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Clarias gracilentus, a new walking catfish (Teleostei: Clariidae) from Vietnam and Cambodia

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Abstract

Clarias gracilentus, a new Southeast Asian walking catfish species, is described from Phu Quoc Island (Vietnam) off the coast of southeastern Cambodia and from mainland southeastern Cambodia. The new species is a member of the *C. nieuhofii* species complex, and can be distinguished from congeners in the complex in having a combination of: head width 11.9–12.9% SL, distance between the occipital process and the base of the first dorsal-fin ray 5.3–8.4% SL, pectoral-fin length 8.5–10.1% SL, body depth at anus 8.2–11.7% SL, pelvic-fin length 4.3–5.5% SL, length of anal-fin base 60.0–63.9% SL, eye diameter 5.4–7.2% HL, interorbital distance 42.7–48.0% HL, occipital-process length 7.8–14.7% HL, 96–101 dorsal-fin rays, 84–89 anal-fin rays and 80–84 total vertebrae.

Key words: Ostariophysi, Siluriformes, Southeast Asia

Introduction

The genus *Clarias* is the most diverse group (56 species; Ferraris, 2007) within the moderately diverse Old World catfish family Clariidae (113 species in 16 genera: Ferraris, 2007). Members of the genus are naturally distributed in inland water bodies in both Africa and Asia, with the bulk of the species being found in the former. Recent studies (e.g. Lim & Ng, 1999; Teugels *et al.*, 2001; Sudarto *et al.*, 2003; Ng, 2004) have resulted in the discovery of greater diversity in Asian *Clarias*, particularly in Southeast Asia, although taxonomic problems within the group remain whose resolution is likely to result in the discovery of additional new species (Ng & Kottelat, 2008).

Nineteen species of Southeast Asian *Clarias* are currently recognized: *C. anfractus* Ng, 1999; *C. batrachus* (Linnaeus, 1758); *C. batu* Lim & Ng, 1999; *C. fuscus* La Cepède, 1803; *C. insolitus* Ng, 2003; *C. intermedius* Teugels, Pouyaud & Sudarto, 2001; *C. kapuasensis* Sudarto, Teugels & Pouyaud, 2003; *C. leiacanthus* Bleeker, 1851; *C. macrocephalus* Günther, 1864; *C. meladerma* Bleeker, 1846; *C. microspilus* Ng & Hadiaty, 2011; *C. microstomus* Ng, 2001; *C. nieuhofii* Valenciennes in Cuvier & Valenciennes, 1840; *C. nigricans* Ng, 2003; *C. olivaceus* Fowler, 1904; *C. planiceps* Ng, 1999; *C. pseudoleiacanthus* Sudarto, Teugels & Pouyaud, 2003; *C. pseduonieuhofii* Sudarto, Teugels & Pouyaud, 2004; *C. sulcatus* Ng, 2004. These species have been roughly divided into two species complexes based on their body forms, with the more elongate and anguilliform species being placed in the *C. nieuhofii* species complex (Sudarto *et al.*, 2003). The taxonomy of the elongate *Clarias* species in the *C. nieuhofii* species complex is sometimes confusing and a brief review is provided in the discussion. The *C. nieuhofii* species complex presently consists of three species (Ng, 2003; Sudarto *et al.*, 2004): *C. nieuhofii*, *C. nigricans* and *C. pseudonieuhofii*.

During ichthyological surveys of Phu Quoc Island off the coast of southern Cambodia, specimens of a *Clarias* species superficially resembling *C. nieuhofii* were collected by the third author. A detailed study of this material and comparison with other Southeast Asian *Clarias* revealed them to belong to an undescribed species that is also found in the adjacent portion of the Indochinese mainland (southern Cambodia). This unnamed species is described in this study as *Clarias gracilentus*, new species.

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Material and methods

Measurements were made point to point with digital calipers and data recorded to tenths of a millimeter. Counts and measurements were made on the left side of specimens whenever possible. Vertebrae and median-fin rays were counted from radiographs, while paired-fin rays were counted under a binocular dissecting microscope. Subunits of the head are presented as proportions of head length (HL). Head length and measurements of body parts are given as proportions of standard length (SL). Measurements follow those of Ng (1999). Asterisks after meristic counts indicate values for holotype. Institutional acronyms follow Ferraris (2007), with the addition of NLHC for the Ichthyology Laboratory of the Fisheries Faculty, Nong Lam University, Ho Chi Minh City, Vietnam.

Clarias gracilentus sp. nov.

(Fig. 1)

Clarias Nieuhofi (non Bleeker)—Pellegrin & Chevey, 1937: 315.
Clarias nieuhofi (non Bleeker)—Rainboth, 1996: 163.

Type material. Holotype: UMMZ 248862, 189.6 mm SL; Vietnam: Phu Quoc Island, swamp draining into Rach Vem, 10°22'N 103°56'E (coordinates approximate); V. T. Nguyen and T. H. Le, 26 February 2010.

Paratypes: BMNH 1937.9.17:39–40 (2), 173.2–207.5 mm SL; Cambodia: Kampot province, Bokor; J. Delacour & W. Lowe, 1928. NLHC 2010.RV1 (1) 251.5 mm SL; NLHC 2010.RV2 (1) 254.5 mm SL; NLHC 2010.RV3 (1) 299.5 mm SL; NLHC 2010.RV4 (1) 317.5 mm SL; NLHC 2010.RV5 (1) 265.5 mm SL; UMMZ 248863 (4), 151.0–224.1 mm SL; ZRC 52046 (1), 221.4 mm SL; data as for holotype. NLHC 2010.RT1 (1), 281.5 mm SL; NLHC 2010.RT2 (1), 260.5 mm SL; NLHC 2010.RT3 (1), 294.5 mm SL; NLHC 2010.RT4 (1) 305.5 mm SL; Vietnam: Phu Quoc Island, swamp draining into Rach Tram, 10°24'N 103°58'E (coordinates approximate); V. T. Nguyen and T. H. Le, 13 January 2010.

Diagnosis. *Clarias gracilentus* can be distinguished from all Southeast Asian congeners, except for *C. nieuhofii*, *C. nigricans* and *C. pseudonieuhofii* in having a greatly elongate body with correspondingly long dorsal- and anal-fin ray bases. This elongation is manifested in the higher number of total vertebrae (74–84 vs. 54–71), dorsal- (81–101 vs. 62–80) and anal-fin (68–89 vs. 47–70) rays seen in all four species of the *C. nieuhofii* species complex compared to all other Southeast Asian *Clarias*. *Clarias gracilentus* differs from *C. nieuhofii* in having a narrower head (11.9–12.9% SL vs. 13.2–15.8), more slender body (8.2–11.7% SL vs. 10.8–14.4) and shorter pelvic fin (4.3–5.5% SL vs. 5.0–6.3), from *C. nigricans* in having a larger eye (5.4–7.2% SL vs. 4.5–5.6), larger interorbital distance (42.7–48.0% HL vs. 40.3–44.0), shorter distance between the occipital process and the base of the first dorsal-fin ray (5.3–8.4% SL vs. 8.1–9.8) and longer pectoral fin (8.5–10.1% SL vs. 5.2–8.5), and from *C. pseudonieuhofii* in having a longer occipital process (7.8–14.7% HL vs. 4.6–6.8), shorter pelvic fin (4.3–5.5% SL vs. 6.4–7.5) and longer anal-fin base (60.0–63.9% SL vs. 56.0–58.9).

Description. Biometric data in Table 1. Head depressed; dorsal profile slightly convex and ventral profile almost straight. Bony elements of dorsal surface of head covered with thick skin; bones not readily visible, but sutures sometimes evident. Anterior pair of nostrils tubular and medial to maxillary barbel base. Posterior pair of nostrils bordered by nasal barbels anteriorly and fleshy membrane posteriorly; posteromedial to maxillary barbel base. Eye ovoid, horizontal axis longest, subcutaneous; located dorsolaterally on head. Anterior fontanel short and squat ("shoe-shaped" of Teugels, 1986); anterior tip reaching to line through middle of orbits. Occipital process rounded. Gill openings narrow, extending from dorsal-most point of pectoral-fin base to isthmus. Gill membranes free from isthmus but united to each other with 8 (n=8) branchiostegal rays. First branchial arch with 3+13* (n=2), 3+14 (n=2) or 4+13 (n=2) gill rakers.

Mouth subterminal, with fleshy, plicate lips. Oral teeth small and in irregular rows on all tooth-bearing surfaces. Premaxillary tooth band rectangular, with median notch on posterior edge. Dentary tooth band much narrower than premaxillary tooth band at symphysis, tapering laterally. Vomerine tooth band unpaired, continuous across midline, crescentic and smoothly arched along anterior and posterior margins. Premaxillary and dentary teeth viliform; vomerine teeth subgranular. Barbels in four pairs; long and slender with thick fleshy bases. Maxillary barbel extending to base of third or fourth dorsal-fin ray. Nasal barbel, extending to middle of pectoral fin. Inner mandibular-barbel origin close to midline; barbel thicker and longer than nasal barbel and extending just

beyond base of last pectoral-fin ray. Outer mandibular barbel originating posterolateral of inner mandibular barbel, extending to midway between base of last pectoral-fin ray and base of first pelvic-fin ray.

TABLE 1. Biometric data for *Clarias gracilentus* (n=11).

	Holotype	Range	Mean ±SD
%SL			
Predorsal length	25.5	22.4–26.8	25.4±1.23
Preanal length	38.8	37.4–41.9	39.8±1.44
Prepelvic length	36.5	35.0–38.2	36.3±1.07
Prepectoral length	15.3	14.0–16.0	14.9±0.63
Length of dorsal-fin base	76.5	72.5–77.6	75.0±1.74
Anal-fin length	62.1	60.0–63.9	62.0±1.24
Pelvic-fin length	5.2	4.3–5.5	4.9±0.38
Pectoral-fin length	10.0	8.5–10.1	9.4±0.52
Pectoral-spine length	7.0	6.1–7.8	6.9±0.47
Caudal-fin length	13.3	10.7–14.6	12.5±1.36
Distance between occipital process and dorsal fin	8.1	5.3–8.4	7.5±0.91
Body depth at anus	11.2	8.2–11.7	10.3±1.24
Caudal peduncle depth	5.3	3.8–5.4	4.9±0.55
Head length	18.4	17.3–19.2	18.2±0.67
Head width	12.8	11.9–12.9	12.6±0.33
Head depth	9.8	8.4–9.8	8.9±0.43
%HL			
Snout length	29.6	23.0–31.5	28.6±2.70
Interorbital distance	43.1	42.7–48.0	44.4±1.81
Eye diameter	6.3	5.4–7.2	6.2±0.54
Frontal fontanelle length	14.4	12.1–18.0	15.8±1.55
Frontal fontanelle width	8.6	6.5–10.3	8.0±1.37
Occipital fontanelle length	11.2	8.5–13.0	11.5±1.62
Occipital fontanelle width	4.9	4.9–7.1	5.8±0.77
Occipital process length	12.6	7.8–14.7	11.0±2.30
Occipital process width	33.0	27.3–33.3	30.4±2.21
Nasal barbel length	71.8	52.8–87.3	71.6±10.38
Maxillary barbel length	149.4	103.7–158.4	139.8±15.49
Inner mandibular barbel length	70.4	50.6–86.4	68.2±8.44
Outer mandibular barbel length	108.0	70.8–121.7	101.9±16.43

Body anguilliform and cylindrical, becoming compressed towards caudal peduncle. Dorsal profile rising very gently from tip of snout to origin of dorsal fin and thereafter almost horizontal to end of caudal peduncle. Ventral profile slightly convex to middle of head and thereafter almost horizontal to end of caudal peduncle. Skin smooth. Lateral line complete and midlateral in position. Vertebrae 22+58=80 (n=1), 23+58=81* (n=1), 22+60=82 (n=1), 23+59=82 (n=2), 23+60=83 (n=1), 24+59=83 (n=1) or 22+62=84 (n=1).

Dorsal fin with long base, spanning posterior three-quarters of body; with 96 (n=1), 97 (n=2), 99 (n=1), 100* (n=3) or 101 (n=1) rays covered by thick layer of skin and without spine. Dorsal-fin margin straight, parallel to dorsal edge of body. Pectoral fin with small spine, sharply pointed at tip, and 8,i (n=8) rays. Almost entire length of anterior spine margin with a series of small serrations; posterior spine margin smooth or with uneven asperities. Pectoral-fin margin straight anteriorly, convex posteriorly. Pelvic-fin origin at anterior third of body, with i,5 (n=8) rays and convex margin; tip of adpressed fin reaching base of first two or three anal-fin rays. Anus and urogenital

openings located at vertical through middle of adpressed pelvic fin. Anal fin with long base, extending for posterior three-fifths of body, and 84 (n=1), 85* (n=2), 86 (n=1),87 (n=1) or 89 (n=3) rays covered by thick layer of skin; margin straight and parallel to ventral edge of body. Caudal peduncle very short. Caudal fin rounded, with i,6,6,i (n=8) principal rays.

FIGURE 1. *Clarias gracilentus*, holotype, UMMZ 248862, 189.6 mm SL; Vietnam: Phu Quoc Island. Dorsal, lateral and ventral views.

Coloration. In 70% alcohol: dorsal and lateral surfaces of head and body dark gray, fading to pale gray on ventral surfaces. Fifteen to twenty-one vertical rows of two to five white spots present, subtended ventrally by two irregular rows of white spots running below lateral line. Dorsal and caudal fins dark gray with very thin hyaline distal margin. Anal fin light gray, with thin hyaline distal margin. Pectoral-fin rays dark gray, with hyaline interradial membranes. Pelvic fins hyaline. Barbels and pectoral spines dark gray dorsally and light gray ventrally.

Distribution. *Clarias gracilentus* is known from the Rach Tram and Rach Vem drainages on the northern part of Phu Quoc Island, Vietnam, and from the Kampot River drainage in southern Cambodia (Fig. 2). This species is expected to occur elsewhere on Phu Quoc Island and southern Cambodia, but further surveys are needed to verify this.

Habitat and ecology. On Phu Quoc Island, *C. gracilentus* inhabits forested swamps and slow-flowing streams. During the dry season, the fish hides in small holes under dead-tree roots. At the type locality, the water was clear, cool (24–27°C), tinted brown, acidic (pH 4.5–5.5) and well oxygenated (DO 4 mgl^{-1}). Other fishes collected at the type locality were *Monopterus albus* (Synbranchidae), *Channa* sp. (Channidae), and *Betta* cf. *prima* (Osphronemidae). Gut contents of dissected specimens consisted of smaller fishes (frequently *Channa* and *Betta*, and occasionally smaller individuals of *C. gracilentus*), freshwater crabs, molluscs, and terrestrial arthropods (insects and spiders).

Etymology. The specific epithet is the Latin adjective *gracilentus,* meaning slender, in reference to the slender body of this species when compared to *C. nieuhofii*.

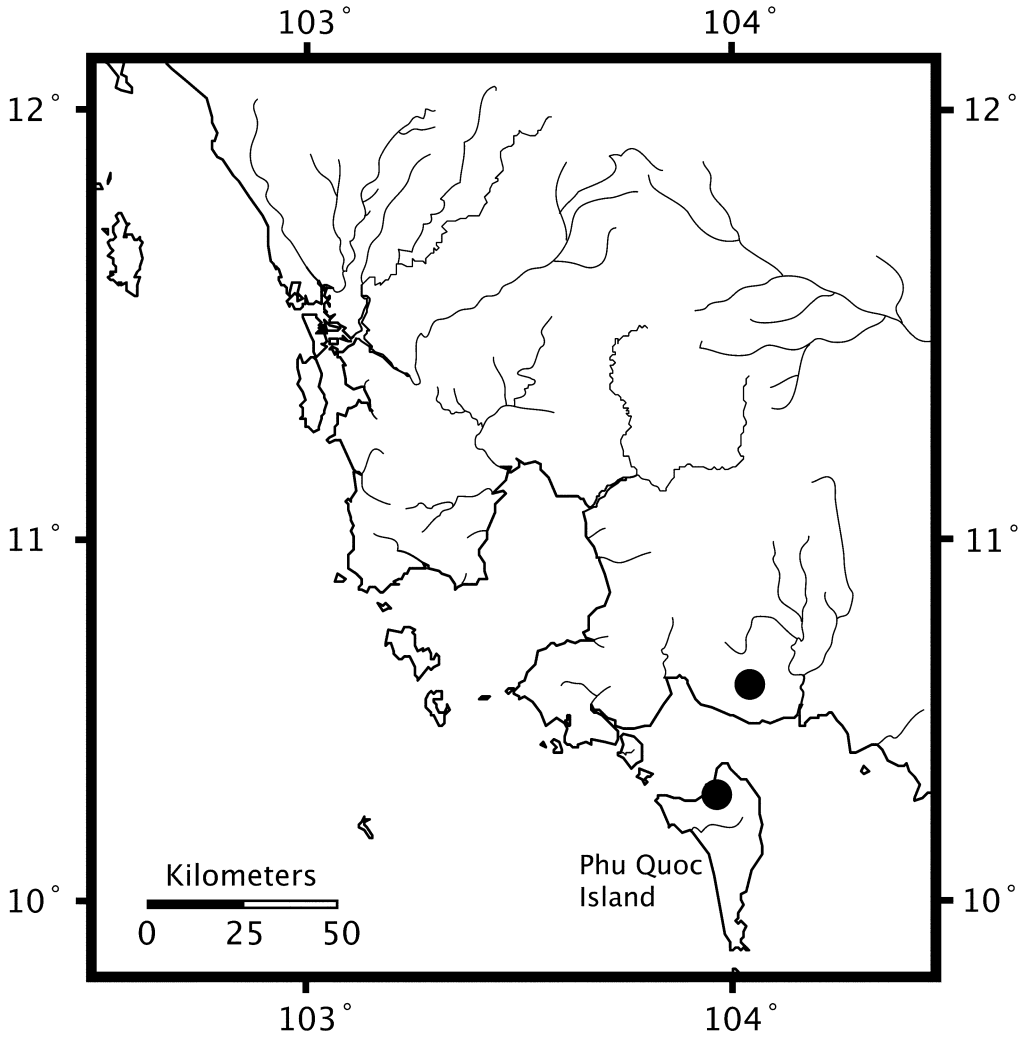

FIGURE 2. Map of southeastern Cambodia and Phu Quoc Island, showing collecting localities of the type series of *Clarias gracilentus*.

Discussion

Clarias nieuhofii was described based on a single specimen of ca 400 mm SL (MNHN B-0300) from "Indé" (Valenciennes in Cuvier & Valenciennes, 1840), usually taken by most authors to refer to the (East) Indies (e.g. Ferraris, 2007), although the type locality of this species has been erroneously given as Java in some works (Ng, 2003). In the original description of this species, Valenciennes referred to the species described and illustrated by Nieuhof (1682) as the "bont-ael" or "negen-oogen" (said to be found in Amboina, where *Clarias* does not naturally occur). According to Article 72.4 of the International Code of Zoological Nomenclature, this makes Nieuhof's material syntypes of *C. nieuhofii*. Examination of Nieuhof's illustration of this species (reproduced here as Fig. 3) indicates that it has a relatively short body and a short distance between the base of the first dorsal-fin ray and the tip of the supraoccipital process. This makes it unlikely to be conspecific with Valenciennes' syntype of *C. nieuhofii*. Based on our current knowledge of *Clarias* taxonomy, the species that Nieuhof illustrated is most likely *C.* aff. *batrachus* (see Ng & Kottelat, 2008 for a discussion of the taxonomy of the Southeast Asian material frequently identified as *C. batrachus*). This may also explain Amboina being given as its distribution, as *C.* aff. *batrachus* is the species is the most likely to be introduced outside of its natural range as a cultured food fish. Given that the syntypes of *C. nieuhofii* represent two species, it becomes necessary to designate a lectotype for *C. nieuhofii* to stabilize its taxonomy. We therefore select MNHN B-0300 as the lectotype of *C. nieuhofii*.

FIGURE 3. Illustration of *Clarias* aff. *batrachus* in Nieuhof (1682).

Recent studies have demonstrated that *C. gilli* (described from the island of Mindanao in the southern Philippines) and *C. pentapterus* (described from Banjarmasin in southern Borneo) are junior subjective synonyms of *C. nieuhofii*; we have followed the results of these studies (Ng, 1999; Sudarto *et al.*, 2004). These studies have also shown that the material previously identified as *C. nieuhofii* from throughout Southeast Asia represents several species with an elongate body often considered as the *C. nieuhofii* species complex. Its members typically possess 82–108 dorsal-fin rays and a distance of 5–10% SL between the base of the first dorsal-fin ray and the tip of the supraoccipital process (Ng, 1999). Although detailed morphological analyses have supported this grouping (Sudarto *et al.*, 2003), analyses of molecular data suggests that this group is not natural (Pouyaud *et al.*, 2009). Besides *C. nieuhofii*, two other species are recognized in this species complex: *C. nigricans* from the Mahakam River drainage in eastern Borneo (Ng, 2003) and *C. pseudonieuhofii* from the Kapuas River drainage in western Borneo (Sudarto *et al.*, 2004). The key diagnostic characters used to distinguish members of this species complex (including *C. gracilentus*) are presented in Table 2.

TABLE 2. Key diagnostic differences among members of the *Clarias nieuhofii* species complex.

Species	Head width (%SL)	Occipital process–dorsal fin distance (%SL)	Pelvic-fin length (%SL)	Body depth at anus (%SL)	Snout shape when viewed dorsally
C. gracilentus	11.9–12.9	5.3–8.4	4.3–5.5	8.2–11.7	Broadly curving
C. nieuhofii	13.2–15.8	6.6–9.3	5.0–6.3	10.8–14.4	Broadly curving
C. nigricans	11.7–12.3	8.1–9.8	4.1–5.4	10.4–13.0	Narrowly curving
C. pseudonieuhofii	12.7–14.3	6.1–7.6	6.4–7.5	11.0–12.9	Broadly curving

Clarias gracilentus is very similar to *C. nieuhofii*, but can be distinguished by the characters mentioned in the diagnosis. *Clarias gracilentus* is further distinguished from *C. nieuhofii* in having the dorsal and anal fins never fully confluent at all sizes (vs. dorsal and anal fins mostly or fully confluent with the caudal fin above ca. 220 mm SL) and in general having more (15–21 vs. 12–18) vertical rows of white spots on the sides of the body. Although both characters can distinguish between the two species, they cannot be reliably used all the time. The confluence of the dorsal, anal and caudal fins can only be used to distinguish only the largest specimens (above ca. 220 mm SL), since the fins are equally separate in small- to medium-sized *C. gracilentus* and *C. nieuhofii*. Similarly, there is enough variation existing within the numbers of rows of white spots along the sides of the body to render this character ambiguous: most of the specimens we have examined from northern and western Borneo, the Malay Peninsula, Mindanao and Sumatra possess fewer rows of spots (12–16) than observed in *C. gracilentus* (15–21), with the spots tending to fade near the caudal peduncle (Fig. 4; vs. with spots still evident near the caudal peduncle). However, specimens from southern Borneo we have examined appear to have just as many rows of spots (16–18) as observed in *C. gracilentus* that are still evident near the caudal peduncle (Fig. 5).

Clarias gracilentus is allopatrically distributed with regards to *C. nieuhofii*, since the northernmost record of the latter species is in Chonburi Province, in southeastern Thailand (Smith, 1945; Humphrey & Bain, 1990). As southeastern Thailand is immediately adjacent to southern Cambodia, the possibility exists that material identified as *C. nieuhofii* from there may instead refer to *C. gracilentus*. We have examined specimens identified as *C. nieuhofii* from southeastern Thailand (USNM 109600, USNM 109601), and note that one specimen (USNM 109600) has suffered damage to the caudal region, resulting in regrowth and fusion of the median fins (see Lim &

Ng, 1999 for a discussion of this phenomenon in clariids and its implication for clariid identification). This makes it very difficult to ascertain its identity (given that accurate measurement of morphometric ratios is not possible). Based on our measurement of the other specimen (USNM 109601) and observations on its caudal-fin morphology, we have identified it as *C. nieuhofii*. On the basis of the available evidence, it appears that *C. gracilentus* does not occur in southeastern Thailand.

FIGURE 4. *Clarias nieuhofii*, ZRC 52047 (3), 194.4 mm SL: Sumatra: Jambi, Batang Hari drainage.

FIGURE 5. *Clarias nieuhofii*, ZRC 40071, 190.8 mm SL; Kalimantan Selatan, market in Banjarmasin.

Comparative material

Clarias nieuhofii: East Indies — MNHN B300 (holotype), 394.8 mm SL.

Borneo — CMK 6868 (1), 179.8 mm SL; Kalimantan Barat, Mintas Sembolong, a short cut between meander S of Kapuas River mainstream upstream of Nanga Embaloh, 0°50'N 112°39'E. ZRC 40043 (1), 280.8 mm SL; Borneo: Kalimantan Tengah, market in Muara Teweh. ZRC 40071 (3), 190.8–204.0 mm SL; Kalimantan Selatan, market in Banjarmasin. ZRC 40522 (6), 218.5–279.1 mm SL; Sarawak, market in Miri. ZRC 47761 (1), 363.2 mm SL; Kalimantan Timur, market in Samarinda.

Java — NMW 46994 (1), 390.0 mm SL; Bogor.

Malay Peninsula — ZRC 15390 (1), 165.2 mm SL; ZRC 15391 (1), 128.1 mm SL; ZRC 15392 (1), 75.8 mm SL; ZRC 17676–17677 (2), 139.0–214.8 mm SL; Selangor, North Selangor peat swamp forest. ZRC 17892 (1), 131.7 mm SL; ZRC 24584–24585 (2), 152.8–249.5 mm SL; ZRC 37603 (1), 89.6 mm SL; Selangor, Sabak Bernam. ZRC 40226 (1), 132.4 mm SL; Terengganu, unnamed stream 5 km from Kuala Brang in the direction of Kuala Terengganu, 5° 4'25.0"N 103° 3'19.8"E.

Mindanao — CAS-SU 13746 (4), 227.0–309.3 mm SL; UMMZ 100322 (2), 284.5–263.5 mm SL; Fort Pikit, Cotabato. USNM 55620 (holotype of *C. gilli*), 292.0 mm SL; Rio Grande.

Sumatra — ZRC 38978 (5) 199.8–238.2 mm SL; ZRC 43219 (10), 165.8–216.4 mm SL; Jambi, fish market in Jambi. ZRC 39093 (5), 204.5–358.0 mm SL; Riau, market in Rengat. ZRC 52047 (3), 194.4–203.4 mm SL: Jambi, blackwater stream and ditch at Batara 10 gas plant, 1 km after turnoff at ca. 40 km to Kuala Tungkal on Jambi–Kuala Tungkal road, 1°4'56.7"S 103°25'17.1"E.

Thailand – USNM 109600 (1), 111.5 mm SL; Thailand: Trat province, Krat River at Khao Saming. USNM 109601 (1), 312.0 mm SL; Thailand: Chonburi province, Ban Hup Bon.

C. nigricans: MZB 10705 (holotype), 307.5 mm SL; ZRC 45590 (2 paratypes), 197.4–315.1 mm SL; Borneo: Kalimantan Timur, market in Samarinda. ZMA 121.631 (5 paratypes), 232.4–305.0 mm SL; Borneo: Kalimantan Timur, Samarinda.

C. pseudonieuhofii: Data from Sudarto *et al.* (2004).

The reader is referred to Ng (1999) and Ng (2004) for a list of additional material examined.

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