fulvoguttatus* is more slender, 3.2–3.8 in FL (vs. 2.7–3.1 in FL), body with indistinct bars or blotches (vs. no bars or blotches), yellow spots on body varying from a few to about two dozen and more numerous on upper half (vs. many yellow spots on side of body, more numerous on lower two-thirds), and tips of caudal-fin lobes usually white (vs. tips of caudal-fin lobes same color as rest of fin).

***Carangoides malabaricus* (Bloch & Schneider, 1801)**

Malabar Trevally

Figs. 10 and 11, Table 1

Scomber malabaricus Bloch & Schneider, 1801: 31 (type locality: India, Tranquebariam [Tharangambadi]; holotype: ZMB 8760).

Caranx (*Carangoides*) *impudicus* Klunzinger, 1884: 99 (Red Sea, Saudi Arabia, Jeddah; original description).

Carangoides chrysophrys (not Cuvier) — Bogorodsky et al. 2014: 421 (off Jizan, Saudi Arabia).

Caranx malabaricus — Klunzinger 1871: 463 (Red Sea).

Carangoides malabaricus — Smith-Vaniz 1984 (Red Sea occurrence likely); Dor 1984: 125 (Red Sea); Goren and Dor 1994: 34 (Red Sea).

Material examined: SMF 394, holotype of *Caranx impudicus* (1, 153.5 mm), Red Sea; SMF 377 (1, 121 mm),

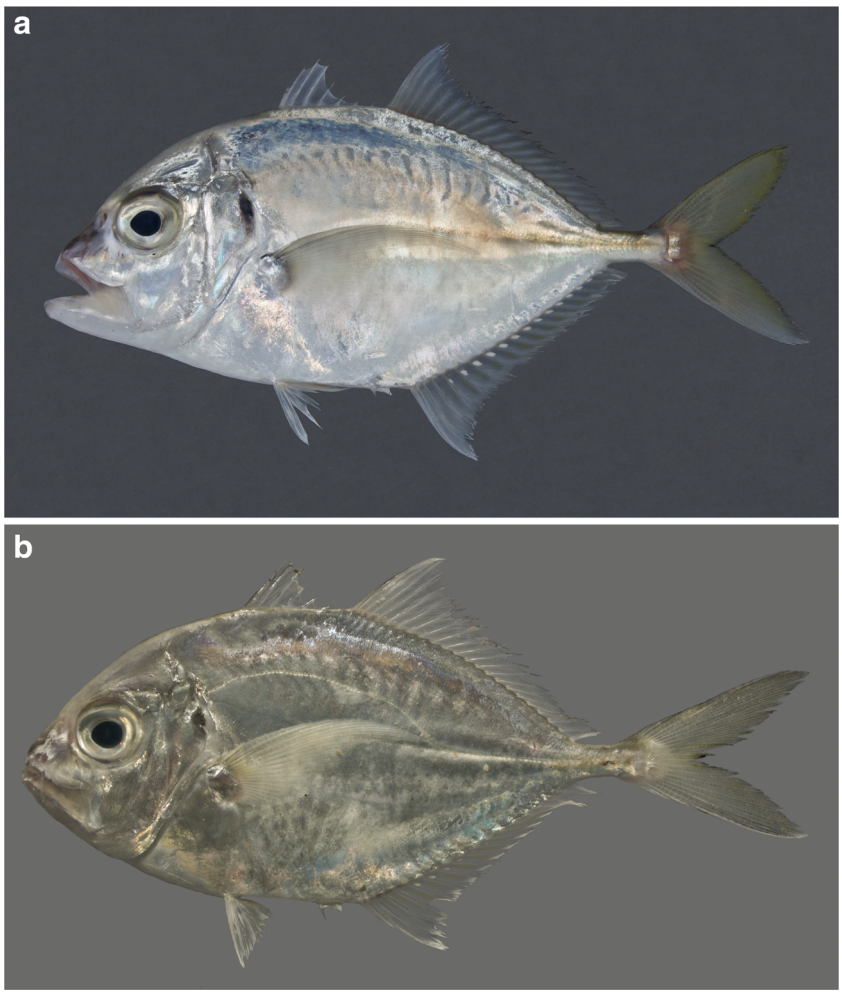


Fig. 10 *Carangoides malabaricus.* **(a)** SMF 35857 [KAU14-154], 144.0 mm, off Jizan, Saudi Arabia, Red Sea **(b)** SMF 35365 [KAU13-649], 91.3 mm, off Jizan, Saudi Arabia, Red Sea. Photos by S.V. Bogorodsky

Fig. 11 *Carangoides plagiotaenia*, uncatalogued, 306.0 mm, Hurghada, Egypt, Red Sea. Photo by S.V. Bogorodsky

Red Sea. Other material was collected off Jizan, southern Saudi Arabia: KAUMM 71 [KAU12-608] (1, 145.5 mm); KAUMM 430 [KAU14-255] (1, 127.0 mm); KAUMM 440 (1, 151.0 mm); KAUMM 432 [KAU14-380] (1, 119.5 mm); KAUMM 433 [KAU14-499] (1, 124.5 mm); KAUMM 434 [KAU14-521] (1, 126.0 mm); SMF 35019 [KAU12-607] (2, 131.0–148.5 mm); SMF 35365 [KAU13-649] (1, 91.3 mm); SMF 35856 (5, 125.5–159.0 mm); SMF 35857 [KAU14-154] (1, 144.0 mm).

Diagnosis (counts of Red Sea specimens in parentheses). Dorsal-fin rays VIII + I,20–23 (21–22); anal-fin rays II + I,17–19 (18–19); straight portion of lateral line with 0–18 scales followed by 20–36 small scutes (14–18 + 21–27); breast naked ventrally, naked area continuing behind pelvic-fins origin, anteriorly small naked area present just above pectoral-fin base; gill rakers 8–12 + 21–27 = 32–38 (9–11 + 23–27 = 32–38); body depth 2.3–2.5 in FL; dorsal profile of snout steep and nearly straight to above eye; band of villiform teeth in jaws, vomerine tooth patch roughly triangular; anterior lobe of second dorsal and anal fins not greatly elevated, the dorsal lobe shorter than head length; first dorsal fin about three-fourth height of lobe of second dorsal fin; pectoral fins long and falcate, but usually not reaching junction of curved and straight parts of lateral line.

Coloration. Silvery blue-green above and silvery with iridescence below, with a vertically elongate black spot posteriorly on operculum at level of upper part of eye; interradial membranes of anal fin with a small basal white spot; margin of anal fin narrowly white; tongue dark brown with white median band.

Size. Reaches 27.5 cm.

Distribution and habitat. Ranges from the Red Sea and Arabian Gulf, south to South Africa, east to Papua New Guinea to eastern Australia (Queensland) and Japan. In the Red Sea *C. malabaricus* is known north to Jeddah. It occurs in coastal waters, usually above soft substrata in depths of 18–140 m.

Remarks. Klunzinger (1871) discussed a specimen, deposited in Senckenberg Museum, resembling *C. talamparoides*, which he later described (Klunzinger 1884) as a new species *Caranx impudicus*. Williams and Venkataramani (1978) recognized two species in the *C. malabaricus* species group, *C. malabaricus* and *C. talamparoides*, redescribing each in detail and, without comment, placing *C. impudicus* in the synonymy of *C. malabaricus*. In their study, 310 specimens of *C. malabaricus* are listed from the Indo-West Pacific, but none from the Red Sea.

Synonymy of *Caranx* (*Carangoides*) *impudicus* is confirmed here by examination of the holotype, which has gill rakers (10 + 26 = 36) in the range of *C. malabaricus*. The species differs from Red Sea congeners in having a distinct premaxillary notch and also toothed dark tongue with median white band where teeth more numerous than at margins. *Carangoides malabaricus* and *C. talamparoides* both possess a white spot at base on most membranes of anal fin, with the spot more obvious in the former.

***Carangoides plagiotaenia* Bleeker, 1857**

Barcheek Trevally

Fig. 12, Table 1

Carangoides plagiotaenia Bleeker, 1857: 59 (type locality: Indonesia, Molucca Islands, Ambon Island; lectotype: RMNH 26974) — Smith-Vaniz 1984 (Red Sea); Dor 1984: 126 (Red Sea); Goren and Dor 1994: 34 (Red Sea); Golani and Bogorodsky 2010: 30 (Red Sea).

Caranx brevicarinatus Klunzinger 1871: 461 (Red Sea, Egypt, Al-Qusair; original description).

Caranx (*Carangoides*) *compressus* — Klunzinger 1884: 98 (Red Sea).

Material examined: Hurghada marine station, uncatalogued (1, 306 mm), Egypt, Hurghada.

Fig. 12 Dorsal and lateral views of anterior end of premaxilla: (**a**, **b**) *Carangoides malabaricus*, SMF 35856, 159.0 mm, off Jizan, Saudi Arabia, Red Sea; (**c**, **d**) *Carangoides talamparoides*, KAUMM 435 [KAU17-100], 191.0 mm, off Jizan, Saudi Arabia, Red Sea. Photos by S.V. Bogorodsky

Diagnosis. Dorsal-fin rays VIII + I,22–24; anal-fin rays II + I,18–20; straight portion of lateral line shorter than anterior curved part, with 20–26 scales followed by 11–18 small scutes; breast fully scaly; gill rakers 8–14 + 18–27 (usually 18–24) = 34–40; body depth 2.8–3.3 in FL; dorsal profile of head to above eye nearly straight in large adults; lower jaw large and projecting; band of small teeth in jaws, vomerine tooth patch triangular; first dorsal fin and anterior lobe of second fin subequal in height; lobe of second dorsal fin and anal fin moderately low, about half head length; pectoral fins long and falcate, but not reaching junction of curved and straight parts of lateral line.

Coloration. Silvery blue-green with iridescence; preopercle with a prominent black posterior margin in adults; margin of anal fin narrowly whitish.

Size. Largest specimen 41.5 cm.

Distribution and habitat. Occurs from the Red Sea south to South Africa (Durban), east to the Samoa Islands and Marshall Islands; in the western Pacific from Australia (Great Barrier Reef) and New Caledonia to the Ryukyu Islands, Japan. In the Red Sea no reports from the Gulf of Aqaba. Usually collected as solitary individuals off seaward reefs from depth 2–200 m.

Remarks. Differs from other species in having projecting lower jaw, fully scaly breast, uniform body without markings, and obvious black preopercular margin.

***Carangoides talamparoides* Bleeker, 1852**

Imposter Trevally

Figs. 12, 13, and 14, Tables 1 and 2

Carangoides talamparoides Bleeker, 1852: 91 (type locality: Indonesia, western Sumatra, Sibogha; lectotype: RMNH 6099).

Carangoides armatus (not Rüppell) — Bogorodsky et al. 2014: 421 (off Jizan, Saudi Arabia).

Material examined: Saudi Arabia, off Jizan. KAUMM 69 [KAU12-559] (1, 69.5 mm), 20–22 m, 29 Feb 2012; KAUMM 70 [KAU12-825] (1, 44.8 mm), 29 Feb 2012; KAUMM 435 [KAU17-100] (1, 191.0 mm), 52–54 m, 30 Jan 2017; SMF 35018 [KAU12-558] (1, 69.6 mm), 20–22 m, 29 Feb 2012; SMF 35864 (1, 60.0 mm), 10–12 m, 31 Oct 2014; SMF 35860 [KAU17-99 & 101] (2, 199.0–203.0), 52–54 m, 30 Jan 2017.

Diagnosis. Dorsal-fin rays VIII + I,20–23; anal-fin rays II + I,17–19; straight part of lateral line with 2–12 scales followed by 20–32 small scutes; breast naked ventrally, naked area continuing behind pelvic-fins origin, anteriorly small naked area present just above pectoral-fin base; gill rakers in adults 7–9 + 18–22 = 25–31; body depth 2.3–2.5 in FL; dorsal profile of snout steep and nearly straight to above eye; snout length 7.4–10.0 in FL (10.0–13.6% FL) in adults; band of villiform teeth in jaws, vomerine tooth patch roughly triangular; anterior lobe of second dorsal and anal fins not greatly elevated, the dorsal lobe shorter than head length; first dorsal fin about three-fourth height of lobe of second dorsal fin; pectoral fins long and falcate, but usually not reaching junction of curved and straight parts of lateral line.

Size. Attains 32.0 cm.

Description (based on seven Red Sea specimens 44.8–203.0 mm, Table 2; frequency data in brackets). Dorsal-fin rays VIII + I,21–23 [21:3; 22:3; 23:1]; anal-fin rays II + I,17–18 [17:1; 18:6]; pectoral-fin rays 19–21 [19:5; 20:1; 21:1]; scales + scutes in straight part of lateral line 9–16 +

Fig. 13 *Carangoides talamparoides*, **(a)** juvenile, KAUMM 70 [KAU12-825], 44.8 mm, off Jizan, Saudi Arabia, Red Sea; **(b)** adult, SMF 35860 [KAU17-99], 203.0 mm, off Jizan, Saudi Arabia, Red Sea. Photos by S.V. Bogorodsky

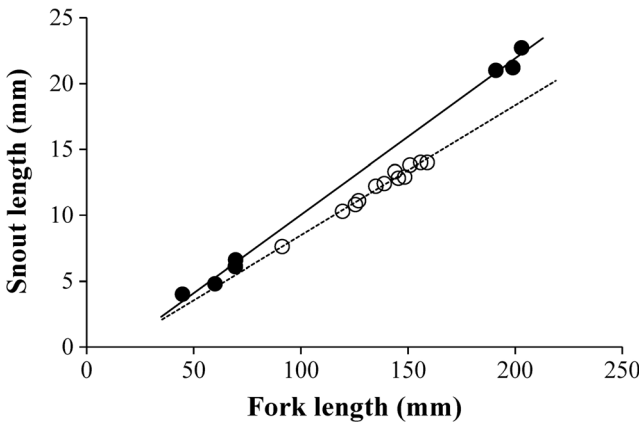


Fig. 14 Relationship of snout length (in mm) to fork length (in mm) in *C. malabaricus* (open circles) and *C. talamparoides* (solid circles)

20–32 = 36–41 [7–8 + 28–31 = 36–37 in adults]; gill rakers on first gill arch 6–8 + 17–18 = 23–31 [6–8 + 17–18 = 23–26 in juveniles; 7–8 + 18 = 25–26 in adults].

Body moderately deep and strongly compressed, the depth 1.6–1.8 in juveniles and 2.3–2.4 in FL in adults. Upper profile of head nearly straight with shallow concavity at level of upper third of eye; lower profile of head nearly straight. Snout length 8.0–9.5% FL in juveniles, 10.7–11.2% FL in adults. Adipose eyelid weakly developed with narrow rim around eye. Mouth below level of eye, slightly oblique. Upper jaw extending to vertical through anterior edge of pupil, with rounded posterior corners and slightly concave posterior margin. Premaxilla with slightly concave anterodorsal margin laterally (Fig. 12). Jaws protrusible, lower slightly projecting. Bands of small villiform teeth in both jaws, narrowing posteriorly; tongue with minute teeth more numerous on median

patch than at margin; vomerine tooth patch roughly triangular. Body mostly scaly; naked area laterally and ventrally on breast sinuously extending just behind free spines of anal fin in juveniles and breast naked ventrally with naked area continuing a little behind pelvic-fin origin in adults, small area anteriorly at pectoral-fin base scaly; small area just above pectoral-fin base naked; head naked except scaly cheek and upper parts of preopercle and opercle. Dorsal and anal fins covered by scaly membrane of two rows of scales: row of small scales and row of enlarged scales at base of each fin, last five dorsal-fin and last four anal-fin membranes without scales.

First dorsal fin moderate in height, its origin above pectoral-fin base, the third spine longest, slightly longer than orbit diameter. Anterior lobes of second dorsal and anal fins prolonged into a long filament in juveniles, varying in length from 0.7 in FL (KAUMM 70 of 44.8 mm) to 2.0 in FL (KAUMM 69 of 69.5 mm); lobes becoming shorter with growth and subequal in length, 4.8–5.1 in FL. Pectoral fins subfalcate, extending behind anal-fin origin, nearly reaching junction of curved and straight parts of lateral line; first ray unbranched, third ray longest. Pelvic fins short, reaching or not to free anal-fin spines. Caudal fin strongly forked. Gill rakers moderately long, raker 1.4 times longer than opposite filament.

Coloration (Fig. 13). Silvery green-gray above and silvery with iridescence below, with vertically elongate black spot posteriorly on operculum at level of upper part of eye; greenish yellow blotch dorsoposteriorly on orbit membrane

Table 2 Morphometric and meristic data for the Red Sea specimens of *Carangoides talamparoides*. Fork and total length are expressed in millimeters, all other measurements are expressed as percentage of fork length

Specimen	small juvenile, KAUMM 70 [KAU12-825]	juveniles, $n = 3$	adults, $n = 3$
Fork length (mm)	44.8	60.0-69.6	191.0-203.0
Total length (mm)	–	78.5-79.0	210.0-222.5
Body depth 1, from origin of first dorsal fin	63.4	54.3-56.0	42.0-42.9
Body depth 2, from origin of second dorsal fin	67.9	56.8-58.6	43.9-45.5
Head length	31.9	30.3-30.6	29.7-30.7
Snout length	8.9	8.0-9.5	10.7-11.2
Orbit diameter	7.8	11.1-11.3	10.0-10.2
Interorbital width	10.5	8.9-9.1	9.4-10.8
Upper-jaw length	13.2	12.6-13.0	12.6-12.8
Caudal peduncle depth	4.2	4.3-4.6	4.5-4.6
Caudal peduncle length	10.4	10.1-10.2	10.4-10.7
Predorsal length 1	43.3	40.5-41.4	40.2-41.1
Predorsal length 2	57.3	54.5-56.3	56.1-56.7
Preanal-fin length	62.5	62.8-63.0	56.3-57.1
Prepelvic length	45.1	39.8-42.8	34.6-35.9
Base of second dorsal fin	41.4	40.5-41.3	37.3-39.7
Third dorsal-fin spine	16.3	12.8-13.7	11.3-13.1
Dorsal-fn lobe, including filament	145.0	51.1-88.4	19.6-20.8
Base of anal fin	37.6	35.8-37.4	32.2-34.4
Postorbital length	11.5	11.6-11.7	11.4-11.7
Length of lateral line (curved + straight)	63.4	62.0-66.1	64.8-67.2
Suborbital depth	5.1	4.9-5.5	6.7-7.1
Anal-fin lobe, including filament	75.9	29.1-48.9	19.4-20.6
Pectoral-fin length	25.2	28.2-30.5	34.7-36.4
Pelvic-fin length	broken	18.8-20.1	12.8-13.0
Meristics			
Straight LL, scale + scutes	16 + 20 = 36	9-15 + 24-32 = 36-41	6-8 + 28-31 = 36-37
Gill rakers incl. Rudim.	6 + 17 = 23	6-8 + 17-18 = 23-26	7-8 + 18 = 25-26
Pectoral-fin rays	19	19-21	19
Second dorsal-fin rays	I,21	I,21-23	I,21-22
Anal-fin rays	I,18	I,18	I,17-18

(obvious in alive fish); interradial membranes of anal fin with small, indistinct, slightly elongate basal white spot; fins uniform except margin of anal fin narrowly white and tips of first three dorsal-fin spines black; dorsal-fin filament blackish in juveniles; black blotch covers second to fourth rays with membranes in middle of pelvic fins in juveniles; tongue white.

Distribution and habitat. Previously known from the Gulf of Oman and Sri Lanka east to the Philippines, Guam, and northern Australia. Here reported from the southern Red Sea for the first time. It is usually collected by trawling above soft bottoms in sandy areas. Red Sea records of juveniles from depths of 10–22 m, whereas adults were trawled from deeper waters of about 50–55 m.

Remarks. Williams and Venkataramani (1978) redescribed in detail the morphologically similar *C. malabaricus* and *C. talamparoides*, and demonstrated that gill raker counts are the most important diagnostic character to differentiate these two species (see their Table 2). The former species is characterized by higher gill raker counts (8–12 + 21–27 = 32–38) than the latter (6–9 + 19–22 = 27–31). Red Sea specimens have lower gill raker counts (23–26 in juveniles and 25–26 in adults) than those from other localities (27–31) reported by Williams and Venkataramani (1978), and are assumed to be specific for the Red Sea population.

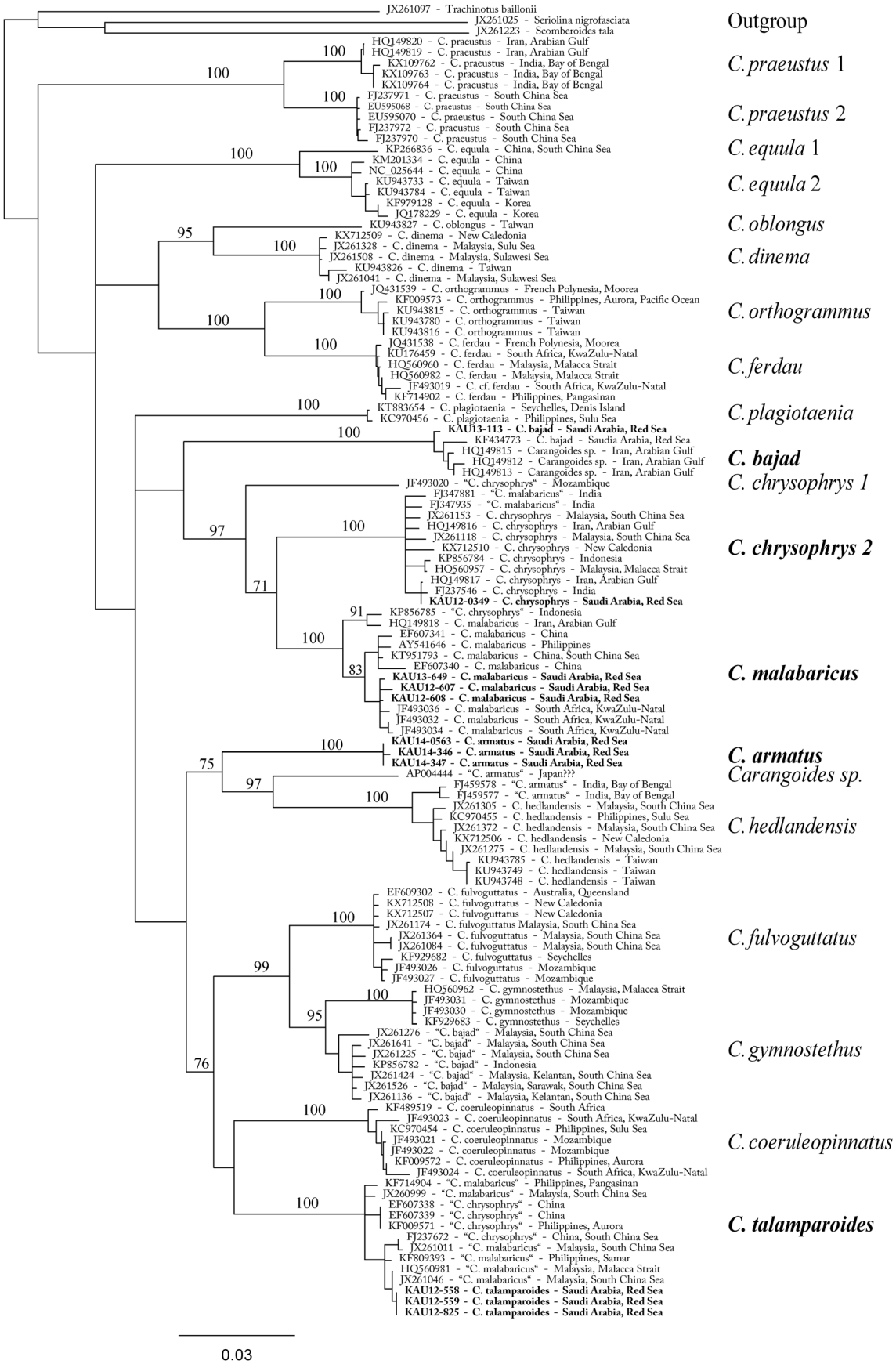
Two additional characters used by Williams and Venkataramani (1978) to distinguish *C. talamparoides* from *C. malabaricus*: snout length and the distance between tip of snout and origin of first dorsal fin. They stated that predorsal distance is normally less than 41.25% FL in *C. malabaricus* and more than 41.25% FL in *C. talamparoides*. The predorsal distance of examined juveniles of *C. talamparoides* (40.5–43.3% FL) was within the proportion of a single specimen of *C. malabaricus* less than 100 mm FL (42.2% FL). Specimens of *C. malabaricus* larger than 100 mm FL have shallower body (37.0–39.4% FL) than examined adults of *C. talamparoides* (40.2–41.1% FL), but the length of the largest specimen of the former species is 159 mm FL while the smallest adult of the latter species was 191 mm FL. However, predorsal distance decreases with growth and is overlapping, and therefore is a difficult character to use for differentiation of these two species.

Williams and Venkataramani (1978) stated that the snout is longer in *C. talamparoides* than in *C. malabaricus*, and provided a diagram of relationship of snout length to fork length (see their Figs. 4 and 5). According to them, snout length is 9.3–13.6% FL in *C. talamparoides* specimens 79–281 mm FL, whereas snout length is 7.7–10.8% FL in *C. malabaricus* specimens 70–240 mm FL. Adult Red Sea specimens of *C. malabaricus* have snout length 8.6–9.2% FL; but in three adults of *C. talamparoides* snout length is 10.7–11.2% FL but in the latter species specimens were a little larger in size. As shown in Williams and Venkataramani (Williams and Venkataramani 1978, Fig. 5) snout length decreases progressively with growth, juveniles examined of *C. talamparoides* have snout length 8.0–9.5% FL and adults 10.7–11.2% FL. Direct comparison of the snout lengths of the three Red Sea specimens of *C. talamparoides* and specimens of about 200 mm SL examined by Williams and Venkataramani (1978) with similar-sized specimens of *C. malabaricus* using Fig. 5 confirms the usefulness of the snout length as specific character for these two species (Fig. 14). Specimens of *C. talamparoides* of 200 mm FL have snout length ca. 11–12% FL (versus ca. 10% FL) in *C. malabaricus*.

In addition to gill raker counts, *C. talamparoides* can be distinguished from *C. malabaricus* in having white tongue covered with minute teeth (vs. tongue mostly dark, brown to grayish brown in life); greenish yellow blotch dorsoposteriorly on orbit membrane (vs. no blotch on orbit membrane); longer snout, the length 10.0–13.6% FL in adults (vs. snout shorter, 8.5–10.8% FL in adults); and premaxilla with slightly concave anterodorsal margin laterally (vs. premaxilla with distinctly concave margin laterally).

Phylogenetic analysis

The neighbor joining analysis resulted in a tree with 20 well-resolved clades for the COI barcoding sequences from specimens of *Carangoides* (see Fig. 15). Only groupings of closely related clades received support from bootstrapped analyses whereas – as expected – higher phylogenetic relationships among these groups were not revealed by the analysis of the COI barcoding sequence. With regard to species directly examined here, *C. chrysophrys* and *C. malabaricus* grouped together with *Carangoides chrysophrys* 1; *C. armatus* and *C. hedlandensis* (Whitley 1934) grouped together with *Carangoides* sp.; and *C. talamparoides* and *C. coeruleopinnatus* grouped together with *C. fulvoguttatus* and *C. gymnostethus* (see discussion regarding assignment of species names). All sequences analyzed in this study grouped in distinct clades by species. The clade with Red Sea *C. bajad* sequences also contained other sequences from the GenBank search that were identified as *Carangoides sp*. In addition to this clade, another clade contained sequences with original taxonomic identification as *C. bajad*; this clade most likely represents *C. gymnostethus* (see discussion). Sequences of Red Sea *C. malabaricus* and *C. chrysophrys* each contained a number of sequences from other localities that were identified as both *C. malabaricus* and *C. chrysophrys* in both cases. Sequences of Red Sea *C. armatus* formed a unique clade, in which no other sequence was included. However, sequences in two other clades were retrieved from specimens that were originally misidentified as *C. armatus* in the original study. The clade that contained sequences of Red Sea *C. talamparoides* also contained specimens misidentified as *C. malabaricus* and *C. chrysophrys*. Average intraspecific molecular divergence was highest in *C. malabaricus* (1.3%)


JX261097 - Trachinotus baillonii
JX261025 - Seriolina nigrofasciata
JX261223 - Scomberoides tala
Outgroup
HQ149820 - C. praeustus - Iran, Arabian Gulf
HQ149819 - C. praeustus - Iran, Arabian Gulf
KX109762 - C. praeustus - India, Bay of Bengal
KX109763 - C. praeustus - India, Bay of Bengal
KX109764 - C. praeustus - India, Bay of Bengal
C. praeustus 1
FJ237971 - C. praeustus - South China Sea
EU595068 - C. praeustus - South China Sea
EU595070 - C. praeustus - South China Sea
FJ237972 - C. praeustus - South China Sea
FJ237970 - C. praeustus - South China Sea
C. praeustus 2
KP266836 - C. equula - China, South China Sea
KM201334 - C. equula - China
NC_025644 - C. equula - China
KU943733 - C. equula - Taiwan
KU943784 - C. equula - Taiwan
KF979128 - C. equula - Korea
JQ178229 - C. equula - Korea
C. equula 1
C. equula 2
KU943827 - C. oblongus - Taiwan
C. oblongus
KX712509 - C. dinema - New Caledonia
JX261328 - C. dinema - Malaysia, Sulu Sea
JX261508 - C. dinema - Malaysia, Sulawesi Sea
KU943826 - C. dinema - Taiwan
JX261041 - C. dinema - Malaysia, Sulawesi Sea
C. dinema
JQ431539 - C. orthogrammus - French Polynesia, Moorea
KF009573 - C. orthogrammus - Philippines, Aurora, Pacific Ocean
KU943815 - C. orthogrammus - Taiwan
KU943780 - C. orthogrammus - Taiwan
KU943816 - C. orthogrammus - Taiwan
C. orthogrammus
JQ431538 - C. ferdau - French Polynesia, Moorea
KU176459 - C. ferdau - South Africa, KwaZulu-Natal
HQ560960 - C. ferdau - Malaysia, Malacca Strait
HQ560982 - C. ferdau - Malaysia, Malacca Strait
JF493019 - C. cf. ferdau - South Africa, KwaZulu-Natal
KF714902 - C. ferdau - Philippines, Pangasinan
C. ferdau
KT883654 - C. plagiotaenia - Seychelles, Denis Island
KC970456 - C. plagiotaenia - Philippines, Sulu Sea
C. plagiotaenia
KAU13-113 - C. bajad - Saudi Arabia, Red Sea
KF434773 - C. bajad - Saudia Arabia, Red Sea
HQ149815 - Carangoides sp. - Iran, Arabian Gulf
HQ149812 - Carangoides sp. - Iran, Arabian Gulf
HQ149813 - Carangoides sp. - Iran, Arabian Gulf
C. bajad
JF493020 - "C. chrysophrys" - Mozambique
FJ347881 - "C. malabaricus" - India
FJ347935 - "C. malabaricus" - India
JX261153 - C. chrysophrys - Malaysia, South China Sea
HQ149816 - C. chrysophrys - Iran, Arabian Gulf
JX261118 - C. chrysophrys - Malaysia, South China Sea
KX712510 - C. chrysophrys - New Caledonia
KP856784 - C. chrysophrys - Indonesia
HQ560957 - C. chrysophrys - Malaysia, Malacca Strait
HQ149817 - C. chrysophrys - Iran, Arabian Gulf
FJ237546 - C. chrysophrys - India
KAU12-0349 - C. chrysophrys - Saudi Arabia, Red Sea
C. chrysophrys 1
C. chrysophrys 2
KP856785 - "C. chrysophrys" - Indonesia
HQ149818 - C. malabaricus - Iran, Arabian Gulf
EF607341 - C. malabaricus - China
AY541646 - C. malabaricus - Philippines
KT951793 - C. malabaricus - China, South China Sea
EF607340 - C. malabaricus - China
KAU13-649 - C. malabaricus - Saudi Arabia, Red Sea
KAU12-607 - C. malabaricus - Saudi Arabia, Red Sea
KAU12-608 - C. malabaricus - Saudi Arabia, Red Sea
JF493036 - C. malabaricus - South Africa, KwaZulu-Natal
JF493032 - C. malabaricus - South Africa, KwaZulu-Natal
JF493034 - C. malabaricus - South Africa, KwaZulu-Natal
C. malabaricus
KAU14-0563 - C. armatus - Saudi Arabia, Red Sea
KAU14-346 - C. armatus - Saudi Arabia, Red Sea
KAU14-347 - C. armatus - Saudi Arabia, Red Sea
C. armatus
AP004444 - "C. armatus" - Japan???
Carangoides sp.
FJ459578 - "C. armatus" - India, Bay of Bengal
FJ459577 - "C. armatus" - India, Bay of Bengal
JX261305 - C. hedlandensis - Malaysia, South China Sea
KC970455 - C. hedlandensis - Philippines, Sulu Sea
JX261372 - C. hedlandensis - Malaysia, South China Sea
KX712506 - C. hedlandensis - New Caledonia
JX261275 - C. hedlandensis - Malaysia, South China Sea
KU943785 - C. hedlandensis - Taiwan
KU943749 - C. hedlandensis - Taiwan
KU943748 - C. hedlandensis - Taiwan
C. hedlandensis
EF609302 - C. fulvoguttatus - Australia, Queensland
KX712508 - C. fulvoguttatus - New Caledonia
KX712507 - C. fulvoguttatus - New Caledonia
JX261174 - C. fulvoguttatus Malaysia, South China Sea
JX261364 - C. fulvoguttatus - Malaysia, South China Sea
JX261084 - C. fulvoguttatus - Malaysia, South China Sea
KF929682 - C. fulvoguttatus - Seychelles
JF493026 - C. fulvoguttatus - Mozambique
JF493027 - C. fulvoguttatus - Mozambique
C. fulvoguttatus
HQ560962 - C. gymnostethus - Malaysia, Malacca Strait
JF493031 - C. gymnostethus - Mozambique
JF493030 - C. gymnostethus - Mozambique
KF929683 - C. gymnostethus - Seychelles
JX261276 - "C. bajad" - Malaysia, South China Sea
JX261641 - "C. bajad" - Malaysia, South China Sea
JX261225 - "C. bajad" - Malaysia, South China Sea
KP856782 - "C. bajad" - Indonesia
JX261424 - "C. bajad" - Malaysia, Kelantan, South China Sea
JX261526 - "C. bajad" - Malaysia, Sarawak, South China Sea
JX261136 - "C. bajad" - Malaysia, Kelantan, South China Sea
C. gymnostethus
KF489519 - C. coeruleopinnatus - South Africa
JF493023 - C. coeruleopinnatus - South Africa, KwaZulu-Natal
KC970454 - C. coeruleopinnatus - Philippines, Sulu Sea
JF493021 - C. coeruleopinnatus - Mozambique
JF493022 - C. coeruleopinnatus - Mozambique
KF009572 - C. coeruleopinnatus - Philippines, Aurora
JF493024 - C. coeruleopinnatus - South Africa, KwaZulu-Natal
C. coeruleopinnatus
KF714904 - "C. malabaricus" - Philippines, Pangasinan
JX260999 - "C. malabaricus" - Malaysia, South China Sea
EF607338 - "C. chrysophrys" - China
EF607339 - "C. chrysophrys" - China
KF009571 - "C. chrysophrys" - Philippines, Aurora
FJ237672 - "C. chrysophrys" - China, South China Sea
JX261011 - "C. malabaricus" - Malaysia, South China Sea
KF809393 - "C. malabaricus" - Philippines, Samar
HQ560981 - "C. malabaricus" - Malaysia, Malacca Strait
JX261046 - "C. malabaricus" - Malaysia, South China Sea
KAU12-558 - C. talamparoides - Saudi Arabia, Red Sea
KAU12-559 - C. talamparoides - Saudi Arabia, Red Sea
KAU12-825 - C. talamparoides - Saudi Arabia, Red Sea
C. talamparoides
0.03

◀ **Fig. 15** Neighbor joining tree inferred from COI barcoding sequences of specimens of Indo-Pacific species of *Carangoides*. Names of species with vouchers examined in this study in *bold*. Misidentified vouchers in *quotation marks*, examined vouchers in *bold*. Values on branches correspond to percent bootstrap support from 200 replicates (only shown if >70). Nodes with less than 50% support are collapsed. Scale bar represents K2P-distance of branch length; assumed correct identifications that differ from those of voucher identifications are highlighted in red

followed by *C. chrysophrys* (0.9%), *C. talamparoides* (0.8%), *C. bajad* (0.7%), and lowest in *C. armatus* (0.1%).

Discussion

Morphological examination of specimens of *Carangoides* collected from coastal waters off Jizan (southern Saudi Arabia) confirms the presence of the previously unreported species *C. talamparoides* in the Red Sea. Special care was taken when additional material of *C. malabaricus* from the Red Sea was examined in order to distinguish it from the morphologically similar *C. talamparoides*. Besides already established morphological differences that can be applied for the distinction of the two species, e.g. gill raker counts and color of tongue (see Smith-Vaniz 1999; also key and accounts for both species), we confirmed herein that the snout length can help to distinguish these two species. In addition, we found that the presence of greenish yellow blotch dorsoposteriorly on orbit membrane in *C. talamparoides* and the shape of the anterodorsal margin of the premaxilla are also useful in the distinction between *C. talamparoides* and *C. malabaricus*. The neighbor joining analysis of Indo-West Pacific *Carangoides* spp. showed that all *C. talamparoides* examined in this study fall into a single clade (see Fig. 15). All specimens in this clade with identifications of "*C. chrysophrys*" and "*C. malabaricus*" (including those we have not personally examined) were reasoned to be *C. talamparoides*, based on their molecular lineage identity with Red Sea specimens of *C. talamparoides*. Published taxonomic identifications for these specimens are, therefore, treated as misidentifications. Unfortunately, no data on key morphological characteristics were available for these specimens in order to confirm this assumption.

Inconsistencies in taxonomic identifications of voucher specimens in other clades were treated the same way, if one or several specimens of a lineage had been examined by us. For example, *Carangoides armatus* specimens from the Red Sea formed a monophyletic clade in which no sequences of specimens from other localities were included, and the clades including Red Sea *C. bajad*, *C. chrysophrys*, and *C. malabaricus* all contained specimens with incongruent identifications (see Fig. 15). Conflicting identifications in other lineages, e.g. the appearance of multiple specimens of "*C. bajad*" in a cluster with specimens of *C. gymnostethus*, were also eliminated, and the respective clade was labeled as *C. gymnostethus* according to the identification of those specimens that were not apparently misidentified. The image of one of the four specimens identified as *C. gymnostethus* (GenBank KF929683, BOLD ID UKFBJ912-08) collected at Victoria Fish Market in Mahe, Seychelles by K.A. Moots et al. also confirms the identification of this specimen. Although some of the remaining clades did not contain specimens identified by us, we tentatively use the remaining original identifications if no further conflicts existed after the described adjustment of taxon identifications (see Fig. 15 and Supplementary Table 1).

Clades with specimens of *C. gymnostethus*, *C. malabaricus*, and *C. hedlandensis* showed signs of genetic substructure that in part was supported in a separation of specimens by geographic origin. Specimens of two closely related, but clearly divergent clades both contained only specimens that were identified as *C. praeustus* (Anonymous [Bennett], 1830), a species described from Sumatra, Indonesia. As no data on the basis of these identifications were available we assigned the names *C. praeustus* 1 and *C. praeustus* 2 to these clades. The first of these two clades was composed of specimens from the Arabian Gulf and the Eastern Indian Ocean, whereas the second included specimens from the South China Sea only. Smith-Vaniz (1984) remarked:"this species [*C. praeustus*] exhibits geographic variation with western Indian Ocean specimens typically having more gill rakers and the breast less fully scaled compared to specimens from the Gulf of Thailand and Indonesia." If two species actually exist, the name *C. ire* Cuvier 1833 will probably apply to "*C. praeustus* 1." In *C. equula* two divergent lineages were also observed (*C. equula* 1 and *C. equula* 2), but the divergence was less prominent and the single sequence in *C. equula* 1 was from the same region as those in *C. equula* 2. The nature of divergence in *C. equula* can only be assessed once more sequences (especially from *C. equula* 1) become available, but the name *C. dasson* (Jordan & Snyder, 1907) could eventually apply to one of the two clades. Two of the clades in the tree received no species identification – *Carangoides chrysophrys* 1 and *Carangoides* sp. – because the single specimens that represented these clades were originally named as *C. chrysophrys* and *C. armatus*, respectively. Eventually, conclusive morphological identification of voucher specimens representing these clades might either lead to assignment of already existing taxonomic identifications or members of these evolutionary lineages might be recognized and described as new species.

It was beyond the scope of the present study to confirm morphological identifications of all COI clades of Indo-West Pacific *Carangoides*, especially as most of the vouchers from outside the Red Sea from which sequences

were used herein have not been deposited in accessible museum collections. We provide evidence of a markedly higher species diversity than would be expected from the original identifications that contained 16 different species identifications of 18 currently recognized Indo-West Pacific species of *Carangoides* including *C. dasson*. The only Indo-West Pacific species not included in our analysis is *C. humerosus* (McCulloch, 1915) as no sequence from this species has been published so far. However, using the identification tool in BOLD (http://www.boldsystems.org/) with e.g. the sequences of *C. oblongus* allows identifying a clade that was not included here consisting of a number of sequences from vouchers identified as *C. humerosus* (all specimens collected from Queensland, Australia, but without accessible image). Integrative morphological and molecular analysis of these specimens might confirm that they indeed represent the one Indo-West Pacific species that is missing in our analysis. While the results obtained herein show that the taxonomy of the genus *Carangoides* is not yet fully resolved, this study shows how this can be overcome in the future. Detailed morphological examination and recognition of key morphological characters of voucher specimens is prerequisite for the establishment of improved identification keys and also enables subsequent correct specimen identification through DNA barcodes by providing a morphological reference.

The purpose of the NJ tree presented herein is to indicate the existence and evolutionary independence of lineages within *Carangoides*. Its purpose explicitly was not to investigate evolutionary relationships of Carangidae, - or more precisely of *Carangoides* and its close relatives. In-depth phylogenetic analyses using more sequence information and broader taxon sampling (i.e. inclusion of species from closely related genera such as e.g. *Ulua*) may show that *Carangoides*, as treated in this study, is paraphyletic. Such insights cannot be gained solely from analyses of the COI barcoding gene that was used in this study where its aim was to shed light on the diversity of Indo-Pacific *Carangoides* at the species level. Finally, we wish to emphasize that making premature generic changes would be a disservice to nomenclature stability in these commercially important fishes.

Acknowledgements Susanne Dorow and Jennifer Steppler are gratefully thanked for technical assistance at SMF and thanks are also due to Matthias Juhas and Stephanie Simon (SMF) for assisting in molecular genetic analyses. We further acknowledge the Grunelius-Möllgaard Laboratory at SMF for lab support. We thank Sven Tränkner (SMF), Laith Jawad, Dadid Darom, Andrey Ryanksiy, Andrey Golubev, and J.E. Randall for providing photographs and permission for reproduction herein. The scientific research cooperation between King Abdulaziz University (KAU), Faculty of Marine Sciences (FMS), Jeddah, Saudi Arabia, and the Senckenberg Research Institute (SRI), Frankfurt, Germany, in the framework of the Red Sea Biodiversity Project, during which the present material was collected, was funded by KAU GRANT NO. "I/1/432-DSR". The authors acknowledge, with thanks, KAU and SRI for technical and financial support as well as Ali Al-Aidaroos, Mohsen Al Sofiyani (KAU) and Fareed Krupp (SRI and Qatar Natural History Museum, Doha) for their help in the realization of the present study.

Compliance with ethical standards

Other material examined (Saudi Arabia, off Jizan): *Ulua mentalis.* KAUMM 431 [KAU14-295] (1, 108.5 mm); SMF 35858 [KAU14-548] (1, 122.5 mm); SMF 35859 [KAU14-463] (1, 139.5 mm).

References

Balanov AA, Markevich AI (2011) First occurrence of *Carangoides equula* (Temminck et Schlegel, 1844) (Carangidae) in Russian waters. J Ichth 51(8):666–669

Bamber RC (1915) Reports on the marine biology of the Sudanese Red Sea, from collections made by Cyril Crossland, M.A., b.Sc., F.Z.S. – XXII. The fishes. J Lin Soc London; Zool 31(210):477–485

Baranes A, Golani D (1993) An annotated list of deep-sea fishes collected in the northern Red Sea, gulf of Aqaba. Isr J Zool 39:299–336

Ben-Tuvia A (1968) Report on the fisheries investigations of the Israel south Red Sea expedition, 1962. Bull Sea Fish Res Stn Israel 52:21–55

Bleeker P (1851) Over eenige nieuwe geslachten en soorten van Makreelachtige visschen van den Indischen Archipel. Natuur Tijd Nederl Ind 1(4):341–372

Bleeker P (1852) Bijdrage tot de kennis der Makreelachtige visschen van den Soenda-Molukschen Archipel. Verh Batav Gen Kunst Weten 24(5):1–93

Bleeker P (1857) Achtste bijdrage tot de kennis der vischfauna van Amboina. Acta Soc Reg Scient Indo-Neêrl 2(7):1–102

Bloch ME, Schneider JG (1801) M. E. Blochii, Systema Ichthyologiae Iconibus cx Ilustratum. Post obitum auctoris opus inchoatum absolvit, correxit, interpolavit Jo. Gottlob Schneider, Saxo. Berolini. Sumtibus Auctoris Impressum et Bibliopolio Sanderiano Commissum. lx + 584 pp

Bogorodsky SV, Alpermann TJ, Mal AO, Gabr MH (2014) Survey of demersal fishes from southern Saudi Arabia, with five new records for the Red Sea. Zootaxa 3852(4):401–437

Borsieri C (1904) Contribuzione alla conoscenza della fauna ittiologica della Colonia Eritrea. Annali Mus Civ Stor Nat di Genova (3) 1(41): 187–220

Clark E, Ben-Tuvia A, Steinitz H (1968) Observation on a coastal fish community, Dahlak archipelago, Red Sea. Bill Sea Fish Res Stn Isr 49:15–31

Cuvier G, Valenciennes A (1833) Histoire naturelle des poissons. Tome neuvième. Suite du livre neuvième. Des Scombéroïdes, volume 9, Levrault, Paris, xxix + 512 pp

Debelius H (2011) Red Sea reef guide, fifth edn. IKAN-Unterwasserarchiv, Frankfurt, pp 321

Dor M (1984) Checklist of the fishes of the Red Sea. CLOFRES II. The Israel Academy of Sciences and Humanities, Jerusalem, i-xxii + 437 pp

Folmer O, Black M, Hoeh W, Lutz R, Vrijenhoek R (1994) DNA primers for amplification of mitochondrial cytochrome c oxidase subunit I from diverse metazoan invertebrates. Mol Mar Biol Biotechnol 3(5): 294–299

Forsskål PS (1775) Descriptiones animalium avium, amphibiorum, piscium, insectorum, vermium; quae in itinere orientali observavit […]. Post mortem auctoris edidit Carsten Niebuhr, Hauniae, 164 pp

Fowler HW, Steinitz H (1956) Fishes from Cyprus, Iran, Iraq, Israel and Oman. Bull Res Counc Isr 5B(3–4):260–292

Geiger MF, Herder F, Monaghan MT, Almada V, Barbieri R, Bariche M et al (2014) Spatial heterogeneity in the Mediterranean biodiversity hotspot affects barcoding accuracy of its freshwater fishes. Mol Ecol Res 14(6):1210–1221

Golani D, Bogorodsky SV (2010) The fishes of the Red Sea—reappraisal and updated checklist. Zootaxa 2463:1–135

Goren M, Dor M (1994) An updated checklist of the fishes of the Red Sea. CLOFRES II. The Israel Academy of Sciences and Humanities, Jerusalem, i-xii + 120 pp

Gushiken S (1988) Phylogenetic relationships of the perciform genera of the family Carangidae. Jap J Ichth 34(4):443–461

Hebert PDN, Stoeckle MY, Zemlak TS, Francis CM (2004) Identification of birds through DNA barcodes. PLoS Biol 2(10):1657–1663

Ivanova NV, de Waard J, Hebert PDN (2006) An inexpensive, automation-friendly protocol for recovering high-quality DNA. Mol Ecol Notes 6:998–1002

Ivanova NV, Zemlak TS, Hanner RH, Hebert PDN (2007) Universal primer cocktails for fish DNA barcoding. Mol Ecol Notes 7(4): 544–548

Jordan DS, Snyder (1907) Notes on fishes of Hawaii, with descriptions of new species. Bull Bur Fisher 26(623)(for 1906):205–218

Joshi KK, Nair RJ, Samad EMA, Thomas S, Kakati VS, Jasmine S, Varghese M, Paul SM, Sukumaran S, George RM, Manisseri MK (2011) The carangids of India - a monograph. Central marine fisheries research Insitute, Kerala, India, i-x + 437 pp

Katoh K, Standley DM (2013) MAFFT multiple sequence alignment software version 7: improvements in performance and usability. Mol Biol Evol 30(4):772–780

Khalaf MA (2004) Fish fauna of the Jordanian coast, Gulf of Aqaba, Red Sea. Mar Sci 15:23–50

Khalaf MA, Disi AM (1997) Fishes of the Gulf of Aqaba. Marine Science Station Aqaba, Aqaba 252 pp

Klausewitz W (1967) Die physiographische Zonierung der Saumriffe von Sarso. Meteor Forsch.-Ergebn. D (2):44–68

Klunzinger CB (1871) Synopsis der Fische des Rothen Meeres. II. Theil. (Schluss). Verh Zool-Bot Ges Wien 21:441–688

Klunzinger CB (1884) Die Fische des Rothen Meeres. Eine kritische Revision mit Bestimmungstabellen. I. Teil. Acanthopteri veri Owen. Stuttgart, IX + 133 pp

Kottelat M (2013) The fishes of the inland waters of southeast Asia: a catalogue and core bibiography of the fishes known to occur in freshwaters, mangroves and estuaries. Raffl Bull Zool, suppl 27:1–663

Lacépède BGE (1801) Histoire naturelle des poissons. Volume 3. Plassan, Paris 558 pp

Lieske E, Myers RF (2004) Coral reef guide. Red Sea to gulf of Aden. HarperCollins Publishers, London, South Oman, pp 384

Marshall NB (1952) The 'Manihine' expedition to the Gulf of Aqaba 1948–1949. IX. Fishes. Bull Brit Mus (Nat Hist), Zool 1(8):221–252

Masters BC, Fan V, Ross HA (2011) Species delimitation – a geneious plugin for the exploration of species boundaries. Mol Ecol Res 11(1):154–157

Ormond RFC (1980) Aggressive mimicry and other interspecific feeding association among Red Sea coral reef predators. J Zool Lond 19(2): 247–262

Randall JE (1983) Red Sea reef fishes. Immel publishing, London, pp 192

Rüppell WPES (1830) Atlas zu der Reise im nördlichen Afrika. Fische des Rothen Meers. Frankfurt am Main (Heinrich Ludwig Brönner), part 3:95–141

Rüppell WPES (1852) Verzeichniss der in dem Museum der Senckenbergischen Naturforschenden Geselleschaft aufgestellten Sammlungen. Vierte Abtheilung: Fische und deren Skelette. Frankfurt am Main, IV + 40 pp

Smith MM (1973) Identity of *Caranx armatus* (Pisces: Carangidae). Copeia 1973(2):352–355

Smith-Vaniz WF (1984) Carangidae. In: Fischer W, Bianchi G, eds. FAO Species Identification Sheets for Fishery Purposes. Western Indian Ocean (Fishing Area 51). Vol. 1: without pagination. FAO, Rome

Smith-Vaniz WF (1999) Carangidae. In: Carpenter KE, Niem VH, eds. FAO species identification guides for fishery purposes: the living marine resources of the Western Central Pacific. Vol. 4: Bony fishes, part 2 (Mugilidae to Carangidae). Rome, FAO, 2659–2756

Suzuki K (1962) Anatomical and taxonomical studies on the carangid fishes of Japan. Rep Fac Fish Univ Mie 4(2):43–232

Swofford DL (1998) PAUP*. Phylogenetic analysis using Parsimony (* and other methods). Version 4. Sinauer Associates, Sunderland, Massachusetts

Temminck CJ, Schlegel H (1844) Pisces. In: Fauna Japonica sive descriptio animalium, quae in itinere per Japoniam, jussu et auspiciis superiorum, qui summum in India Batava imperium tenent, suscepto, annis 1823–1830 collegit, notis, observationibus et adumbrationibus illustravit Ph. Fr. de Siebold, parts 5–6:73–112

Tortonese E (1935) Pesci del mar Rosso. Boll Mus Zool Anat Comp Univ Torino 3(63):153–218

Tortonese E (1983) List of fishes observed near Jeddah (Saudi Arabia). J Fac Mar Sci 3:105–109

Ward RD, Zemlak TS, Innes BH, Last PR, Hebert PDN (2005) DNA barcoding Australia's fish species. Philos Trans R Soc Lond Ser B Biol Sci 360(1462):1847–1857

Whitley GP (1934) Studies in ichthyology. No. 8. Rec Austr Mus 19(2): 153–163

Williams F, Heemstra PC, Shameem (1980) Notes on indo-Pacific carangid fishes of the genus *Carangoides* Bleeker. II. The *Carangoides* armatus group. Bull Mar Sci 30(1):13–20

Williams F, Venkataramani VK (1978) Notes on indo-Pacific carangid fishes of the genus *Carangoides* Bleeker. I. The *Carangoides* malabaricus group. Bull Mar Sci 28(3):501–511