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THE ARIID CATFISHES (TELEOSTEI: SILURIFORMES: ARIIDAE) OF
MADAGASCAR, WITH THE DESCRIPTION OF TWO NEW SPECIES

By Heok Hee Ng* and John S. Sparks*†

ABSTRACT.—The ariid catfishes of Madagascar are reviewed in this study. Four valid species are recognized, of which two species new to science are described: *Arius festinus* from the headwaters of the Sofia River drainage in northeastern Madagascar, and *A. uncinatus* from Lake Andrapongy, a large floodplain lake in the Ankofia River drainage in northwestern Madagascar. The identities and geographic ranges of *A. dussumieri* and *A. madagascariensis* are clarified, and the latter species is redescribed on the basis of recently collected material.

Key words: *Arius dussumieri*, *A. festinus*, *A. madagascariensis*, *A. uncinatus*, Teleostei, Siluriformes, Ariidae, catfishes, Madagascar, Malagasy, taxonomy, biological diversity

INTRODUCTION

Ostariophysans make up 40% of the world's freshwater fishes (Nelson, 1994), yet they are represented in freshwater habitats on Madagascar by only two native groups: the primarily marine catfish family Ariidae and the endemic freshwater catfish family Anchariidae (Stiassny & Raminosoa, 1994; Sparks & Stiassny, 2003). On the island of Madagascar, catfishes of the family Ariidae are often found in nearshore marine and brackish water habitats, although some species occur exclusively in fresh water, including those described in this study. The largest genus, *Arius* Valenciennes in Cuvier & Valenciennes, 1840, is now understood to be polyphyletic (Kailola, 1999). Until a detailed phylogenetic analysis of ariid catfishes is undertaken, we herein follow previous authors (e.g., Kailola, 1999) in tentatively assigning the species reviewed and newly described in this study to *Arius*.

*Fish Division, Museum of Zoology, University of Michigan, 1109 Geddes Avenue, Ann Arbor, Michigan 48109-1079, U.S.A.

†Current address: Department of Ichthyology, Division of Vertebrate Zoology, American Museum of Natural History, Central Park West at 79th Street, New York, New York 10024-5192, U.S.A.

Because *Arius* is now recognized to comprise a polyphyletic assemblage, the taxonomic treatment of species presumably belonging to the genus is problematic. Given that the intrarelationships within *Arius* are poorly known, the most logical approach would seem to be to compare novel species with all other species of *Arius*. However, such an approach would clearly be problematic given the cosmopolitan distribution of the assemblage and the fact that well over 250 nominal species of *Arius* exist (Eschmeyer, 1998). In recent years, many workers (e.g., Kailola, 2000) have tended to restrict comparisons to species occurring within a limited geographical area. Although not an ideal solution, we feel that in the case of the Malagasy and East African ariids this approach is justified for a number of reasons. With very few exceptions, *Arius* species are restricted to continental waters and thus generally have limited geographical distributions. For example, in this study only *Arius dussumieri* exhibits a fairly wide distribution, and even then it is restricted to the continental waters in the Sunda Shelf and those rimming the Indian Ocean. Although we have found no unique characters to diagnose the species of *Arius* that occur on Madagascar as a monophyletic group, with the exception of *A. dussumieri*, all other Malagasy species possess a single pair of ovoid or triangular palatal tooth patches. Although this character is fairly widespread in species of *Arius* having a Gondwanan (i.e., Africa, Indo-Madagascar, Australia and South America) distribution, none of the Australian and South American ariids, and none of the ariids occurring in Indian waters (with the exception of *A. dussumieri*), are known also to occur in Africa. Even the pan-African distribution of species of *Arius* is also sharply bipolar, with no species in common found on either side of the Cape of Good Hope. Thus, it is evident that many *Arius* exhibit quite restricted geographic ranges, and that the *Arius* of Madagascar and East Africa have, for the most part, evolved in isolation from species found elsewhere. Based on this evidence, and for practical reasons as well, we are restricting our comparisons of *Arius* occurring in Madagascar with those found in East African coastal waters. Moreover, although we are able to distinguish the species described herein on the basis of a combination of morphological characteristics, we are unable to find any autapomorphic features to diagnose them at this time.

Historically, all *Arius* collected well inland in freshwater habitats on Madagascar have been assigned to *A. madagascariensis* Vaillant, 1894 (see below), and a comprehensive study of this group has not been undertaken until now. While carrying out a survey of the fresh and brackish water fishes of Madagascar, the second author obtained specimens of *Arius* that were determined to belong to four distinct species, two of which are new to science. The purpose of this study is to review the ariid catfishes of Madagascar, which includes a redescription of the endemic freshwater species *Arius madagascariensis*, and the description of two new freshwater species: *A. festinus*

from the headwaters of the Sofia River drainage in northeastern Madagascar and *A. uncinatus* from the Ankofia River drainage in northwestern Madagascar (Fig. 1).

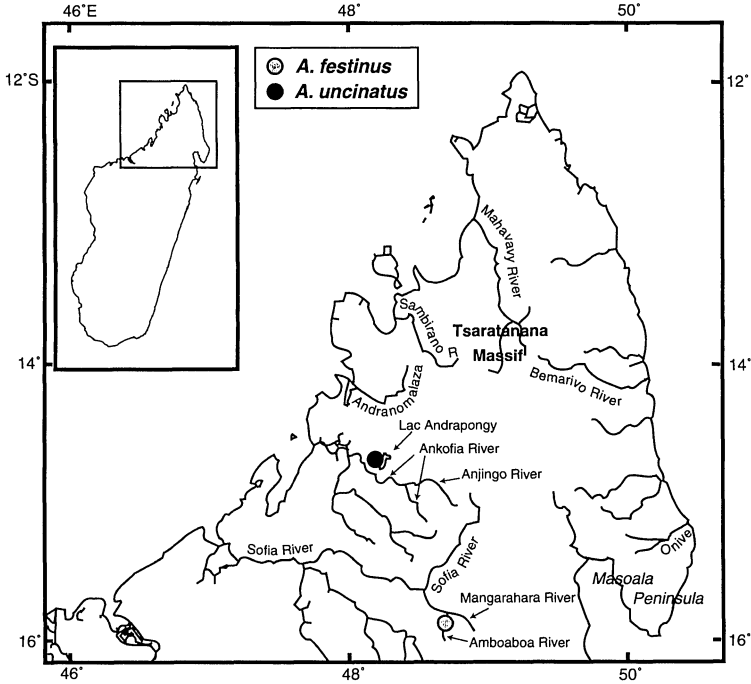


Fig. 1. Map showing collection localities of *A. festinus* and *A. uncinatus*.

METHODS AND MATERIALS

Measurements were made point to point with dial calipers and data recorded to the nearest tenth of a millimeter. Counts and measurements were made from the left side of specimens whenever possible. Subunits of the head are presented as proportions of head length (HL). Head length itself and measurements of body parts are given as proportions of standard length (SL).

Measurements and counts were made following Ng & Dodson (1999). Fin rays were counted under a binocular dissecting microscope using transmitted light. Vertebral counts were taken from radiographs following the method of Roberts (1994). Numbers in parentheses following a particular fin-ray, branchiostegal-ray, gill-raker or vertebral count indicate the number of specimens with that count. The specimens included in the present study are deposited in: American Museum of Natural History (AMNH), New York; Natural History Museum (BMNH), London; Muséum Histoire d'Naturelle

Geneve (MHNG), Geneva; National Museums of Kenya, Nairobi (NMK); Museum of Zoology, University of Michigan, Ann Arbor (UMMZ).

SYSTEMATIC ACCOUNTS

Arius dussumieri Valenciennes in Cuvier & Valenciennes, 1840

Fig. 2

Arius falcarius: Bleeker, 1875: 103 (in part ?).

Arius falcarius (non Richardson): Sauvage, 1891: 526.

Arius madagascariensis (non Vaillant): Pellegrin, 1914: 111.

Arius africanus (non Boulenger): Pellegrin, 1922: 418; Pellegrin, 1933: 61, fig. 39; Pellegrin, 1934: 427; Arnould, 1959: 25, pl. 3 fig. 3; Kiener, 1961: 53, fig. 64bis; Kiener, 1963: 56, pl. 27; Kiener, 1966: 1052, 1117; Taylor, 1986: 153 (in part); Stiassny & Raminosoa, 1994: 139; Reinthal & Stiassny 1997: 354.

Arius polystaphylodon (non Bleeker): Bauchot & Bianchi, 1984: 39.

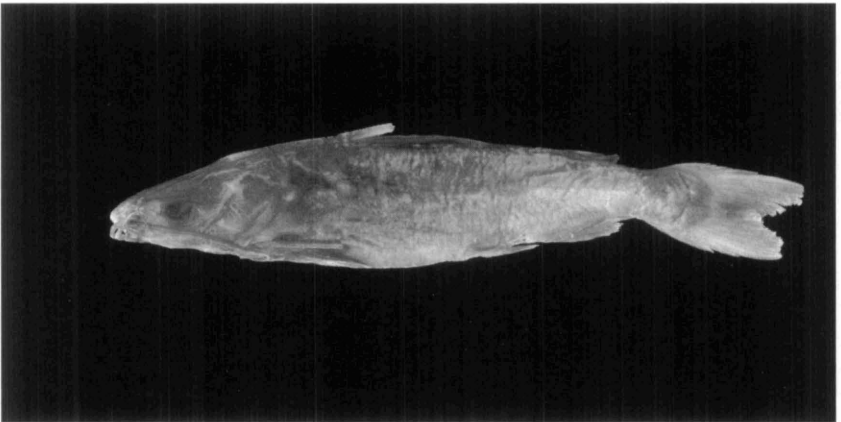


Fig. 2. *Arius dussumieri*, AMNH 88084, 130.8 mm SL; Madagascar: Mahanoro market.

Diagnosis. *Arius dussumieri* can be distinguished from other *Arius* species found in the region (Madagascar, East Africa and the western Indian Ocean) by any of the following features: a prominent lateral ethmoid that forms a “shelf” between the eye and the nostrils, very short adipose-fin base (4.3-4.5% SL), and two pairs of vomerine toothplates.

Distribution. Known from Mozambique and Madagascar to Sri Lanka, the east coast of India, Bangladesh, Myanmar to Sumatra, and probably also occurs on the Malay Peninsula (Kailola, 1999). The collection localities of *A. dussumieri* within Madagascar are indicated in Fig. 3.

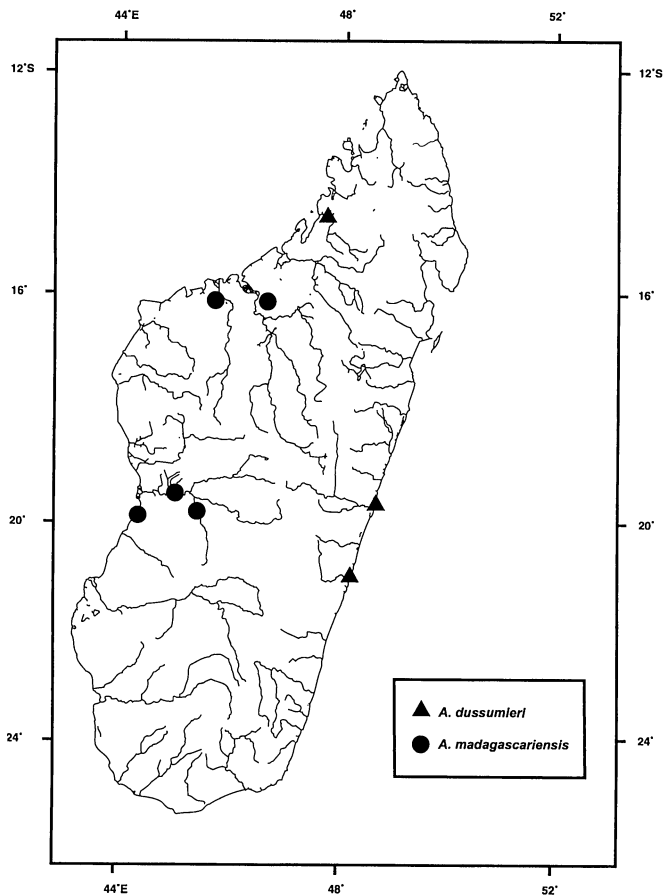


Fig. 3. Map showing collection localities of *A. dussumieri* and *A. madagascariensis*.

Material examined. AMNH 88084, 1 ex., 130.8 mm SL; AMNH 97050, 3 ex., 103.2-103.9 mm SL; Madagascar: Tamatave (Toamasina) province, Pangalanes Canal, N of Mangoro River, Mahanoro market. UMMZ 238055, 3 ex., 228.4-246.9 mm SL; Madagascar: Antsohihy market.

Arius festinus new species

Fig. 4

Type material. Holotype: UMMZ 239806, 141.9 mm SL; Madagascar: Amboabo River, near its confluence with the Mangarahara River (left bank tributary of the Sofia River), 15°50'1"S 48°42'52"E; J. Sparks & K. Riseng, 24 July 1994.

Paratype. AMNH 211457, 1 ex., 151.4 mm SL; data as for holotype.

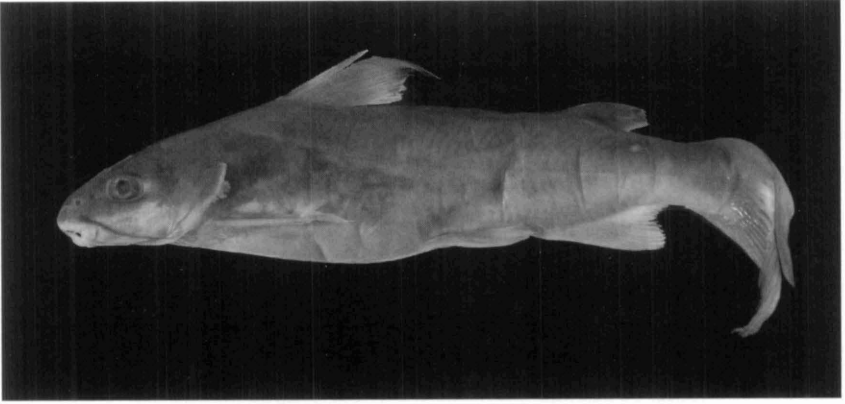


Fig. 4. *Arius festinus*, UMMZ 239806, holotype, 141.9 mm SL; Madagascar: Amboaboa River.

Diagnosis. *Arius festinus* can be distinguished from other *Arius* species found in the region (Madagascar, East Africa and the western Indian Ocean) by a combination of short pelvic fins (15.2-15.6% SL) that do not reach anal-fin origin when adpressed and vomerine teeth in a single pair of ovoid patches.

Description. Body moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally to end of caudal peduncle. Ventral profile flat to anal-fin base, then sloping gently dorsally to end of caudal peduncle. Anus and urogenital openings located at vertical through midpoint of adpressed pelvic fin. Skin smooth. Lateral line complete and midlateral in placement, forming a network of anastomosing canals on flanks and curving dorsally at caudal-fin base.

Head compressed, and broadly triangular when viewed laterally. Fleshy upper lip extending anteriorly beyond upper jaw. Gill openings wide, extending from exposed surface of posttemporal to isthmus. Gill membranes fused to, and attached across, isthmus. Bony elements of dorsal surface of head covered with thin layer of skin. Midline of cranium with dorsomedial groove extending from vertical through posterior orbital margin to point halfway between anterior orbital margin and tip of snout. Supraoccipital spine moderately broad, with converging sides and truncate posterior tip. Cleithral process well-ossified anteroventrally, with oblique shaft and extending along proximal third of pectoral spine.

Barbels in three pairs. Maxillary barbel long and slender, extending to base of pectoral spine. Inner mandibular barbel origin near to midline; and extending to just beyond level of posterior margin of orbit. Outer mandibular barbel originates posterolateral of inner mandibular barbel, extending to midpoint between level of posterior margin of orbit and base of pectoral spine.

Eye ovoid, horizontal axis longest; located entirely in dorsal half of head. Orbit with free margin.

Mouth inferior, premaxillary tooth band not exposed when mouth is closed. Oral teeth fine, sharp and depressible. Premaxillary tooth band strongly arched, of equal width throughout and with 5-6 irregular rows of teeth. Dentary tooth band narrower than premaxillary tooth band at symphysis, tapering laterally, and with 4-5 irregular rows of teeth. Palatal teeth fine and sharp, arranged in 5-6 irregular rows in two ovoid patches on each side of the anterior part of the palate and separated by a narrow medial gap.

Dorsal fin located centrally on body; origin nearer tip of snout than caudal (hypural) flexure, with 7 (2) rays. Dorsal-fin margin slightly convex, with first branched fin-ray longer than other branched rays. Dorsal-fin spine of moderate length, straight and robust, with 12-17 small serrations on anterior margin and 6-8 very weak antrorse serrations on posterior edge.

Margin of adipose fin convex or straight for entire length; deeply incised posteriorly.

Caudal fin deeply forked; upper and lower lobes pointed, with i,8,7,i (2) principal rays. Procurrent rays symmetrical and extend only slightly anterior to fin base.

Anal-fin origin immediately anterior to vertical through origin of adipose fin, with vi,13 (1) or vi,14 (1) rays. Posterior fin margin concave.

Pelvic-fin origin at vertical through point on anterior quarter of region between dorsal and adipose fins, with i,5 (2) rays. Pelvic-fin margin slightly convex, tip of adpressed fin not reaching anal-fin origin.

Pectoral fin with moderately long spine, ornamented with fine grooves, and extending to vertical through last dorsal-fin ray. Anterior spine margin with 15-16 small serrations along entire length; posterior spine margin with 7 weak serrations along entire length. Pectoral-fin margin straight anteriorly, convex posteriorly, with 11 (2) rays.

In % SL: head length 25.5-26.3, head width 15.6-16.1, head depth 16.5-17.3, predorsal distance 34.1-35.1, preanal length 68.2, prepelvic length 53.4-54.1, prepectoral length 21.8-24.0, body depth at anus 17.7-18.0, length of caudal peduncle 15.5-16.6, depth of caudal peduncle 7.5-8.1, pectoral-spine length 14.9-15.0, pectoral-fin length 20.6-20.9, dorsal-spine length 15.1-15.8, length of dorsal-fin base 9.8-11.1, pelvic-fin length 15.2-15.6, length of anal-fin base 18.2, caudal-fin length 26.8-26.9, length of adipose-fin base 10.0-10.4, adipose maximum height 3.8-4.1, dorsal to adipose distance 31.0, post-adipose distance 18.6-18.9; in % HL: snout length 35.4-36.7, interorbital distance 35.4-38.1, eye diameter 19.6-19.8, maxillary barbel length 89.8-92.2, inner mandibular barbel length 36.7-39.7, outer mandibular barbel length 55.3-55.5. Branchiostegal rays 6 (2). Gill rakers slender and stiff, half as long as opposing gill filaments; 4+12 (2) on first gill arch. Rakers present on hind aspect of all but first two arches. Vertebrae 30+23=53 (2).

Coloration. Dorsal surface of head and body uniform gray to grayish brown, upper third of head and body darkest, gradually fading to lighter color along middle third of head and body; lower third and ventral surfaces of head and body dirty white. Adipose fin gray; dorsal-fin rays gray, fin rays of all other fins with scattered gray melanophores; inter-radial membranes of all fins yellowish or dirty white. Posterior margins of dorsal and caudal fins sometimes edged with black.

Distribution and habitat. Known only from the Amboaboa River near its confluence with the Mangarahara River, in northeastern Madagascar. The Mangarahara is a moderately sized left bank tributary of the westward flowing Sofia River, one of the largest rivers in Madagascar. The Amboaboa River is shallow, clear, and the current is swift (Fig. 5). The substrate is generally rocky and sandy, with small cascades and numerous riffles. At the time of collection, exposed rocks and boulders were common throughout many shallower stretches of the river, although numerous deeper pools were also present. It is likely that *Arius festinus* is more widely distributed within the upper Sofia River drainage basin, given that this area of Madagascar has been poorly surveyed for fishes due to its relative inaccessibility. Nevertheless, a speciose fauna of freshwater fishes has been recorded for the Amboaboa River to date, including two species of the endemic cichlid genus *Paretroplus* (*P. nourissati* and *P. cf. kieneri*), an undescribed ptychochromine cichlid (Sparks, 2002), an undescribed species of *Pachypanchax*, and recently described species



Fig. 5. Type locality of *A. festinus* (Amboaboa River).

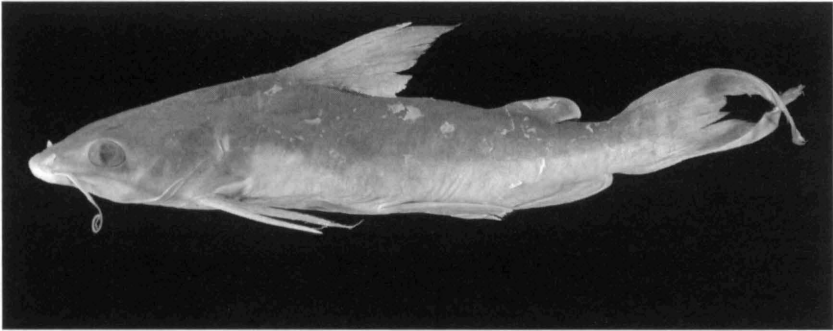
belonging to the endemic genera *Rheocles* (see Stiassny & Rodriguez, 2001) and *Sauvagella* (see Stiassny, 2002).

Etymology. From the Latin *festino*, meaning to move rapidly, in allusion to its habitat, *i.e.*, a swift-flowing river.

Arius madagascariensis Vaillant, 1894

Fig. 6

Arius madagascariensis Vaillant, 1894: 77; Boulenger, 1911: 388; Pellegrin 1922: 418; Pellegrin, 1933: 60, pl. 1 fig. 1; Pellegrin, 1934: 426; Bertin & Estève, 1950: 8; Arnoult, 1959: 24, pl. 3 fig. 4; Kiener, 1961: 55 fig. 64ter; Kiener, 1963: 56, pl. 27, pl. 109; Kiener & Thézénien, 1963: 5, pl. 1; Kiener, 1966: 1049, 1084, 1092, 1117; Kiener & Richard-



Vindard, 1972: 490; Bauchot & Bianchi, 1984: 38; Taylor, 1986: 156; Reinthal & Stiassny, 1991: 232; Stiassny & Raminosoa, 1994: 139, 141.

Arius falcarius: Bleeker, 1875: 103 (in part ?)

Arius venosus (non Valenciennes in Cuvier & Valenciennes): Sauvage, 1891: 526; Vaillant, 1894: 76.

Arium madagascariensis: Pellegrin, 1920: 207.

Fig. 6. *Arius madagascariensis*, UMMZ 238056, 181.0 mm SL; Madagascar: Lake Kinkony.

Diagnosis. *Arius madagascariensis* can be distinguished from other *Arius* species found in the region (Madagascar, East Africa and the western Indian Ocean) by the combination of a single pair of ovoid vomerine tooth patches (which distinguishes it from *A. africanus*, *A. dussumieri* and *A. uncinatus*) and head width 17.5-20.5% SL (which distinguishes it from *A. festinus*).

Description. Body moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently ventrally to end of caudal peduncle. Ventral profile flat to anal-fin base, then sloping gently dorsally to end of caudal peduncle. Anus and urogenital openings located at vertical through middle of adpressed pelvic fin. Skin smooth. Lateral line complete and midlateral in placement, forming a network of anastomosing canals on head and sides of body and curving dorsally at caudal-fin base.

Head depressed and broad, acutely triangular when viewed laterally and with broadly convex snout margin when viewed from above. Mesethmoid

gently curving ventrally, causing tip of snout to appear almost flat when viewed laterally. Fleshy upper lip extending anteriorly beyond upper jaw. Gill openings wide, extending from exposed surface of posttemporal to isthmus. Gill membranes fused to, and attached across, isthmus. Bony elements of dorsal surface of head exposed and ornamented with small tubercles. Midline of cranium with dorsomedial groove extending from midway between base of supraoccipital and posterior orbital margin to a point three-quarters of distance between anterior orbital margin and tip of snout. Supraoccipital spine moderately broad, with converging sides and truncate posterior tip. Cleithral process well-ossified anteroventrally, with oblique shaft and extending along proximal third of pectoral spine.

Barbels in three pairs. Maxillary barbel long and slender, extending to middle of pectoral-fin base. Inner mandibular-barbel origin close to midline; and extending just beyond level of posterior margin of orbit. Outer mandibular barbel originates posterolateral of inner mandibular barbel, extending to base of pectoral spine.

Eye ovoid, horizontal axis longest; located entirely in dorsal half of head. Orbit with free margin.

Mouth inferior, premaxillary tooth band not exposed when mouth is closed. Oral teeth fine, sharp and depressible. Premaxillary tooth band strongly arched, of equal width throughout and with 5-6 irregular rows of teeth. Dentary tooth band narrower than premaxillary tooth band at symphysis, tapering laterally, and with 4-5 irregular rows of teeth. Palatal teeth fine and sharp, arranged in 6-7 irregular rows in two ovoid patches on each side of anterior part of palate and separated by narrow medial gap.

Dorsal fin located above middle of body; origin nearer tip of snout than caudal flexure, with 7 (18) rays. Dorsal-fin margin somewhat falcate, with first branched ray longer than other rays. Dorsal-fin spine long, straight and robust, with 11-27 serrations on anterior margin and 10-19 antrorse serrations on posterior edge.

Margin of adipose fin convex for entire length; deeply incised posteriorly.

Caudal fin deeply forked; upper and lower lobes pointed, with i,8,7,i (18) principal rays. Procurrent rays symmetrical and extend only slightly anterior to fin base.

Anal-fin origin immediately in front of vertical through origin of adipose fin, with vi,12 (10), vi,13 (3), vii,12 (4) or viii,12 (1) rays. Posterior fin margin concave.

Pelvic-fin origin at vertical through point on anterior quarter of region between dorsal and adipose fins, with i,5 (18) rays. Pelvic-fin margin slightly convex, tip of adressed fin reaching just beyond anal-fin origin.

Pectoral fin with stout spine, ornamented with fine grooves and extending to vertical through last dorsal-fin ray. Anterior spine margin with 10-22

serrations along entire length; posterior spine margin with 8-9 strong serrations along entire length. Pectoral-fin margin straight anteriorly, convex posteriorly, with 11 (18) rays.

In % SL: head length 26.4-31.4, head width 17.5-20.5, head depth 16.1-18.9, predorsal distance 36.3-41.6, preanal length 67.4-72.9, prepelvic length 52.9-57.8, prepectoral length 22.7-27.9, body depth at anus 14.4-18.2, length of caudal peduncle 15.6-16.7, depth of caudal peduncle 6.3-7.8, pectoral-spine length 18.6-21.8, pectoral-fin length 22.5-29.4, dorsal-spine length 19.1-20.4, length of dorsal-fin base 10.4-12.3, pelvic-fin length 16.0-20.0, length of anal-fin base 13.9-16.7, caudal-fin length 26.9-32.8, length of adipose-fin base 8.9-11.2, adipose maximum height 3.9-6.2, dorsal to adipose distance 23.1-32.0, post-adipose distance 17.3-19.8; in % HL: snout length 36.6-41.1, interorbital distance 37.7-42.3, eye diameter 15.6-19.3, maxillary barbel length 98.0-127.3, inner mandibular barbel length 39.6-59.5, outer mandibular barbel length 58.2-88.1. Branchiostegal rays 6 (18). Gill rakers slender and stiff, half as long as opposing gill filaments; 4+13 (2), 5+13 (1) or 6+12 (1) on first gill arch. Rakers present on hind aspect of all but first two arches. Vertebrae 26+23=49 (1), 27+24=51 (3), 27+25=52 (1), 28+24=52 (7), 29+23=52 (1), 28+25=53 (2), 29+24=53 (1) or 29+25=54 (2).

Coloration. Dorsal surface of head and body uniform gray to grayish brown, upper third of head and body darkest, gradually fading to a lighter color along middle third of head and body; lower third and ventral surfaces of head and body dirty white. Adipose fin gray; dorsal fin-rays gray, fin rays of all other fins with scattered gray melanophores; inter-radial membranes of all fins yellowish or dirty white. Posterior margins of dorsal and caudal fins sometimes edged with black. Pelvic and anal fins of some specimens reddish in life.

Distribution. Known only from the lower to middle reaches of drainages along the western coast of Madagascar. The range of *Arius madagascariensis* extends from the Tsiribihina and Morondava River drainages northwards to the Mahavavy du Sud and Betsiboka River River drainages (Fig. 3). Although *A. madagascariensis* has been reported from the coast of Tanzania in East Africa by Eccles (1992), this putative occurrence is most likely erroneous and due to a misidentification of *A. africanus*, given that the shape of the vomerine toothplates of both species are quite similar.

Material examined. AMNH 17454, 1 ex., 194.1 mm SL; AMNH 58768, 1 ex., 196.8 mm SL; Madagascar: Lake Kinkony. UMMZ 238056, 6 ex., 142.0-181.0 mm SL; Madagascar: Lake Kinkony, 16°5'38"S 45°51'37"E. UMMZ 238057, 4 ex., 146.4-230.0 mm SL; Madagascar: Lake Ravelobe, across from Ampijoroa Forestry Station, 16°18'34"S 46°48'59"E. UMMZ 238426, 3 ex., 151.7-231.2 mm SL; Madagascar. UMMZ 238363, 2 ex., 118.8-125.8 mm SL; Madagascar: Ankazondringitra River. UMMZ 238920, 4 ex., 138.2-192.7 mm SL; UMMZ 239809, 3 ex., 199.7-212.5 mm SL; Madagascar: Lake

Akazomanga at Miandrivazo. UMMZ 239808, 3 ex., 163.6-213.2 mm SL; Madagascar: Manambolo River at camp. UMMZ 240022, 1 ex., 136.6 mm SL; Madagascar: Morondava River.

Arius uncinatus new species

Fig. 7

Type material. Holotype: MHNG 2622.81, 173.4 mm SL; Madagascar: Lake Andrapongy, near Antsohihy; P. de Rham & J.-C. Nourissat, 27 October 1992.

Paratypes. MHNG 2537.66, 6 ex., 175.5-185.3 mm SL; data as for holotype. AMNH 211458, 1 ex., 199.2 mm SL; UMMZ 238058, 1 ex., 164.6 mm SL; Madagascar: Ankofia River drainage, Lake Andrapongy, North Basin, 14°41'49"S 48°7'54"E; J. Sparks & K. Riseng, August 1994.

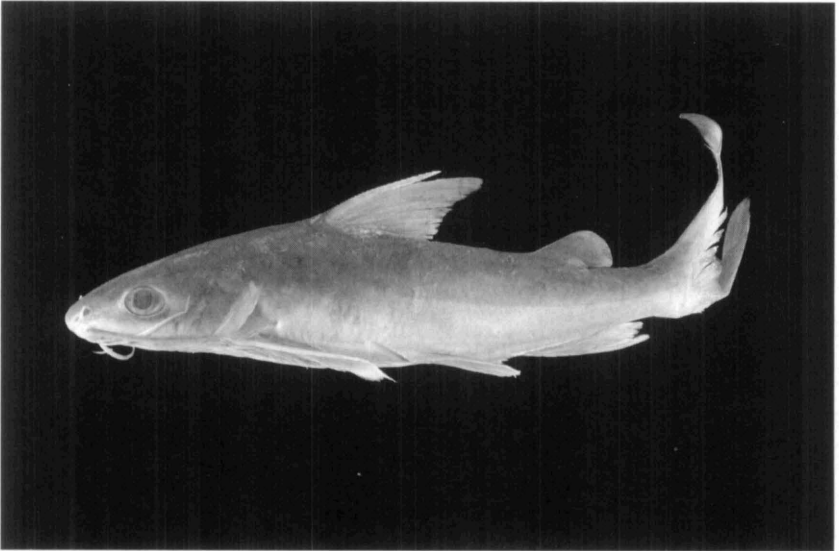


Fig. 7. *Arius uncinatus*, MHNG 2622.81, holotype, 173.4 mm SL; Madagascar: Lake Andrapongy, near Antsohihy.

Diagnosis. *Arius uncinatus* can be distinguished from other *Arius* species found in the region (Madagascar, East Africa and the western Indian Ocean) by the combination of vomerine teeth in a single pair of triangular patches (which distinguishes it from *A. dussumieri*, *A. festinus* and *A. madagascariensis*) and adipose maximum height 4.5-5.8% SL (which distinguishes it from *A. africanus*).

Description. Body moderately compressed. Dorsal profile rising evenly but not steeply from tip of snout to origin of dorsal fin, then sloping gently

ventrally to end of caudal peduncle. Ventral profile flat to anal-fin base, then sloping gently dorsally to end of caudal peduncle. Anus and urogenital openings located at vertical through middle of adpressed pelvic fin. Skin smooth. Lateral line complete and midlateral in placement, forming a network of anastomosing canals on head and sides of body and curving dorsally at caudal-fin base

Head depressed and broad, and with acutely convex snout margin when viewed from above. Mesethmoid strongly curving ventrally, causing tip of snout to appear sharply curved when viewed laterally. Fleishy upper lip extending anteriorly beyond upper jaw. Gill openings wide, extending from exposed surface of posttemporal to isthmus. Gill membranes fused to, and attached across, isthmus. Bony elements of dorsal surface of head exposed and ornamented with numerous small tubercles. Midline of cranium with dorsomedial groove extending from midway between base of supraoccipital and posterior orbital margin to point three-quarters of distance between anterior orbital margin and tip of snout. Supraoccipital spine moderately broad, with converging sides and truncate posterior tip. Cleithral process well-ossified anteroventrally, with oblique shaft and extending along proximal third of pectoral spine.

Barbels in three pairs. Maxillary barbel long and slender, extending to middle of pectoral-fin base. Inner mandibular-barbel origin close to midline, extending just beyond level of posterior margin of orbit. Outer mandibular barbel originates posterolateral of inner mandibular barbel, extending to base of pectoral spine.

Eye somewhat large and ovoid, horizontal axis longest; located entirely in dorsal half of head. Orbit with free margin.

Mouth inferior, premaxillary tooth band not exposed when mouth is closed. Oral teeth fine, sharp and depressible. Premaxillary tooth band strongly arched, of equal width throughout and with 5-6 irregular rows of teeth. Dentary tooth band narrower than premaxillary tooth band at symphysis, tapering laterally, and with 4-5 irregular rows of teeth. Palatal teeth fine and sharp, arranged in 8-9 irregular rows in two triangular patches on each side of the anterior part of the palate and separated by a narrow medial gap.

Dorsal fin located above middle of body; origin nearer tip of snout than caudal flexure, with 7 (9) rays. Dorsal-fin margin somewhat falcate, with first branched ray longer than other rays. Dorsal-fin spine long, gently curved and robust, with 15-22 serrations on anterior margin and 11-13 antrorse serrations on posterior edge.

Margin of adipose fin convex or straight for entire length; deeply incised posteriorly.

Caudal fin deeply forked; upper and lower lobes pointed, with $i,8,7,i$ (9) principal rays. Procurrent rays symmetrical and extend only slightly anterior to fin base.

Anal-fin origin immediately in front of vertical through origin of adipose fin, with vii,12 (2), vii,13 (2), vii,14 (1), vii,11 (1), viii,12 (1) or ix,12 (2) rays. Posterior fin margin concave.

Pelvic-fin origin at vertical through point on anterior quarter of region between dorsal and adipose fins, with i,5 (9) rays. Pelvic-fin margin slightly convex, tip of adpressed fin reaching just beyond anal-fin origin.

Pectoral fin with stout spine, ornamented with fine grooves and extending to vertical through last dorsal-fin ray. Anterior spine margin with 18-25 serrations along entire length; posterior spine margin with 13-17 strong serrations along entire length. Pectoral-fin margin straight anteriorly, convex posteriorly, with 11 (9) rays.

In % SL: head length 27.8-31.3, head width 17.6-19.0, head depth 16.2-18.0, predorsal distance 36.3-41.1, preanal length 68.6-73.6, prepelvic length 53.8-57.2, prepectoral length 24.6-27.8, body depth at anus 14.4-17.9, length of caudal peduncle 14.6-16.6, depth of caudal peduncle 6.7-7.3, pectoral-spine length 19.4-22.7, pectoral-fin length 23.8-28.5, dorsal-spine length 18.2-21.8, length of dorsal-fin base 10.6-12.4, pelvic-fin length 17.7-21.5, length of anal-fin base 14.4-16.0, caudal-fin length 29.1-34.5, length of adipose-fin base 7.7-9.1, adipose maximum height 4.5-5.8, dorsal to adipose distance 25.8-29.6, post-adipose distance 17.2-19.7; in % HL: snout length 37.1-40.7, interorbital distance 35.5-37.1, eye diameter 20.0-21.6, maxillary barbel length 99.6-116.3, inner mandibular barbel length 37.5-50.2, outer mandibular barbel length 61.8-76.1. Branchiostegal rays 6 (9). Gill rakers slender and stiff, half as long as opposing gill filaments; 4+12 (1) or 5+13 (1) on first gill arch. Rakers present on hind aspect of all but first two arches. Vertebrae 26+24=50 (2), 27+24=51 (1), 27+24=51 (2), 28+24=52 (3) or 28+25=53 (1).

Coloration. Dorsal surface of head and body uniform gray to grayish brown, upper third of head and body darkest, gradually fading to a lighter color along middle third of head and body; lower third and ventral surfaces of head and body dirty white. Adipose fin gray; dorsal fin-rays gray, fin rays of all other fins with scattered gray melanophores; inter-radial membranes of all fins yellowish or dirty white.

Distribution and habitat. Known only from Lake Andrapongy (part of the Ankofia River drainage) (Fig. 8), a large oligotrophic floodplain lake comprised of two major basins. Similar to other lakes in northwestern Madagascar, Lake Andrapongy is very shallow and highly turbid. Similar lakes in northwestern Madagascar include Lake Kinkony and the lakes near Sarodrano. The ichthyofauna of Lake Andrapongy is under threat due to overfishing, agricultural conversion of the basin for rice cultivation (especially the southern basin), and the impact of several nearby villages. The Andrapongy basin is almost completely deforested, and can be characterized as moderately to highly disturbed in its entirety. Severe erosion of deforested shorelines is a



Fig. 8. Type locality of *A. uncinatus* (Lake Andrapongy); photo by P. de Rham.

major problem throughout the basin. The northern basin, from which the new species was collected, is currently much less disturbed than the southern basin, of which a significant portion to date has been converted for rice cultivation. It is distressing to note that a vast majority of native fishes that the second author collected from this lake were found to occur only in the less degraded northern portion of the lake. The Ankofia basin, including Lake Andrapongy, is a comparatively speciose region for freshwater fishes, and is habitat to a number of endemic and native species, including two species of the endemic cichlid genus *Paretroplus*, a recently described endemic cichlid of the genus *Ptychochromis* (Sparks, 2002), the rare atherinid *Teramulus waterloti* (otherwise found only in the Sambirano basin to the north), and an undescribed species of aplocheiloid belonging to the genus *Pachypanchax*.

Etymology. From the Latin *uncinatus*, meaning hooked; in reference to the curved snout of this species.

DISCUSSION

Prior to this study, only four valid species of *Arius* had been recorded from Madagascar, East Africa and the western Indian Ocean (Taylor, 1986), viz. *Arius africanus* Boulenger, 1911, *Arius dussumieri* Valenciennes in Cuvier & Valenciennes, 1840, *Arius madagascariensis* Vaillant, 1894, and *Arius*

thalassinus (Rüppell, 1837). This is at least partly the result of inadequate sampling of freshwater fishes throughout much of Madagascar until the past decade, and that ariid catfishes from this region have in general received little attention from ichthyologists.

Eccles (1992) recorded the presence of *A. polystaphylodon* Bleeker, 1846 from the coast of East Africa, a species that is otherwise restricted to the coastal waters of Southeast Asia and New Guinea (Kailola, 1999). This is most likely due to a misidentification of *A. dussumieri*, a morphologically similar species that shares a prominent lateral ethmoid and two pairs of vomerine toothplates with *A. polystaphylodon*. As far as we can determine, *Arius thalassinus* is not found in the coastal waters around Madagascar (it is only known from the coast of East Africa through to the Red Sea, India through to Southeast Asia, and New Guinea and northern Australia; Kailola, 1999). In any case, *A. thalassinus* is readily distinguished from all other species of *Arius* occurring in the Mascarene region in having vomerine teeth in three (*vs.* one or two) patches on each side of the palate.

Arius africanus is also not known from the coastal waters around Madagascar, and instead is restricted entirely to the coastal region of East Africa. We attribute previous records of *A. africanus* from Madagascar to misidentifications of *A. dussumieri* (see below). *Arius africanus* can be distinguished from *A. madagascariensis* and *A. uncinatus* in having shorter pelvic fins (not reaching anal-fin origin when adpressed *vs.* reaching just beyond anal-fin origin), and granular (*vs.* villiform) teeth on the palate. It further differs from both *A. festinus* and *A. madagascariensis* in having triangular (*vs.* ovoid) vomerine tooth plates and a smaller adipose fin (Table 1), and from *A. uncinatus* in having more widely set eyes (Table 1).

Arius dussumieri can be easily distinguished from all other *Arius* in the region (Madagascar, East Africa and the western Indian Ocean) in having a prominent lateral ethmoid that forms a “shelf” between the eye and the nostrils (*vs.* lateral ethmoid not prominent and “shelf” absent), very short adipose-fin base (4.3-4.5% SL *vs.* more than 7.5), and two (*vs.* one) pairs of vomerine toothplates. *Arius dussumieri* has often been confused with *A. africanus* (see synonymy list in species account) as these taxa share short pelvic fins that do not reach the anal-fin origin when adpressed, but the latter species lacks the diagnostic characters for *A. dussumieri* listed above.

Arius festinus differs from *A. madagascariensis* and *A. uncinatus* in having a narrower head (Fig. 9), and shorter dorsal and pectoral spines (Table 1) that are weakly (*vs.* strongly) serrated on the posterior edges. The species further differs from *A. madagascariensis* and *A. uncinatus* in having shorter pelvic fins (not reaching anal-fin origin when adpressed *vs.* reaching just beyond anal-fin origin), and from *A. uncinatus* in the shape of the vomerine toothplates (ovoid *vs.* triangular; Fig. 10).

Table 1. Distinguishing morphometric characters of East African and Malagasy species of *Arius*.

	<i>Arius africanus</i>	<i>Arius festinus</i>	<i>Arius madagascariensis</i>	<i>Arius uncinatus</i>
Head width (% SL)	17.2–21.9	15.6–16.1	17.5–20.5	17.6–19.0
Dorsal-spine length (% SL)	19.5–24.8	15.1–15.8	19.1–20.4	18.2–21.8
Pectoral-spine length (% SL)	19.2–20.6	14.9–15.0	18.6–21.8	19.4–22.7
Length of adipose-fin base (% SL)	7.1–8.9	10.0–10.4	8.9–11.2	7.7–9.1
Adipose maximum height (% SL)	3.2–3.8	3.8–4.1	3.9–6.2	4.5–5.8
Eye diameter (% HL)	12.8–21.8	19.6–19.8	15.6–19.3	20.0–21.6
Interorbital distance (% HL)	39.1–42.8	35.4–38.1	37.7–42.3	35.5–37.1

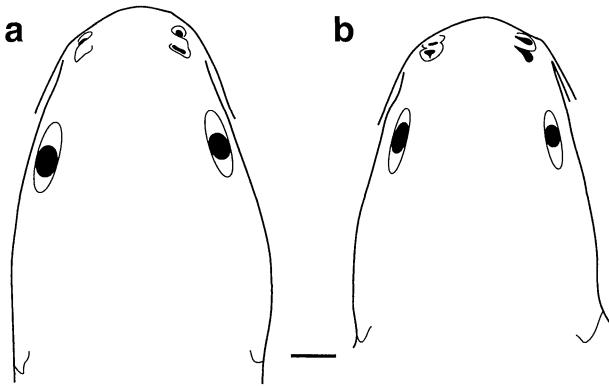


Fig. 9. Dorsal view of heads of **a**, *A. festinus*, UMMZ 239806, holotype, 141.9 mm SL; **b**, *A. madagascariensis*, UMMZ 240022, 136.6 mm SL. Scale bar represents 5 mm.

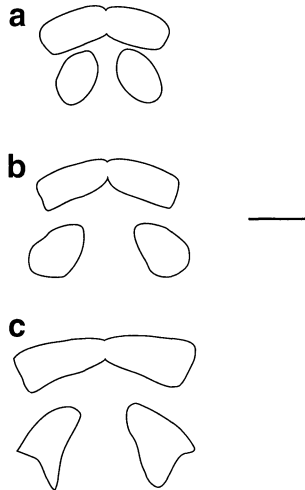


Fig. 10. Vomerine toothplates of: **a**, *A. festinus*, UMMZ 239806, holotype, 141.9 mm SL; **b**, *A. madagascariensis*, UMMZ 238056, 181.0 mm SL; **c**, *A. uncinatus*, UMMZ 238058, paratype, 199.2 mm SL. Scale bar represents 5 mm.

Arius uncinatus can be distinguished from *A. madagascariensis* in having a more strongly curved mesethmoid when viewed laterally, resulting in a more steeply curved snout tip in *A. uncinatus* (Fig. 11). Further differences between the two species include a larger eye, smaller interorbital distance, and a shorter adipose-fin base in *A. uncinatus* (Table 1), and different shapes of the vomerine toothplates (ovoid in *A. madagascariensis* vs. triangular in *A. uncinatus*).

It is likely that with continued exploration of remote freshwater habitats on Madagascar, additional members of *Arius* new to science will be discovered.

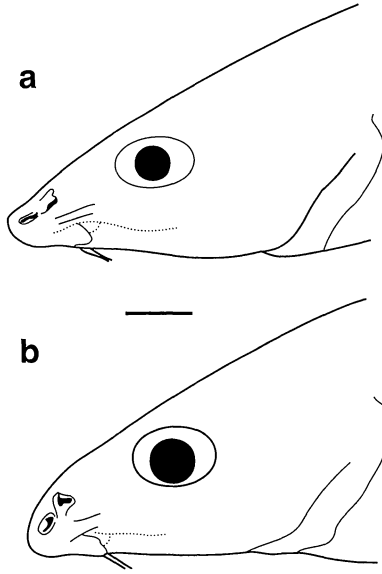


Fig. 11. Lateral view of heads of: **a**, *A. madagascariensis*, UMMZ 238056, 181.0 mm SL; **b**, *A. uncinatus*, MHNG 2622.81, paratype, 181.3 mm SL. Scale bar represents 10 mm.

The collection of *Arius* from the Amboaboa River in the upper reaches of the Sofia drainage basin demonstrates that these fishes are not only restricted to lowland habitats in coastal regions, but may occur quite far inland. As a result of intensive collection efforts over the past decade, numerous undescribed species of freshwater fishes have been collected throughout Madagascar (Sparks & Stiassny, 2003). As these authors point out, the notion of a depauperate freshwater ichthyofauna for Madagascar is no longer tenable. Based on worldwide species-area comparisons, the island is found to contain almost exactly as many native species as one would predict given its surface area (Sparks & Stiassny, 2003). Further, with more intensive study of Malagasy fish groups that have traditionally received little attention, including ariid catfishes, and the continued accumulation of new material from remote regions of the island, a more detailed examination of geographic variation and species boundaries for endemic members of *Arius* will be possible.

Comparative material. *Arius africanus*: BMNH 1865.9.12.16, syntype, 223.1 mm SL; BMNH 1867.3.9.499, syntype, 169.6 mm SL; Zanzibar: Pangani River. BMNH 1955.1.18.32, 1 ex., 173.8 mm SL; Kenya: Sabaki River. BMNH 1969.3.6.52, 1 ex., 247.8 mm SL; Kenya: Tana River at Kipini. NMK uncat., 2 ex., 101.0-102.0 mm SL; Kenya: lower Sabaki River at bridge on Malindi-Garsen road.

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