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PARETROPLUS MAROMANDIA, A NEW CICHLID FISH
FROM THE NORTHWEST OF MADAGASCAR

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ABSTRACT. - *Sparks, J. S., and P. N. Reinthal. Paretroplus maromandia, a new cichlid fish from the northwest of Madagascar. Occ. Pap. Mus. Zool. Univ. Michigan 727:1-18, 5 figures, 3 tables. Paretroplus maromandia n. sp. is described from the Andranomalaza drainage, Maromandia, Madagascar. This deep-bodied and laterally compressed Paretroplus is distinguished from congeners by the presence in life of localized vivid red pigmentation on the flanks interrupted by seven much darker gray vertical bands. Paretroplus maromandia is also characterized by an elevated lateral line scale count (40 or 41), and a pronounced dorsal concavity rostral to the orbit, owing to possession of both a conspicuous interorbital bump and a straight, comparatively weakly sloping snout. Origin of the dorsal fin, located well posterior to a vertical through pectoral fin insertion, is also diagnostic. The new species is further distinguished from congeners, excluding its sister taxon P. menarambo, by an elevated precaudal vertebral count (16), an elevated total vertebral count (34), and an increased number of dorsal fin soft rays (21 - 23). The geographic range of P. maromandia includes large, tidally influenced rivers and estuaries. Other closely related Paretroplus species are restricted to shallow lacustrine environments in northwestern Madagascar.*

Key words: *Paretroplus, maromandia, Cichlidae, Madagascar, systematics.*

INTRODUCTION

Endemic freshwater fishes of Madagascar are disappearing at an alarming rate due to combined pressures of human encroachment,

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deforestation, and the introduction of exotic species. Although Madagascar is characterized by a depauperate freshwater ichthyofauna, recent survey efforts continue to discover novel endemic taxa (Stiassny and Reinthal, 1992; Allgayer, 1996, 1998; Reinthal and Stiassny, 1997; Nourissat, 1998; Sparks, in prep.). It is distressing that most recently discovered species are restricted to relatively undisturbed regions of the island, where limnological surveys indicate limited ecosystem disturbance (Reinthal and Stiassny, 1991; Riseng, 1997). Where there is a great deal of ecosystem degradation, including a vast majority of Madagascar's freshwater systems, primarily exotic species survive (Sparks, pers. obs.). Increased sediment load and water turbidity, resulting from extensive deforestation and subsequent runoff, appears to be a major factor leading to the rapid decline of endemic species.

While eastern rainforests have traditionally been reported to contain the highest diversity of freshwater fishes in Madagascar, the results of recent collecting expeditions in the northwest of the island indicate that this region may be equally, if not more, species rich (Sparks, pers. obs.). This is especially true for endemic cichlids, numbering 12 described and currently recognized species, with a majority of these species, in addition to a number of undescribed taxa, restricted to northwestern Madagascar.

Paretroplus Bleeker (1868), the most speciose cichlid genus in Madagascar, comprises six described species. Monophyly of *Paretroplus* is well established, based on a number of morphological and nucleotide characters (Stiassny, 1991, pers. comm.; Sparks, unpub. data). All but a single described taxon (*P. polyactis*) are restricted to northwestern Madagascar, and a number of undescribed species are reported from that region. Another recently described species was given new generic rank, *Lamena nourissati* (Allgayer, 1998), but is assuredly a member of *Paretroplus*, based on a number of morphological and molecular synapomorphies (Sparks, unpub. data; Stiassny, in prep.).

Despite extremely low species diversity, morphological and molecular variation among endemic Malagasy cichlids is substantial (Reinthal and Stiassny, 1997; Stiassny, pers. comm.; Sparks, unpub. data). In this paper we describe a new species of *Paretroplus* from the region of Maromandia, located along the northwest coast of Madagascar, and present comparative data for other members of the genus.

MATERIALS AND METHODS

The holotype of the new species is deposited at the University of Michigan Museum of Zoology (UMMZ), and the paratype at the American Museum of

Natural History (AMNH). Counts and morphometric measurements follow Barel et. al. (1977), and Kullander (1986) for upper jaw length and pelvic fin length, unless noted otherwise. Lateral line scales were counted in accordance with Greenwood (1956). Measurements were recorded to the nearest 0.1 mm using Sylvac digital calipers.

Vertebral counts exclude the last hypural-bearing vertebra (i.e. last half centrum), and were obtained from radiographs generated using a Hewlett-Packard Cabinet X-Ray System. A number of *Paretroplus* specimens were examined possessing abdominal ribs, in addition to a fully developed hemal spine, on what we determine to represent the first caudal vertebra. Due to the presence of these anomalous specimens, the first caudal vertebra is defined as the most anterior vertebra bearing a fully developed hemal spine, terminating either between the first and second, or between the second and third anal fin pterygiophore, regardless of the presence of abdominal ribs. All fin spine and ray counts were obtained from radiographs. Dorsal and anal fin soft ray counts recognize the last ray as two rays if this ray is split completely to the fin base, which is generally the case in *Paretroplus*. There is only one supporting (articulating) pterygiophore for this terminal split ray in *Paretroplus*. Without the use of radiographs this condition would be difficult to discern, and would appear as two distinct rays. Thus in accordance with Barel et. al. (1977), a split extending to the fin base is counted as two rays.

Institutional abbreviations are: AMNH, American Museum of Natural History, New York; BMNH, Natural History Museum, London; MNHN, Muséum National d'Histoire Naturelle, Paris; UMMZ, Museum of Zoology, University of Michigan, Ann Arbor; USNM, National Museum of Natural History, Smithsonian Institution, Washington, D. C. Specimens included for comparative analyses were either preserved in 70% ethanol, or cleared and double stained for bone and cartilage using a modified protocol based on Taylor and Van Dyke (1985). Comparative material includes: *Etroplus maculatus* (USNM 301168); *Etroplus suratensis* (USNM 301178); *Paretroplus maculatus* (UMMZ 235019, 235020, UMMZ uncat.); *Paretroplus dami* (UMMZ 235021, 235022, 235023, UMMZ uncat.); *Paretroplus polyactis* (UMMZ 235015, 235016, 235017, UMMZ uncat.); *Paretroplus kieneri* (UMMZ 235018, UMMZ uncat.); *Paretroplus menarambo* (UMMZ 233522, 235013, 235014, UMMZ uncat.); *Paretroplus petiti* (UMMZ 199406, 235024, UMMZ uncat.); *Lamena nourissati* (UMMZ, uncat.); *Oxylapia polli* (AMNH 97111; MNHN 1965-317, 1966-1034); *Ptychochromoides betsileanus* (UMMZ 199409; BMNH 1882.2.25:69, 1882.2.25:70, BMNH 1909.7.27:53; MNHN 1919-11, 1965-314); *Ptychochromoides katria* (AMNH 93701); *Ptychochromis oligacanthus* (UMMZ 233524, UMMZ uncat.); *Paratilapia polleni* (UMMZ 235043, 235044, 235045).

Diagnostic characters were obtained from Cichocki (1976), Stiassny (1990, 1991), and from a phylogenetic analysis of Malagasy cichlids based upon mitochondrial DNA sequence data (16s ribosomal RNA and cytochrome c oxidase subunit I) and morphology (Sparks, in prep.). All characters from the literature were reexamined and verified. Note that sample size varies for both meristic and morphometric data, due to limited specimen availability.

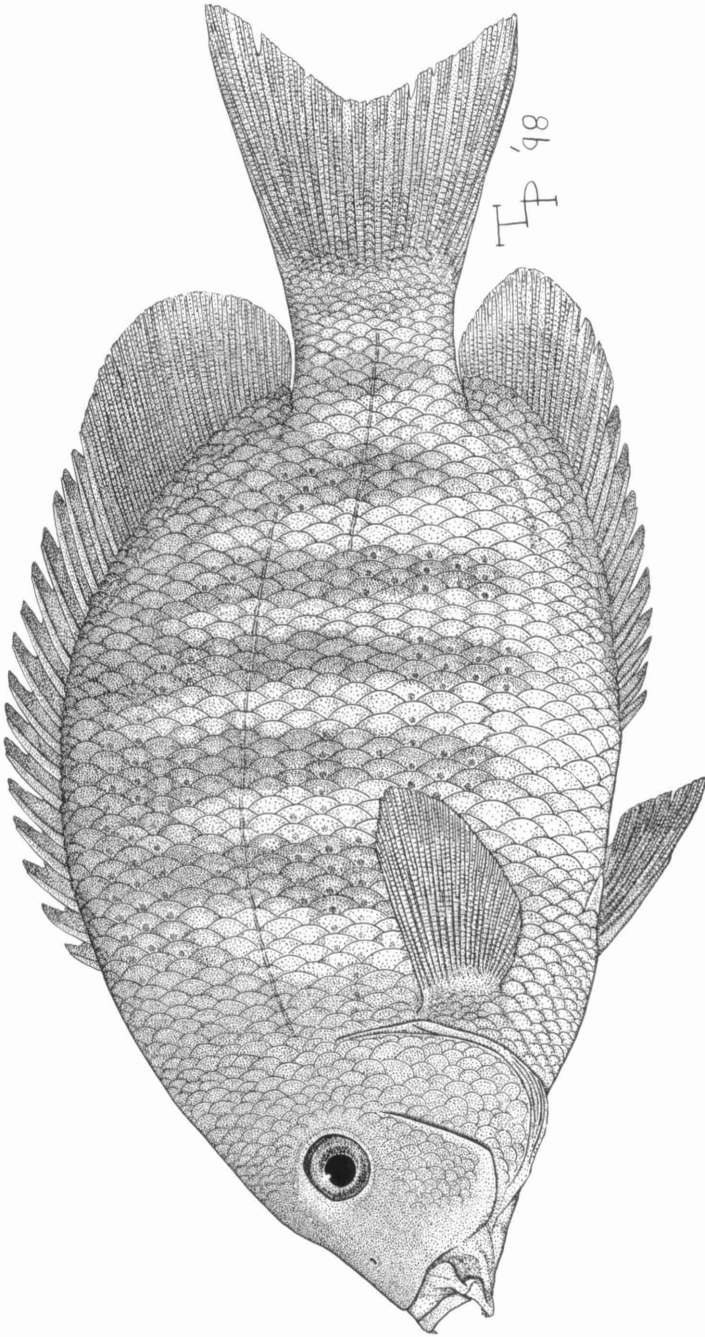


Fig. 1. Holotype of *Paretroplus maromandia*, UMMZ 234790, 126.9 mm SL, Maintsomalaza River, Maromandia, Madagascar. Drawing by Teresa L. Peterson.

Paretroplus maromandia, new species
Figs. 1 - 3

Holotype.—UMMZ 234790, adult, likely male (sex undetermined due to poor internal preservation), 126.9 mm SL; Madagascar, Region of Maromandia, Antalaha Province, Maintyomalaza River (on 1: 500,000 scale FTM map this river is not depicted; collection locality is near confluence of Adranomalaza and Manongarivo rivers, downstream from where these two rivers unite; local villagers refer to the river as

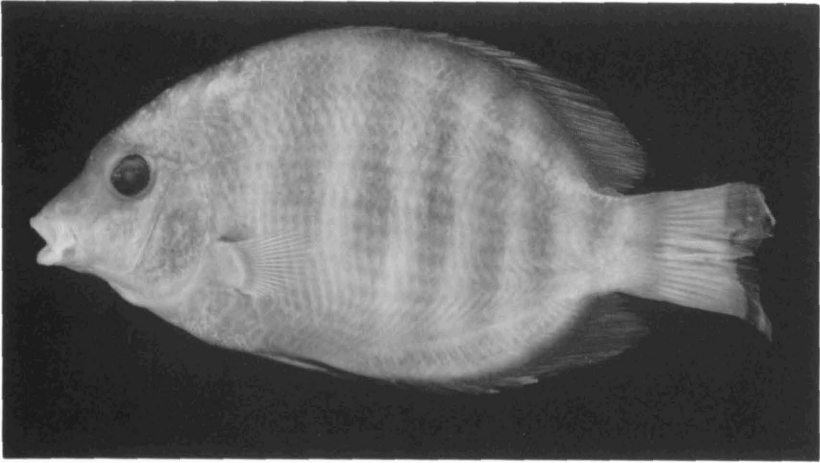


Fig. 2. *Paretroplus maromandia*, holotype, UMMZ 234790, 126.9 mm SL.

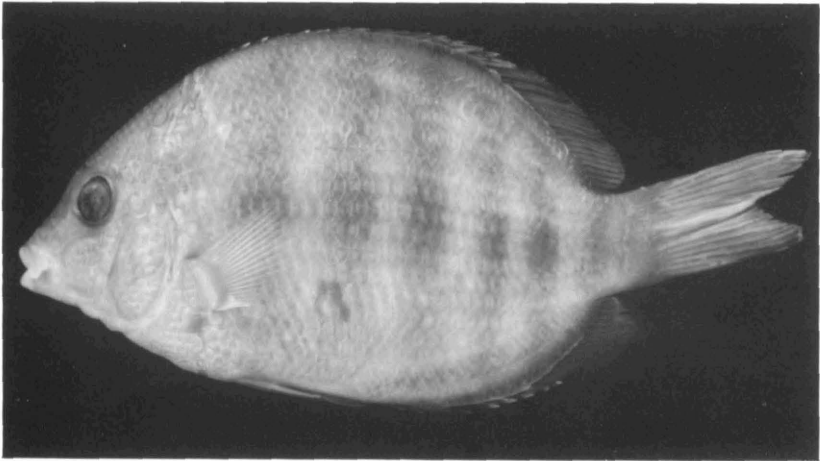


Fig. 3. *Paretroplus maromandia*, paratype, AMNH 227336, 113.0 mm SL.

the Maintyomalaza River), immediately south of the village of Maromandia (S: 14° 12', E: 48° 04') (Fig. 4). The holotype and paratype were obtained from fisherpersons; field number JSS Mad 96-13; a large, shallow, clear river, mostly sandy to silty and muddy substrate, tidally influenced; several marine/euryhaline taxa were collected with the new species (all deposited at the UMMZ; field number JSS 96-13); 7 July 1996; John S. Sparks, Karen Jo Riseng, Richard Randriamampionina.

Paratype.—AMNH 227336, 1 juvenile, presumably female (gonads are reasonably well developed with abundant lipids, although no oocytes were detected), taken with holotype, 113.0 mm SL; same data as holotype.

Non-type material.—Additional material has subsequently been collected by Nourissat (1998), from same general locality (Andranomalaza River near the village of Maromandia, no exact (GPS) locality coordi-

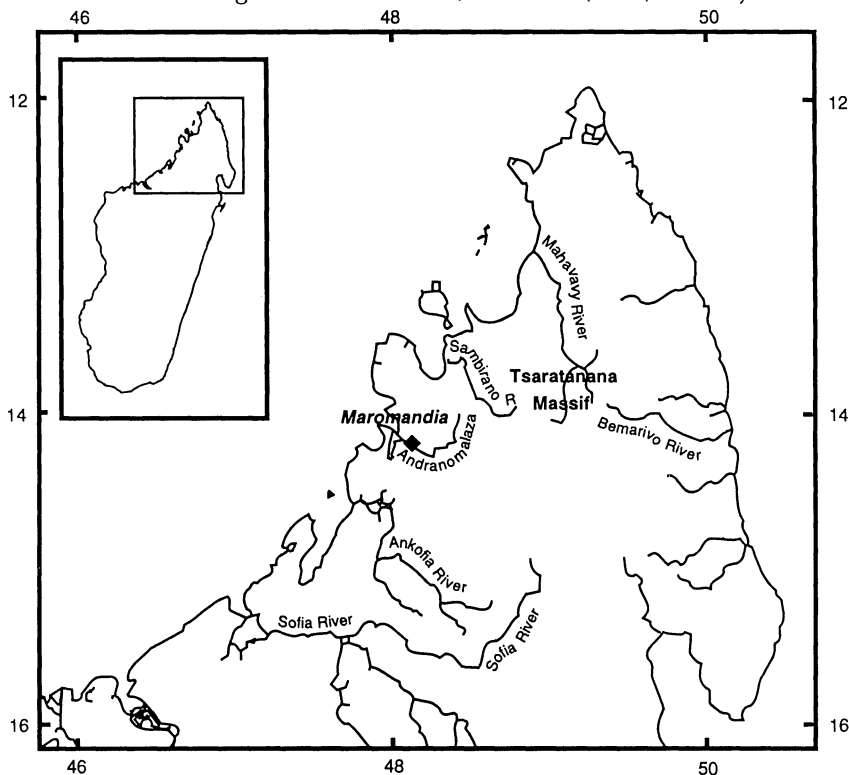


Fig. 4. Map of northern Madagascar showing the type locality of *Paretroplus maromandia* and other major drainage systems in the region. The diamond symbol indicates the village of Maromandia on the Maintyomalaza River, type locality of *P. maromandia*, near where the river splits into the Andranomalaza and Manongarivo rivers.

nates provided).

Differential diagnosis.—A deep-bodied and laterally compressed *Paretroplus* characterized by an elevated count of 40 or 41 lateral line scales (congeners possess 39 or fewer (Table 1)), and a dorsal fin origin that is located well posterior to a vertical through pectoral fin insertion. *Paretroplus maromandia* is also characterized by a conspicuous dorsal concavity anterior to the orbit, resulting from possession of an interorbital bump, and a straight lateral snout profile rising at a comparatively slight angle from horizontal. This concavity is much less pronounced in congeners. In life, *P. maromandia* is readily diagnosed by localized bright red, mid-lateral flank pigmentation, interrupted by seven charcoal-gray vertical bands (see Nourissat (1998) for a color photograph). An increased number of dorsal fin soft rays (21 - 23), an elevated precaudal vertebral count (16), and a total ver-

Table 1. Frequency distribution of pre-caudal vertebrae, total vertebral count, and lateral line scales for *Paretroplus maromandia* n. sp. and other closely related *Paretroplus* species.

Taxon	Pre-caudal Vertebrae		
	14	15	16
<i>P. maromandia</i> n. sp.			2
<i>P. menarambo</i>		23	1
<i>P. maculatus</i>	25	6	
<i>P. petiti</i>	5	22	
<i>P. polyactis</i>	24		

Taxon	Total Vertebrae			
	31	32	33	34
<i>P. maromandia</i> n. sp.				2
<i>P. menarambo</i>		1	21	2
<i>P. maculatus</i>		11	20	
<i>P. petiti</i>	1	19	7	
<i>P. polyactis</i>	3	19	2	

Taxon	Scales in Lateral Line										
	31	32	33	34	35	36	37	38	39	40	41
<i>P. maromandia</i> n. sp.										1	1
<i>P. menarambo</i>							13	5			
<i>P. maculatus</i>				1	1	3	4	7	2		
<i>P. petiti</i>						9	6	3			
<i>P. polyactis</i>	2	5	5	4	2						

tebral count (34), also distinguish the new species from all congeners, excluding its sister taxon, *P. menarambo*.

Description.—Morphometric data are presented in Table 2, while frequency distributions for pre-caudal vertebrae, total vertebrae, and lateral line scales are given in Table 1. Comparative morphometric data of other closely related members of *Paretroplus* are presented in Table 3. Although members of all species of *Paretroplus* were examined, comparative data are only presented for closely related taxa as determined by parsimony analysis using both nucleotide and morphological characters. Morphological characteristics and general pigmentation pattern (preserved in 70% ethanol) can be observed in Figures 1 through 3.

Paretroplus maromandia is laterally compressed and extremely deep-bodied. Mean body depth as a percentage of standard length (SL) exceeds that of all congeneric species. Overall body shape of the

Table 2. Morphometric and meristic data of *Paretroplus maromandia* n. sp. Measurements (mm) are in percent of standard length (SL) or percent of head length (HL), unless noted otherwise.

Character	N	<i>P. maromandia</i>		Mean
		Holotype	Range	
Standard length (mm)	2	126.9	113.0-126.9	120.0
Head length % SL	2	29.3	28.9-29.3	29.1
Body length % SL	2	60.1	57.7-60.1	58.9
Snout length % HL	2	46.2	44.2-46.2	45.2
Caudal peduncle length % SL	2	6.2	6.2	6.2
Caudal peduncle width % SL	2	4.3	4.3	4.3
Caudal peduncle depth % SL	2	16.7	15.8-16.7	16.3
Caudal peduncle length/width	2	1.4	1.4	1.4
Orbit diameter % HL	2	31.5	31.5-32.2	31.8
Head width (max.) % SL	2	15.8	15.2-15.8	15.5
Upper jaw length % HL	2	28.0	27.0-28.0	27.5
Lower jaw length % HL	2	33.6	33.6-35.6	34.6
Interorbital width % HL	2	33.3	33.1-33.3	33.2
Preorbital depth % HL	2	32.8	32.8	32.8
Pectoral fin length % SL	2	20.4	20.4-21.2	20.8
Pelvic fin length % SL	2	22.4	22.4-22.9	22.7
Last dorsal spine length % SL	2	17.0	15.5-17.0	16.3
Scales in lateral line	2	41 (holotype, UMMZ 234790), 40 (paratype, AMNH 227336)		
Scales: lateral line to dorsal fin	2	7 (holotype), 8 (paratype)		
Gill rakers (lower limb)	2	10		
Vertebrae (pre-caudal + caudal)	2	16 + 18 = 34		
Dorsal fin	2	XVI 23 (holotype), XVI 21 (paratype)		
Anal fin	2	IX 15 (holotype), IX 16 (paratype)		

Table 3. Morphometric and meristic data of *Paretroplus menarambo*, *P. maculatus*, *P. petiti*, and *P. polyactis*. Measurements (mm) are in percent of standard length (SL) or percent of head length (HL), unless noted otherwise.

Character	<i>P. menarambo</i>			<i>P. maculatus</i>			<i>P. petiti</i>			<i>P. polyactis</i>		
	N	Range	Mean	N	Range	Mean	N	Range	Mean	N	Range	Mean
Standard length (mm)	18	72.1-166.8	125.3	18	48.4-148.1	106.5	18	40.7-186.8	117.0	18	49.5-183.8	125.8
Head length % SL	18	28.0-30.1	29.1	18	28.4-32.4	29.6	18	27.8-33.2	30.6	18	29.4-34.2	31.0
Body depth % SL	18	54.8-60.3	57.8	18	51.2-60.5	56.8	18	48.6-57.1	52.8	18	48.9-58.9	54.7
Snout length % HL	18	38.5-47.9	44.2	18	36.9-47.0	43.0	18	33.3-48.9	44.1	18	33.2-50.3	44.5
Caudal peduncle length % SL	18	5.7-8.8	7.1	18	5.2-7.1	6.3	18	5.1-8.6	6.5	18	6.8-10.1	8.2
Caudal peduncle width % SL	18	3.7-6.4	4.6	18	3.6-4.6	4.1	18	3.2-5.8	4.5	18	3.7-5.8	4.7
Caudal peduncle depth % SL	18	15.0-17.4	16.3	18	15.3-16.6	15.9	18	15.5-18.2	16.7	18	14.6-17.1	16.0
Caudal peduncle length/width	18	1.1-2.0	1.6	18	1.3-1.9	1.6	18	1.1-2.0	1.5	18	1.3-2.1	1.8
Orbit diameter % HL	18	27.3-32.5	30.6	18	30.3-37.6	33.7	18	26.4-39.3	31.2	18	25.0-38.5	28.7
Head width (max.) % SL	18	14.9-17.2	16.0	18	16.3-17.5	16.8	18	16.0-17.5	16.7	18	14.8-18.4	16.1
Upper jaw length % HL	18	26.4-29.4	27.9	18	26.1-29.3	27.5	18	25.7-31.3	28.2	18	24.5-29.6	28.1
Lower jaw length % HL	18	32.7-36.4	34.4	18	32.1-36.6	34.6	18	29.9-36.3	33.9	18	33.7-37.5	35.9
Interorbital width % HL	18	33.3-40.9	36.6	18	33.1-40.0	37.3	18	31.1-41.7	35.8	18	31.4-35.2	33.6
Preorbital depth % HL	18	26.8-36.5	33.3	18	27.4-34.7	31.3	18	26.3-37.6	31.7	18	22.5-34.1	30.5
Pectoral fin length % SL	18	20.7-23.1	21.7	18	20.9-24.5	22.2	18	20.1-23.0	21.5	18	20.9-24.1	22.1
Pelvic fin length % SL	18	22.4-25.2	23.8	18	22.7-25.1	24.0	18	22.1-26.3	23.5	18	19.4-23.0	21.1
Last dorsal spine length % SL	18	14.2-17.6	15.9	18	12.9-18.2	16.6	18	13.3-16.9	15.4	18	14.2-16.3	15.1
Scales in lateral line	18	37 (13), 38 (5)		18	34 (1), 35 (1), 36 (3), 37 (4), 38 (7), 39 (2)		18	36 (9), 37 (6), 38 (3), 34 (4), 35 (2)		18	31 (2), 32 (5), 33 (5),	
Dorsal fin	24	XV 19 (1), XV 20 (4), XV 21 (5), XVI 19 (3), XVI 20 (8), XVI 21 (2), XVII 19 (1)		31	XV 19 (1), XV 20 (1), XVI 16 (1), XVI 18 (2), XVI 19 (10), XVI 20 (4), XVII 17 (2), XVII 18 (6), XVII 19 (2), XVII 20 (1), XVIII 18 (1)		27	XVI 18 (3), XVI 19 (1), XVII 17 (6), XVII 18 (13), XVII 19 (3), XVIII 17 (1)		24	XVI 17 (2), XVI 18 (4), XVII 16 (4), XVII 17 (11), XVII 18 (1), XVII 15 (1), XVIII 16 (1)	
Anal fin	24	VII 17 (1), VIII 15 (5), VIII 16 (10), IX 15 (8)		31	VIII 15 (4), VIII 16 (1), IX 13 (2), IX 14 (5), IX 15 (14), IX 16 (3), X 15 (2)		27	VIII 14 (3), VIII 15 (2), IX 13 (8), IX 14 (9), IX 15 (2), X 13 (2), X 14 (1)		24	VII 14 (1), VIII 14 (4), VIII 15 (3), IX 13 (5), IX 14 (6), IX 15 (2), X 13 (1), X 14 (2)	
Gill rakers (lower limb)	18	9 (16), 10 (2)		18	10 (16), 11 (2)		18	9 (12), 10 (6)		18	11 (3), 12 (13), 13 (2)	
Vertebrae (pre-caudal + caudal)	24	15 + 17 = 32 (1), 15 + 18 = 33 (21), 15 + 19 = 34 (1), 16 + 18 = 34 (1)		31	14 + 18 = 32 (11), 14 + 19 = 33 (14), 15 + 18 = 33 (6)		27	14 + 18 = 32 (4), 14 + 19 = 33 (1), 15 + 16 = 31 (1), 15 + 17 = 32 (15), 15 + 18 = 33 (6)		24	15 + 16 = 31 (3), 15 + 17 = 32 (19), 15 + 18 = 33 (2)	
Scales: lateral line to dorsal fin	18	6 (1), 6.5 (1), 7 (13), 7.5 (1), 8 (2)		18	6.5 (1), 7 (17)		18	6 (3), 6.5 (1), 7 (14)		18	6 (13), 6.5 (1), 7 (4)	

new species is noticeably compressed caudally in comparison to congeners. A well-developed 'keel' dorsolateral to the anal fin base is present in *P. maromandia* (Figs. 1 - 3). Developed to a lesser extent in congeneric species, this 'keel' is a compressed ridge of muscle and scales. Although this condition does not appear to be an artifact of preservation, additional material must be examined before we can consider this feature diagnostic. The predorsal head profile is moderately to strongly curved, with a conspicuous interorbital bump producing a distinct concavity rostral to the orbit. The lateral snout outline is essentially straight, with an obtuse profile forming an angle of approximately 50° to horizontal. The jaws are isognathous and very short, with both the upper and lower jaws bearing tiny, fleshy papillae. The caudal margins of both the soft dorsal and anal fins are noticeably more rounded compared to congeners of similar standard length. Unfortunately, only two specimens of the new species were available for examination, thus precluding statistical comparison to other species of *Paretroplus*, for which much larger sample sizes are available.

Vertebrae.—The vertebral count is 34 for both specimens, with a formula of $16 + 18$. Among 24 specimens of *P. menarambo* examined, only a single individual was found to have 16 precaudal vertebrae, whereas two specimens had a total vertebral count of 34. All other specimens of *Paretroplus* examined were found to have 15 or fewer precaudal vertebrae, and a total vertebral count of 33 or less (Table 1). Due to the presence of several anomalous specimens, the first caudal vertebra is here defined as the most anterior vertebra bearing a fully developed hemal spine, regardless of the presence of abdominal ribs. Anomalous specimens possess both abdominal ribs and a hemal spine on the first caudal vertebra. These abdominal ribs range from reduced and feeble to fully developed.

Teeth.—Buccal dentition consists generally of widely and irregularly spaced procumbent, spatulate, unicuspid teeth, comprising a single row in both upper and lower jaws. Teeth are wide and flattened at the crown. In the upper jaw, dentition is restricted to the anterior portion of the premaxillary arcade, with two enlarged and closely set central teeth near the premaxillary symphysis, and five or six smaller teeth laterally on either side. These lateral teeth are slightly graded in size and widely set. Lower jaw teeth are not uniform in size or spacing, and are not graded laterally in size. In the holotype, seven rather small spatulate, unicuspid teeth are present on the lower jaw, whereas in the paratype there are nine similar teeth. Lower jaw teeth are not enlarged near the symphysis, and dentition is restricted to

the anterior portion of the dentary.

Gill rakers.—The first gill arch has 10 robust and rather stout gill rakers, very closely spaced along the ceratobranchial. This count excludes the elongate and generally feeble gill raker located in the angle of the arch, marking the transition from ceratobranchial to epibranchial. These ceratobranchial gill rakers are distally denticulate along the dorsal margin, and are noticeably robust proximally compared to other *Paretroplus*. The most rostral one or two ceratobranchial gill rakers are somewhat reduced. The epibranchial of the first arch has 10 elongate and slender gill rakers. These epibranchial raker counts were made on the right side to limit specimen damage.

Scales.—The body is covered with large and regularly imbricate cycloid scales from the level of the orbit to the base of the caudal fin. Scales extending posteriorly from the base of the caudal fin are reduced in size and closely set. The head is naked anteriorly from the jaws to the orbit, and also scaleless along the dorsal margin of the orbit in a narrow band. The lachrymal is completely naked. The preopercle and opercle are fully scaled, whereas the interopercle is scaled except near the rostral tip. Ventral chest scales are much smaller than the lateral body scales and tightly embedded. Lateral line scales number 40 or 41, with 30 (holotype) and 27 (paratype) scales in the upper branch, and 11 (holotype) and 13 (paratype) in the lower branch. Lateral line pores are well developed. Scales between the lateral line and the origin of the dorsal fin number seven in the holotype and eight in the paratype. Cheek scales in an oblique series, running from the ventral margin of mid-orbit to the ventral margin of the preopercle, number seven in both specimens. Both dorsal and ventral caudal fin rays are scaled well over $2/3$ their length, and up to at least $3/4$ the length of the caudal fin in the extreme dorsal and most ventral rays. Squamation extends and overlaps in one to three rows, approximately the caudal $2/3$ of the dorsal fin base, and almost the entire anal fin base, except near the origin. This squamation pattern, found in all members of *Paretroplus*, creates a ridge of scales on either side of the body into which the dorsal and anal fins may retract (Fig. 1).

Fins.—The dorsal has XVI spines and 21 (paratype) to 23 (holotype) soft rays. The anal has IX spines and 15 (holotype) to 16 (paratype) soft rays. A count of greater than 21 dorsal fin soft rays was restricted to the new species (holotype) (Tables 2 and 3). Several specimens of *P. menarambo* were examined with a maximum of 21 dorsal fin soft rays, but none possessed more than 21. The caudal fin is strongly

emarginate, with the dorsal and ventral margins lending a forked appearance to the fin. In *P. menarambo*, sister taxon to the new species, the caudal fin is more lunate, with elongate, trailing dorsal and ventral rays, and a concave, rounded caudal margin. The pelvic fins extend just past origin of the anal fin when adducted. Origin of the dorsal fin is located well posterior to a vertical through origin of the pectoral fins. In closely related congeners, origin of the dorsal fin is at about the level of pectoral fin insertion. Origin of the dorsal fin is slightly anterior to pelvic fin insertion. Caudal margins of both the soft dorsal and anal fins are rounded, and not at all pointed, for *Paretroplus* specimens of this length (i.e. > 100 mm SL; Fig. 1; Sparks, pers. obs.). The new species shares this condition only with *P. maculatus*. However, in specimens of *P. maculatus* of similar size, the caudal margin of the anal fin is noticeably more pointed than in *P. maromandia*.

Lower pharyngeal jaw and dentition.—Examination of the intact lower pharyngeal jaw (LPJ) revealed robust, enlarged unicuspid to extremely robust molariform dentition located medially on the lower pharyngeal plate. These molariform teeth are restricted centrally on the caudal half of the LPJ. Peripheral dentition consists of slender, unicuspid, and slightly curved teeth, becoming enlarged medially on the rostral half of the LPJ. These slender, unicuspid peripheral teeth are closely set, whereas the enlarged and molariform teeth are widely and irregularly set.

Color in life.—Live specimens of *Paretroplus maromandia* have localized vivid red pigmentation on the mid to lower flanks, interrupted by seven much darker gray vertical bars (Nourissat, 1998, provides a color photograph). These wide vertical charcoal-gray bars extend from the caudal margin of the opercle to the caudal peduncle, fade ventrally, and are barely discernible on the chest and belly. Overall body ground coloration is light olive, appearing darker dorsally and becoming lighter ventrally. In life, the dorsal and anal fins appear dark charcoal-gray. The caudal fin is dark gray proximally, becoming lighter at the distal margin of the fin, which is fringed in red. The pelvic fins are dark gray, and the pectoral fins appear relatively translucent. All fins, except the pectorals, have a slight reddish tinge in life.

Color in preservative.—In alcohol the red pigmentation on the flanks is lost. Base body coloration is tan, with some golden-brown hues. Overall body pigmentation is somewhat darker dorsally, becoming lighter ventrally. There are seven distinct, darker brown vertical bands on the flanks, extending from the posterior margin of the head to the caudal peduncle. These bands are darker dorsally and fade ventrally.

The cheek and opercle are light golden-brown in color. The dorsal fin is light grayish-brown, and the anal fin is a darker grayish-brown. The caudal fin is tan, similar to base body coloration, and there is a faint dark grayish-brown saddle extending from termination of the dorsal fin to the dorsal caudal fin rays. The pelvic fins are similar in color to the anal fin, grayish-brown, with a light leading edge, becoming darker posteriorly. The pectoral fins are mostly hyaline, with light tan rays. Although the red, mid-lateral flank pigmentation of *P. maromandia* fades completely in alcohol, the prominent vertical banding pattern that is retained is diagnostic of the new species.

Diet.—Based on examination of radiographs of the holotype and paratype, it appears that *Paretroplus maromandia* feeds primarily (if not exclusively) on snails, as the gut of each specimen was tightly packed with crushed shells. The presence of robust molariform pharyngeal dentition would also suggest this feeding behavior. Additional specimens collected in different seasons are needed to determine specific diet of the new species.

Habitat and distribution.—*Paretroplus maromandia* is known only from the immediate vicinity of the village of Maromandia (S: 14° 12', E: 48° 04') along the northwest coast of Madagascar (Figs. 4 and 5). The holotype and paratype were taken by fishermen working out of dugout canoes in the Maintsomalaza River (which is the local Malagasy name for the river just downstream from the confluence of the Manongarivo and Andranomalaza rivers). Collection of these specimens corresponds to the dry season in Madagascar. This tidally influenced river is wide and generally shallow near the collection locality. The water is relatively clear, with a moderate current. The substrate is mostly sand and silt, becoming exceedingly muddy in places. No aquatic macrophytes were noted in the area. Local fishermen report catches of the new species from estuaries in the area, and from the Andranomalaza River, in addition to the Maintsomalaza River (Nourissat, 1998). Based on this information the range of *P. maromandia* appears limited to estuaries and large, tidally influenced rivers in the proximity of Maromandia. Other closely related *Paretroplus* species are restricted to shallow lacustrine environments in northwestern Madagascar. Several marine/euryhaline species were collected at this locality along with the new species, representing the families Gerreidae, Sparidae, Haemulidae, Lutjanidae, Anguillidae, Leiognathidae, Sillaginidae, Mugilidae, Carangidae, and Muraenesocidae.

Coastal areas of northwestern Madagascar are relatively disturbed and degraded, given that the level terrain and rich floodplain soil are ideal for agriculture and grazing livestock. The region surround-

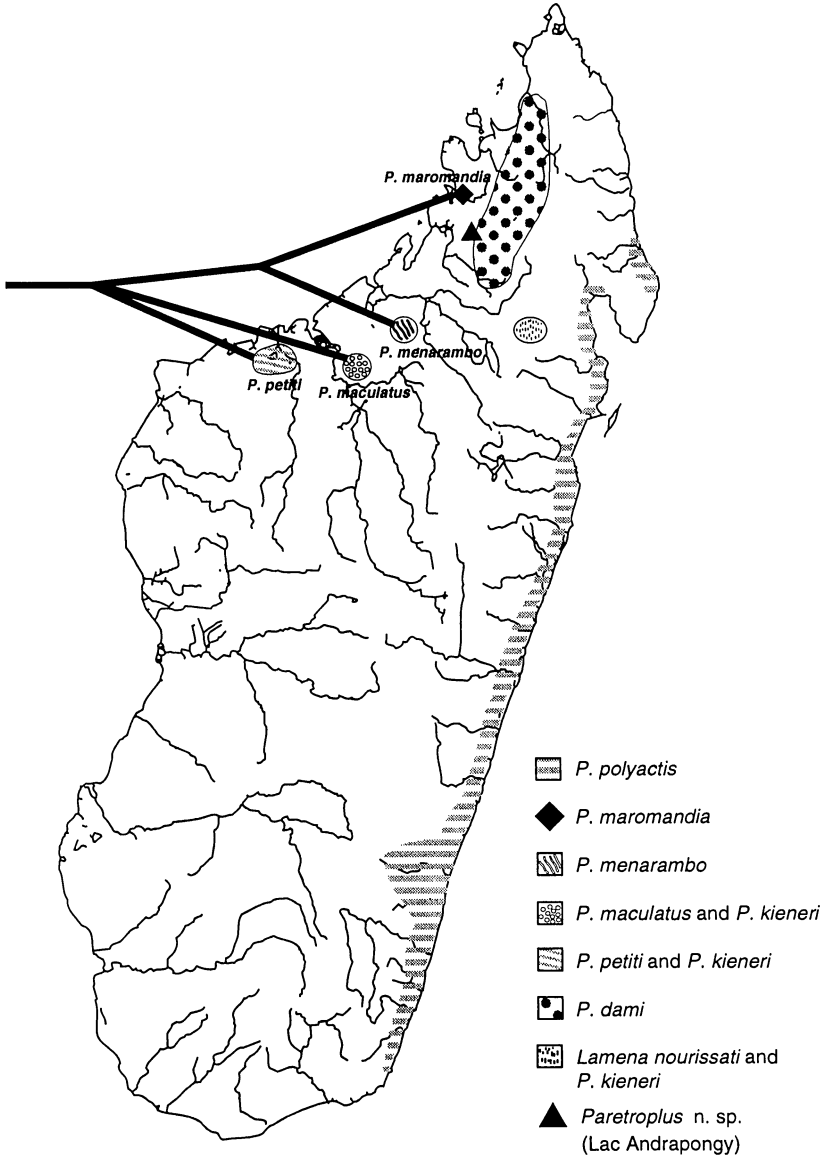


Fig. 5. Map of Madagascar illustrating current geographic ranges for members of *Paretroplus* based on localities from which specimens have been collected in recent surveys. These are only approximate distributions, as many remote areas of the island remain poorly surveyed. The cladogram superimposed on the map depicts the phylogenetic position of *P. maromandia* and its close relatives. Note, although *P. kieneri* co-occurs with both *P. petiti* and *P. maculatus*, it is not a member of the clade depicted, and its phylogenetic position is not shown.

ing Maromandia is desperately in need of ichthyological surveys, as the Tsaratanana Massif, the highest point in Madagascar (Mt. Maromakotro, 2876 m), is located just inland and slightly to the north of Maromandia. This inland region contains large sections of intact rainforest due to the steep and inaccessible terrain, with the result that the land is very unsuited for slash and burn (tavy) agriculture (Sparks, pers. obs.). The massif also creates what is referred to as the Sambirano (micro-) climate beginning immediately to the north of Maromandia. The climate near the massif and extending westward to the island of Nosy Be is much wetter than the dry western climate to the south. The Tsaratanana Massif creates a unique environment for a segment of the northwest coast of Madagascar, whereas the remainder of western Madagascar is very hot and dry in comparison. Tsaratanana has been recognized as a discrete biogeographical region by Raxworthy and Nussbaum (1995), based on extensive herpetological surveys.

Relationships.—The phylogenetic relationships discussed herein are part of a more comprehensive study of cichlid systematics, focusing on the endemic Malagasy cichlids (Sparks, unpub. data). The relationships of *Paretroplus maromandia* and its close relatives are discussed briefly so that diagnostic characters of the new species can be interpreted in a phylogenetic context. A parsimony analysis, based on morphological evidence and nucleotide characters from two mitochondrial genes (16s ribosomal RNA and cytochrome c oxidase subunit I), indicates that *P. maromandia* is most closely related to the other deep-bodied and extremely laterally compressed members of *Paretroplus*. Results of this investigation also suggest that the new species is sister taxon to *P. menarambo*, and that this species pair belongs to a well-supported clade within *Paretroplus* that also includes *P. petiti* and *P. maculatus* (Fig. 5) (Sparks, unpub. data). *Paretroplus maromandia* is diagnosed by 17 nucleotide characters, and six morphological apomorphies. Members of this deep-bodied clade are all restricted to northwestern Madagascar. As illustrated in Figure 5, each of these species exhibits an extremely localized geographic distribution, frequently occurring in only a single major body of water and the immediate vicinity.

An undescribed species of *Paretroplus*, occurring with *P. dami* in Lac Andrapongy (S: 14° 41'; E: 48° 07') (denoted by a triangle in Fig. 5), is presumably also a member of this clade. However, on a visit to that locality only a single poorly preserved (dried) specimen was available for examination. Additional material is required for both morphological and molecular studies, before the phylogenetic status of this

undescribed *Paretroplus* species can be resolved.

Conservation status.—As *Paretroplus maromandia* has only recently been discovered by ichthyologists, and given that the surrounding region is extremely poorly surveyed, very little can be said concerning the current status of this species. However, if *P. maromandia* can tolerate estuarine conditions, as suggested by habitat conditions at the type locality, this species may not be in as immediate danger of extinction as other members of *Paretroplus*, which have extremely restricted inland geographic ranges that are currently suffering from high levels of disturbance. Reinthal and Stiassny (1991) suggested that estuaries serve as refugia for native Malagasy species. The only other *Paretroplus* species occurring in coastal estuarine conditions is the relatively common and widespread, *P. polyactis*, which is found along virtually the entire eastern coast of Madagascar (Fig. 5). However, with intensive collecting efforts on the island during the last decade, the account described herein represents the first time that *P. maromandia* has been collected, suggesting that it is not only restricted in geographic distribution, but also rare where it does occur (Sparks, pers. obs.). Subsequent material has been collected from the same general locality by Nourissat (1998). Based on recent island-wide surveys and historical distribution data (Kiener, 1963; Kiener and Mauge, 1966), most members of *Paretroplus* exhibit extremely restricted geographic ranges, frequently a single general locality or body of water, are not abundant where they occur, and should be considered extremely threatened (Fig. 5).

Local Name.—Damba or damba mena (meaning red damba). Damba is the Malagasy name given to the deep bodied, laterally compressed *Paretroplus* species in the northwest of Madagascar. In addition to the new species, the name damba is used by the Malagasy people to refer to *P. maculatus*, *P. petiti*, and *P. menarambo*. All of these *Paretroplus* species are closely related, forming a well-supported clade within the genus. This Malagasy word does not appear to have any direct English translation.

Etymology.—Named for the village and general region from which the species was first collected. The Malagasy prefix maro- translates to many in English, and the Malagasy suffix -mandia means to tread on or to go on a way (= journey) in English. The epithet, *maromandia*, is used as a noun in apposition.

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