Pacific Science (1997), vol. 51, no. 3: 306–313
© 1997 by University of Hawai'i Press. All rights reserved

Allenbatrachus, A New Genus of Indo-Pacific Toadfish (Batrachoididae)[1]

DAVID W. GREENFIELD[2]

ABSTRACT: *Allenbatrachus* is described as a new genus for two Indo-West Pacific species previously known as *Batrichthys grunniens* (Linnaeus, 1758) and *Batrachus reticulatus* (Steindachner, 1870). It is included in the subfamily Batrachoidinae and is separated from other genera on the basis of the following combination of characters: a dorsocranium foramen behind each eye; two subopercular spines; no pectoral-fin axil foramina; raised flange on dorsal surface of maxilla; and protruding lower jaw. The two species of *Allenbatrachus* are redescribed and a neotype designated for *Batrachus reticulatus.*

NEARSHORE COLLECTIONS FROM the Indo-Australian Archipelago to the Ganges River area of India may yield two species of toadfish that lack a foramen in the pectoral-fin axil. One of these species has been identified as *Batrichthys grunniens* by Hutchins (1981). The second species has masqueraded under the name of *B. grunniens,* but in fact is the species described as *Batrachus reticulatus* by Steindachner (1870); it has blunt, rounded teeth rather than the pointed teeth of *Batrichthys grunniens.*

Hutchins (1981) unraveled the complex nomenclature of the toadfish species of India and correctly determined that the species described by Linnaeus (1758) as *Cottus grunniens* had priority over *Batrachoides gangene* described by Hamilton (1822). Hutchins followed Menon (1963) in utilizing South African genera (Smith 1952) for the Indian species he treated and placed *grunniens* in the genus *Batrichthys;* however, he commented that of the recognized batrachoidid genera, "... none is apparently suitable for either of the above two Indian species."

As part of a revision of the batrachoidid genera, I have cleared and stained representatives of all described genera in the family. Examination of this material has demonstrated that Hutchins' misgivings about the use of the genus *Batrichthys* for *grunniens* is correct and neither *grunniens* nor *reticulatus* can be included in that genus or any other toadfish genus. The genus *Allenbatrachus* is described here for these two species.

Three subfamilies of toadfishes are recognized: Thalassophryninae (*Thalassophryne, Daector*); Porichthyinae (*Aphos, Porichthys*); and Batrachoidinae (18 currently recognized genera including *Allenbatrachus*) (Smith 1952). The Thalassophryninae have two venomous, hollow, dorsal-fin spines; two venomous, hollow, opercular spines; no subopercular spines; and accessory upper pectoral-fin radial only slightly expanded distally. The Porichthyinae also have two dorsal-fin and two opercular spines, but not hollow and not venomous; lack subopercular spines; and distal end of accessory upper pectoral-fin radial is broadly expanded. The Batrachoidinae have three solid dorsal-fin spines; three solid opercular spines; lack venom glands; have one to three subopercular spines; and accessory upper pectoral-fin radial is rodlike or only slightly expanded distally.

MATERIALS AND METHODS

All counts and measurements follow Hubbs and Lagler (1964) except that the last two fin rays are not counted as one unless it is clear that they are joined at the base. Measurements were made to the nearest 0.1 mm using dial calipers. All measurements are expressed as thousandths of standard length (SL). Some counts were made from radiographs. Range of counts or measurements is followed by mean or mode in parentheses. Within the description of *Allenbatrachus*

[1] Manuscript accepted 10 October 1996.

[2] Department of Zoology and Hawai'i Institute of Marine Biology, University of Hawai'i at Mānoa, 2538 The Mall, Honolulu, Hawai'i 96822.

reticulatus, the data for the neotype are presented first in brackets. Quotes around generic names indicate that the species is questionably placed in that genus. Institutional abbreviations are listed in Leviton et al. (1985).

Genus *Allenbatrachus* Greenfield, n. gen.

Type species: *Cottus grunniens* (Linnaeus, 1758).

DIFFERENTIAL DIAGNOSIS: A genus of the subfamily Batrachoidinae differing from known batrachoidine genera by the following characters: epaxial trunk musculature covers entire dorsocranium, whereas in *Amphichthys, Sanopus, "Triathalassothia" gloverensis,* and some species of *Halophryne,* epaxial trunk musculature does not extend onto and cover entire dorsocranium, leaving area of bone exposed under skin in center portion of dorsocranium posterior to orbits; from *Bifax* by lacking flap with eye spot at end of each maxilla (Greenfield et al. 1994). *Allenbatrachus* has two subopercular spines, whereas the following genera have only one: *Austrobatrachus, "Austrobatrachus" dussumieri, Batrachoemoeus, Halobatrachus, Opsanus,* and *Triathalassothia. Potamobatrachus* has three subopercular spines (Collette 1995). There is a foramen on each side behind eyes bordering sphenotic and frontal bones in *Allenbatrachus,* as in *Batrachoemoeus* and *Halophyrne,* but the dorsocranium is solid in all other genera. *Batrachoemoeus* has pectoral-fin axil foramen that is absent in *Allenbatrachus,* and *Halophryne* has a rounded head with lower and upper jaws about equally terminal, whereas *Allenbatrachus* has a more pointed, flattened head with lower jaw protruding. *Allenbatrachus* lacks scales on the body, whereas species in the following genera have the body either completely scaled: *Barchatus, Batrachoides, Chatrabus* (= *Tharbacus*), and *Halobatrachus;* or partially scaled: *Riekertia.* The accessory upper pectoral-fin radial is totally ossified in *Allenbatrachus,* whereas it is all or part cartilage in the following batrachoidine genera: *Austrobatrachus, "Batrichthys" apiatus, Halobatrachus, Perulibatrachus, Riekertia,* and *Triathalassothia.*

Although *grunniens* most recently has been placed in *Batrichthys,* both *grunniens* and *reticulatus* differ from that genus in several characters. The type species of the genus *Batrichthys* is *B. albofasciatus* Smith. Two other species currently are recognized in that genus, *B. felinus* Smith and *B. apiatus* Cuvier (= *ophiocephalus* Smith). Because *B. apiatus* differs in several characters from *B. albofasciatus* and *B. felinus,* and may more properly belong in a separate genus, the comparison of *Allenbatrachus* to *Batrichthys* is based on the latter two species only.

Dorsocranium of *Allenbatrachus* has foramen on each side of head behind eyes bordering sphenotic and frontal bones, whereas *Batrichthys* has no foramina (Figure 1). Distance from end of sphenotic to posttemporal bone equal to about one-half width between tips of sphenotics in *Batrichthys* and more than three-quarters that distance in *Allenbatrachus.* Maxilla of *Allenbatrachus* has raised flange on dorsal surface for attachment of section A1 of adductor mandibulae and posterior margin broadly rounded, whereas flange not raised and posterior margin more square in *Batrichthys* (Figure 2). Posterior end of premaxilla broadly rounded and high in *Allenbatrachus,* whereas it is pointed and more elongate in *Batrichthys* (Figure 2).

DESCRIPTION: Three solid dorsal-fin spines without venom glands. Three opercular and two subopercular spines, one subopercular filament. Dorsocranium completely covered by muscle, no exposed bone under skin. Body lacking scales. Dorsocranium with foramen on each side behind eyes, bordering sphenotic and frontal bones. Accessory upper pectoral-fin radial totally ossified. No foramen, shallow pit, or glandular tissue present in pectoral-fin axil. No glandular tissue on pectoral-fin rays or membranes. Three lateral lines, upper extending from behind opercular spine to past end of second dorsal fin and down to caudal-fin base; middle starts just below upper lateral line near front of second dorsal fin and drops to near center of side extending back to caudal peduncle; lower extends from front of pectoral-fin base to caudal-fin base, single pore at base of caudal peduncle, joining the three rows; two rows of pores extending onto caudal fin. Pores on head extending forward from upper lateral line above opercular spines to eye and then down behind

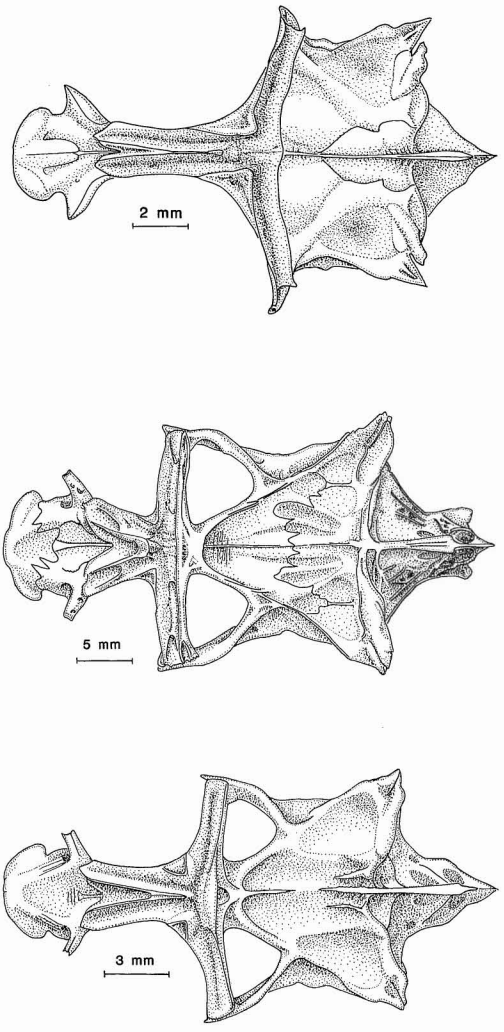

FIGURE 1. Dorsal view of neurocranium. *Top, Batrichthys felinus* RUSI 75-25; *middle, Allenbatrachus grunniens* ZSI 2099; *bottom, Allenbatrachus reticulatus* CAS-SU 30658.

eye and forward under eye to anterior nostril. Two additional rows of pores from each side of front of first dorsal fin forward on head to line near end of maxilla. Gill opening extends down five-sixths of distance of pectoral-fin base. Head moderately depressed, wider than deep. Lower jaw protruding. Skin over maxilla with many barbels associated with pores. Series of barbels associated with pores running from posterior end of maxilla back and up edge of preopercle. Lower jaw below lips with series of pore-associ-

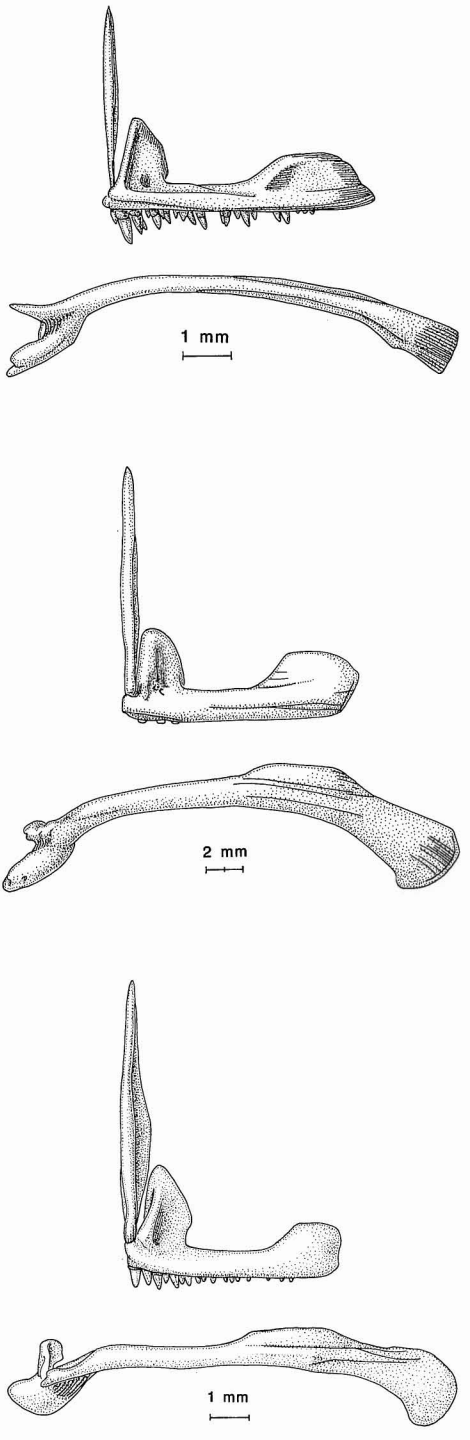

FIGURE 2. Upper jaw bones. *Top, Batrichthys felinus* RUSI 75-25; *middle, Allenbatrachus grunniens* ZSI 2099; *bottom, Allenbatrachus reticulatus* CAS-SU 30658.

ated barbels Vertebrae 26–29, 9 precaudal and 17–20 caudal (including terminal centra). Dorsal-fin elements III, 18–20; anal-fin rays 16–17; pectoral-fin rays 20–22.

ETYMOLOGY: Named for george Allen, Professor Emeritus, Humboldt State University, who introduced me to ichthyology and encouraged me to pursue graduate education. Gender is masculine.

Allenbatrachus grunniens (Linnaeus)
Figure 3

Cottus grunniens Linnaeus, 1758. See Hutchins (1981) for a discussion of the origin of Linnaeus' description and type locality.
Cottus indus Linnaeus, 1764. Considered a nomen dubium by Hutchins (1981).
Batrachus grunniens (Linnaeus), Bloch and Schneider, 1801.
Batrachoides gangene Hamilton, 1822. Type locality: Ganges River.

DESCRIPTION: Dorsal-fin elements III, 18–22 (usually 19); anal-fin rays 16–17 (usually 17); pectoral-fin rays 20–22 (usually 21); vertebrae 9 precaudal plus 17–18 caudal (including terminal centrum); upper lateral-line pores 26, middle lateral line with about 5 pores, lower lateral-line pores 26–30, single pore at caudal-fin base, two rows of 4 pores each extending onto caudal fin, head length 341.7–406 (377.6); head width 262.3–319 (299.3); head depth 137.3–217 (184); bony interorbital width 44–84.7 (56.9); fleshy interorbital width 67.7–109 (95.8); orbit diameter 43.1–68 (57.8); snouth length 54–78.2 (65.6); upper jaw length 151–187 (171.4); width of mouth at rictus 196.8–239 (220.9); first predorsal-fin distance 369–408.5 (388.7); second predorsal-fin distance 362.7–510.9 (489.3); preanal-fin distance 576–642 (602.2); prepelvic-fin distance 210.2–298.6 (249.1); greatest body depth 152–227.8 (210.1); caudal-peduncle depth 71–102 (78.8); length of second dorsal-fin base 416–524.7 (450.6); length of anal-fin base 366–421.2 (393.6); caudal-fin length 198.6–250.3 (228.7); pectoral-fin length 199–233.5 (218.1); pelvic-fin length 187.3–245.4 (216.7); distance between pelvic-fin bases 41.3–93 (71.7). Anterior orbital cirrus simple, tip pointed, posterior cirrus with two or more pointed tips (Figure 4*c,d*). Largest barbel at end of maxilla with two or more long pointed tips (number increasing with size) (Figure 5*a*). All teeth in jaws pointed (Figure 6*a*); vomer and palatines with single row; dentary with single row on sides and double row at symphysis; premaxilla with double row.

COLOR IN ALCOHOL: Background color tan with dark brown color pattern. Body with three main irregular dark blotches; anteriormost from base of first dorsal fin extending ventrally to lateral line (sometimes to top of pectoral-fin base) and forward onto head; second under second dorsal fin from about rays 4 to 11 extending ventrally to lower lateral line; third at end of second dorsal fin under last four to five rays extending ventrally to anal fin. Irregular marking encircling caudal-fin base and joining last blotch. Head mottled with an irregular marking

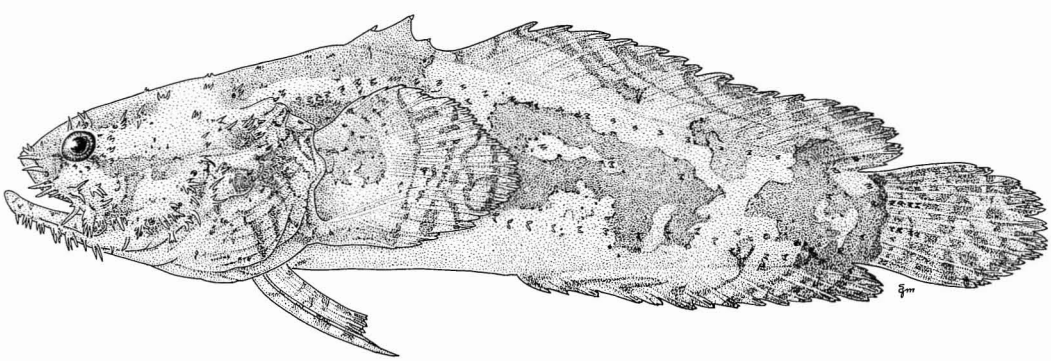

FIGURE 3. *Allenbatrachus grunniens,* CAS-SU 32944, 142.2 mm SL, Borneo.

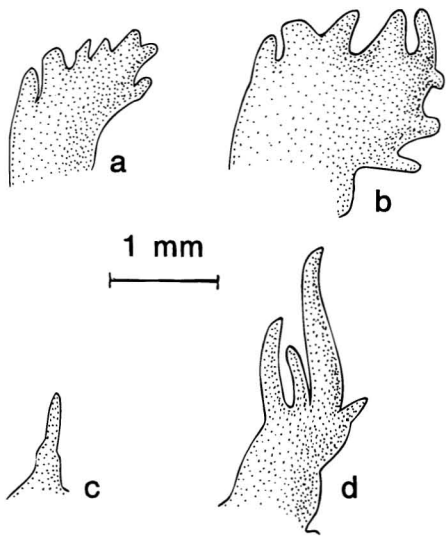

FIGURE 4. Orbital cirri. *Allenbatrachus reticulatus: a,* anterior; *b,* posterior. *Allenbatrachus grunniens: c,* anterior; *d,* posterior.

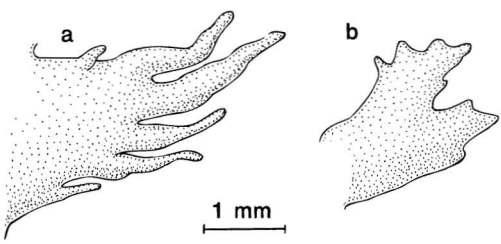

FIGURE 5. Largest barbel at end of maxilla: *a, Allenbatrachus grunniens; b, Allenbatrachus reticulatus.*

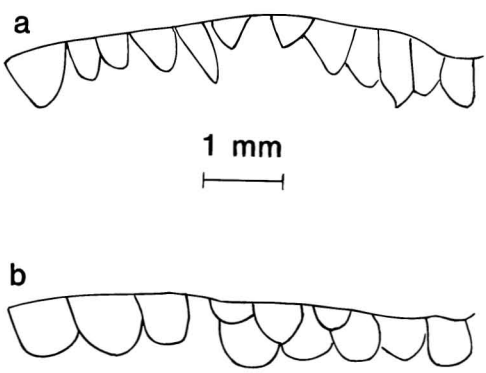

FIGURE 6. Lateral view of teeth on vomer (*right*) and palatine bone (*left*). *a, Allenbatrachus grunniens; b, Allenbatrachus reticulatus.*

running across top of head behind eyes; irregular marking running posteroventrally from eye onto cheek; lower lip crossed by series of narrow bars. Pectoral fin crossed by about four to five irregular markings, caudal fin by about six. Dorsal fin with about seven diagonal bands, anal fin with about seven. Pelvic fins crossed by four to five bars. Ventral surface of body lighter, but mottled.

MATERIAL EXAMINED: Thailand: CAS 75217(2); CAS 75218(1). Vietnam: USNM 047986(1). Malaysia: AMS I.27634008(1). Borneo: CAS-SU 32944(2); CAS-SU 27732(4). Philippines: ANSP 48783(1); ANSP 77373(1); CAS-SU 26909 (1 cleared and stained); CAS-SU 38261(1); CAS-SU 38262(1); USNM 148493(1). India: CAS-SU 41321(1); AMS B.8319(1); ZSI 2099 (1 cleared and stained).

Allenbatrachus reticulatus (Steindachner)
Figure 7

Batrachus reticulatus Steindachner, 1870, Sitzungsber. Akad. Wiss. Wien V 60(3): 564–565.

DESCRIPTION: Dorsal-fin elements [III,18] III, 18–20 (usually 19); anal-fin rays [16] 16–17 (usually 16); pectoral-fin rays [21] 20–22 (usually 21 or 22); vertebrae 9 precaudal plus 18–20 caudal (including terminal centrum); upper lateral-line pores [26] 24–26, middle lateral line with [6] about 5–7 pores, lower lateral-line pores [24] 23–26, single pore at caudal-fin base, two rows of 3–4 pores each extending onto caudal fin; head length [342.1] 331.2–422.6 (384); head width [331.7] 297.9–348 (316); head depth [228.8] 203.6–320.7 (237.3); bony interorbital width [42.1] 30.2–58 (43.3); fleshy interorbital width [87.4] 56.7–108.2 (89.7); orbit diameter [70.7] 57.7–105.3 (76.4); snout length [67.5] 41.4–86.8 (67.9); upper-jaw length [167.6] 149.9–184.8 (171.1); width of mouth at rictus [228.4] 190.7–246.6 (213.5); first predorsal-fin distance [375.6] 363.5–408.4 (382.7); second predorsal-fin distance [487.5] 470.3–528.3 (495.9); preanal-fin distance [575] 561.9–656.7 (606); prepelvic-fin distance [223.8] 216.3–

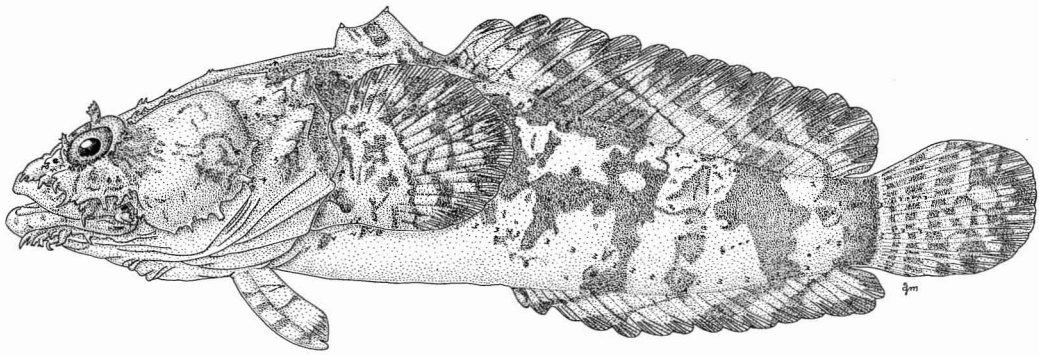

FIGURE 7. *Allenbatrachus reticulatus,* CAS-82188, 110.3 mm SL, neotype, Singapore.

316.6 (257.4); greatest body depth [258.3] 214.7–273.4 (244.8); caudal-peduncle depth [100.1] 77.9–106.2 (94.7); length of second dorsal-fin base [507] 473.5–526.4 (497.2); length of anal-fin base [405.1] 329.5–416.1 (380); caudal-fin length [182.1] 196.4–256.7 (222.7); pectoral-fin length [191.7] 161.5–254.5 (207.4); pelvic-fin length [186.7] 181.4–263.5 (225.4); distance between pelvic-fin bases [61.6] 37.2–90.5 (60.6). Anterior orbital cirrus with four or more rounded tips, posterior cirrus with five or more rounded tips (Figure 4*a,b*). Largest barbel at end of maxilla with five or more rounded tips (Figure 5*b*). All teeth in jaws rounded, without sharp points (Figure 6*b*); vomer with two rows and palatines with single row; dentary with single row on sides and double row at symphysis; premaxilla with double row.

COLOR IN ALCOHOL: Background color tan with dark brown color pattern. Body crossed by four irregular dark blotches; anteriormost enclosing first dorsal fin extending back to origin of second dorsal fin and running forward on head to line near posterior end of preopercle and extending ventrally to top of pectoral-fin base; second under second dorsal fin from fifth to ninth rays including base of fin and extending ventrally to center of side with three separate extensions down to ventral surface or anal fin; third under rays 14 to 16 of second dorsal fin including base of fin and extending ventrally to anal fin. Blotch encircling caudal peduncle. Top of head with diffuse dark pigment across head behind eyes. Dark pigment behind eye extending across cheek. Pectoral and caudal fins crossed by about five irregular bars. Dorsal fin with about five diagonal bands, tips of last two rays and their membranes dark. Anal fin with about four diagonal bands, tips of last two rays and their membranes dark. Pelvic fins crossed by four bars. Ventral surface of body lighter, but mottled.

MATERIAL EXAMINED: Singapore: CAS-SU 30658(20; 1 cleared and stained); CAS-SU 33701(1); CAS-SU 35153(2); CAS 82188(1 neotype). Thailand: CAS 66821(1); CAS 75216(1); CAS 17652(1); CAS 88690(7); AMS I.21036003(2). Burma: ZSI 10741(1); ZSI 10957(1). Sumatra: USNM 333283(5).

The holotype of *Batrachus reticulatus* Steindachner, 1870 cannot be located at the Naturhistorisches Museum Wien (William N. Eschmeyer and Ernst Mikschi, pers. comm., May 1996). Because it cannot be located, I designate CAS 82188, a male 110.3 mm SL from Singapore and immediate vicinity, collected by M. Racowicz in 1947, as the neotype. Seven smaller specimens (26.8–67.8 mm SL) collected with the neotype are now catalogued as CAS 88690.

OTHER MATERIAL EXAMINED: *Batrichthys albofasciatus:* RUSI 29413(1).

Batrichthys felinus: RUSI 4341(1); RUSI 75-23(1); RUSI 75-25(1 cleared and stained).

"Batrichthys" apiatus: RUSI 12733(15; 1 cleared and stained); RUSI 2348(1 cleared and stained).

Other cleared and stained Batrachoidinae genera: *Amphichthys cryptocentrus:* USNM 144888; *"Austrobatrachus" dussumieri:* USNM 147914, USNM 226512; *Austrobatrachus foedus:* RUSI 12748; *Barchatus cirrhosus:* HUJ 13711; *Batrachoides gilberti:* FMNH 84549; *Batrachomoeus trispinosus:* CAS 69938; *Bifax lacinia:* BPBM 35843; *Chatrabus* (= *Tharbacus*) *hendersoni:* RUSI 8611; *Chatrabus melanurus:* RUSI 12749; *Halobatrachus didactylus:* USNM 205066; *Halophryne diemensis:* USNM 147024, NTM S-10005-01; *Halophryne,* undescribed sp.: CAS-SU 20462; *Opsanus beta:* CAS 56794; *Opsanus tau:* uncat. S. Carolina; *Perulibatrachus elminensis:* MNHN 1970-43; *Potamobatrachus trispinosus:* USNM 330064 (paratype); *Riekertia ellisi:* RUSI 12738; *Sanopus barbatus:* SIO 67-45; *Triathalassothia argentinus:* USNM 214438; *"Triathalassohia" gloverensis:* FMNH 105005.

Cleared and stained Porichthyinae genera: *Aphos porosus*: CAS 65051; GCRL 12469; *Porichthys notatus*: uncat. Washington; *Porichthys plectrodon*: uncat. S. Carolina.

Cleared and stained Thalassophryninae genera: *Daector dowi*: SIO 64-360, CAS 66822; *Daector reticulata*: GCRL 16194; *Thalassophryne maculosa*: USNM 199524; *Thalassophryne megalops*: FMNH 66907.

DISCUSSION

Allenbatrachus forms a clade of three genera with *Batrachoemoeus* and *Halophryne* that is defined by a synapomorphy not found in any other batrachoidid or paracanthopterygian: a foramen on each side of the neurocranium behind the eyes bordering the sphenotic and frontal bones (Figure 1). Within this clade, *Batrachoemoeus* has a pore in the top of the pectoral-fin axil that is shared only with *Halobatrachus* (Greenfield 1996), a west African genus (*Sanopus* and *Opsanus* have a pore in the axil but it is in the center part). *Halophryne* has three autopomorphies: all bones of the branchial arches are very slender, whereas they are broad in all other members of the family; the posterior process of the ventral hypohyal is absent; and the medial process at the base of the pelvic-fin spine is distinctly shaped. *Allenbatrachus* does not have any autopomorphies, but is distinctive in having the synapomorphy of the clade and lacking the characters found in the other members of the clade.

The holotype of *Batrachus reticulatus* could not be located; however, Steindachner described *B. reticulatus* as having blunt, conical teeth on the vomer, palate, and lower mandible. He questioned whether *B. reticulatus* was a separate species or a variety of *B. grunniens* Bleeker (spelled *gruniens* with authorship attributed to Bleeker). In a footnote, Steindachner stated that Günther had examined *B. grunniens* and Günther said that it had a single row of teeth on the vomer. Because Steindachner's specimen had two rows of teeth on the vomer, that caused him to at least provisionally separate *B. reticulatus* from *B. grunniens.* All of the specimens in the genus *Allenbatrachus* from the Singapore area have blunt, conical teeth, with two or more rows of teeth on the vomer, conforming to Steindachner's description of *B. reticulatus;* thus I consider this species to be *Allenbatrachus reticulatus* (Steindachner).

ACKNOWLEDGMENTS

B. B. Collette provided general information on toadfishes. J. B. Hutchins shared important information relating to species included in *Allenbatrachus*, arranged for the transfer of toadfish specimens he had been studying, and provided information on types. W. N. Eschmeyer and E. Mikschi both searched for the holotype of *Batrachus reticulatus* Steindachner in the Naturhistorisches Museum Wien. I thank the following museum personnel for the processing and shipping of loans, gifts of specimens, and/or hospitality during visits: M. E. Anderson, W. D. Anderson, Jr., M. L. Bauchot, E. B. Böhlke, D. Catania, B. Chernoff, B. B. Collette, G. Duhamel, W. N. Eschmeyer, D. Golani, P. C. Heemstra, S. L. Jewett, L. W. Knapp, H. Larson, M. McGrouther, J. R. Paxton, T. W. Pietsch, S. G. Poss, M. A. Rogers, R. H. Rosenblatt, C. Roux, V. G. Springer, P. K. Talwar, and W. R. Taylor. I especially thank S. G. Mondon for drawing all figures. J. E. Randall reviewed the manuscript.

LITERATURE CITED

BLOCH, M. E., and J. G. SCHNEIDER. 1801. Systema Ichthyologiae.

COLLETTE, B. B. 1995. *Potamobatrachus trispinosus*, a new freshwater toadfish (Batrachoididae) from the Rio Tocantins, Brazil. Ichthyol. Expl. Freshwaters 6:333–336.

GREENFIELD, D. W. 1996. *Perulibatrachus kilburni*, a new toadfish from East Africa (Teleostei: Batrachoididae). Copeia 1996: 901–904.

GREENFIELD, D. W., J. K. L. MEE, and J. E. RANDALL. 1994. *Bifax lacinia*, a new genus and species of toadfish (Batrachoididae) from the south coast of Oman. Fauna Saudi Arabia 14:276–281.

HAMILTON, F. B. 1822. An account of the fishes found in the River Ganges and its branches. Edinburgh.

HUBBS, C. L., and K. F. LAGLER. 1964. Fishes of the Great Lakes Region. University of Michigan Press, Ann Arbor.

HUTCHINS, J. B. 1981. Nomenclatural status of the toadfishes of India. Copeia 1981: 336–341.

LEVITON, A. E., R. H. GIBBS, JR., E. HEAL, and C. E. DAWSON. 1985. Standards in herpetology and ichthyology: Part 1. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. Copeia 1985:802–832.

LINNAEUS, C. 1758. Systema naturae, ed. 10. Tomus 1. L. Salvii, Holmiae.

———. 1764. Systema naturae, ed. 12. Tomus 1. L. Salvii, Holmiae.

MENON, A. G. K. 1963. Taxonomy of the Indian frog-fishes (Fam. Batrachoididae). LABDEV, J.S.T., Kanpur, 1 (pages not numbered).

SMITH, J. L. B. 1952. The fishes of the family Batrachoididae from South and East Africa. Ann. Mag. Nat. Hist. (12)5: 313–339.

STEINDACHNER, F. 1870 (for Oct. 1869). Bericht über eine Sammlung von Fischen aus Singapore. Sitzungsber. Akad. Wiss. Wien V 60 (3): 557–571.