Three simultaneous and independent approaches to the characterization of a new species of *Labeo* (Teleostei, Cyprinidae) from West Africa

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A new species of *Labeo* (Cuvier, 1817) is defined and described from the Upper Niger River and Upper Senegal (Baoulé) River basins. Although it is diagnosed as a new species, there is some overlap with two other sympatric species, *L. coubie* and *L. senegalensis*, in identifying characters. This overlap is sufficient to introduce the alternative possibility that the putative new species is a hybrid. Three separate techniques were used to test the two competing hypotheses: morphological/morphometric analysis, chromosomal/enzymological analysis, and comparative parasitology. These complementary studies were carried out simultaneously but essentially independently, to minimize any scientific bias during the investigation. It was established that the three species can be distinguished by a combination of mouth morphology and meristics (notably gill raker counts). Though all three have the same chromosome number ($2N = 50$), the new species can be identified allelically by four homozygous loci that are not present in *L. coubie* and *L. senegalensis*. This genetic result indicates that the new species is sexually isolated from the other two. Also, calculations of Nei's genetic distance produce an index which is shorter between *L. coubie* and *L. senegalensis* than between either of these two and the prospective new species. All three species can be further separated by their specific monogenean gill-parasite complement: *L. coubie* (five *Dogielius* spp., seven *Dactylogyrus* spp.); *L. senegalensis* (two *Dogielius* spp., five *Dactylogyrus* spp.); *Labeo roseopunctatus* n.sp (1 *Dogielius* sp., one *Dactylogyrus* sp.). As a result of these investigations, the idea of hybridism is rejected and a formal taxonomic description of ***Labeo roseopunctatus*** n.sp. is included in this paper.

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Une nouvelle espèce de *Labeo* (Cuvier, 1817) a été trouvée dans les hauts bassins du Niger et du Sénégal (Baoulé). Quoique reconnue comme une nouvelle espèce, certains caractères se chevauchent avec ceux de deux autres espèces sympatriques : *L. coubie* et *L. senegalensis*. Ce chevauchement est d'ailleurs suffisant pour ne pas écarter le fait que cette supposée nouvelle espèce ne soit en réalité qu'un hybride des deux autres. Pour vérifier l'une ou l'autre hypothèse, trois méthodes séparées ont été utilisées : une analyse morphologique/morphométrique, une analyse chromosomique/enzymologique et une étude de parasitologie comparative. Ces trois études complémentaires ont été menées simultanément mais surtout de façon indépendante afin de minimiser au mieux tout préjugé. À partir de cela, nous avons pu montrer que chacune des trois espèces pouvait être caractérisée grâce à la combinaison de caractères morphologiques (forme de la bouche notamment) et méristiques (nombre de branchiospines essentiellement). Si les trois espèces possèdent le même nombre de chromosomes ($2N = 50$), le nouveau morphotype présente quatre loci homozygotes pour des allèles qui n'existent ni chez *L. coubie* ni chez *L. senegalensis*. Cela indique que la nouvelle forme est sexuellement isolée. De même les distances génétiques de Nei montrent qu'il existe une similarité génétique plus importante entre *L. coubie* et *L. senegalensis* qu'entre ces deux espèces et la supposée nouvelle forme. De plus les trois espèces peuvent être séparées grâce à la spécificité des Monogènes qui parasitent leurs branchies : *L. coubie* (cinq *Dogielius* spp., sept *Dactylogyrus* spp.); *L. senegalensis* (deux *Dogielius* spp., cinq *Dactylogyrus* spp.); *Labeo raseopunctatus* n.sp. (un *Dogielius* sp., un *Dactylogyrus* sp.). Les résultats de ces trois démarches nous permettent de rejeter l'idée d'un possible hybride ce qui nous permet de donner la description de ***Labeo roseopunctatus*** n.sp. dans cette note.

Introduction

Revisions by Jégu and Lévêque (1984), Lévêque and Daget (1984), and Reid (1985) indicate that there are seven species of *Labeo* in western Africa. Three are recognized from the Sahelain zone: *L. coubie* Rüppell, 1832, *L. parvus* Boulenger, 1902 (= *L. ogunensis* Boulenger, 1910 sensu Reid 1985), and *L. senegalensis* Valenciennes, 1842.

Following a detailed macroscopic examination of fishes of the genus *Labeo* (Cuvier, 1817) from the Baoulé River (Upper Senegal basin in Mali) (Fig. 1), several specimens were identified as being distinct from *L. coubie* and *L. senegalensis*.

Compared with sympatric *L. senegalensis*, these specimens have darker pectoral, pelvic, and anal fins, and five or six rows of pink–orange spots on either side of the lateral line. Other diagnostic characters were evident, such as the number of scales above the lateral line and the form of the suckerlike lips, which more closely approach those of *L. coubie*. In fact, the newly recognized form looks like *L. coubie* with the general pattern and silver coloration of *L. senegalensis*. As a result, we first thought that these specimens were hybrids of *L. senegalensis* × *L. coubie*. However, we continued to catch this type of fish in subsequent years at the same site, as well as at other localities in the Baoulé and Niger rivers. We surmised, therefore, that we could be dealing with a new species.

Because the morphological data were inconclusive, we used three additional techniques to determine whether these specimens belonged to a new species or represented a hybridization: examination of branchial parasitic monogeneans, karyotyping

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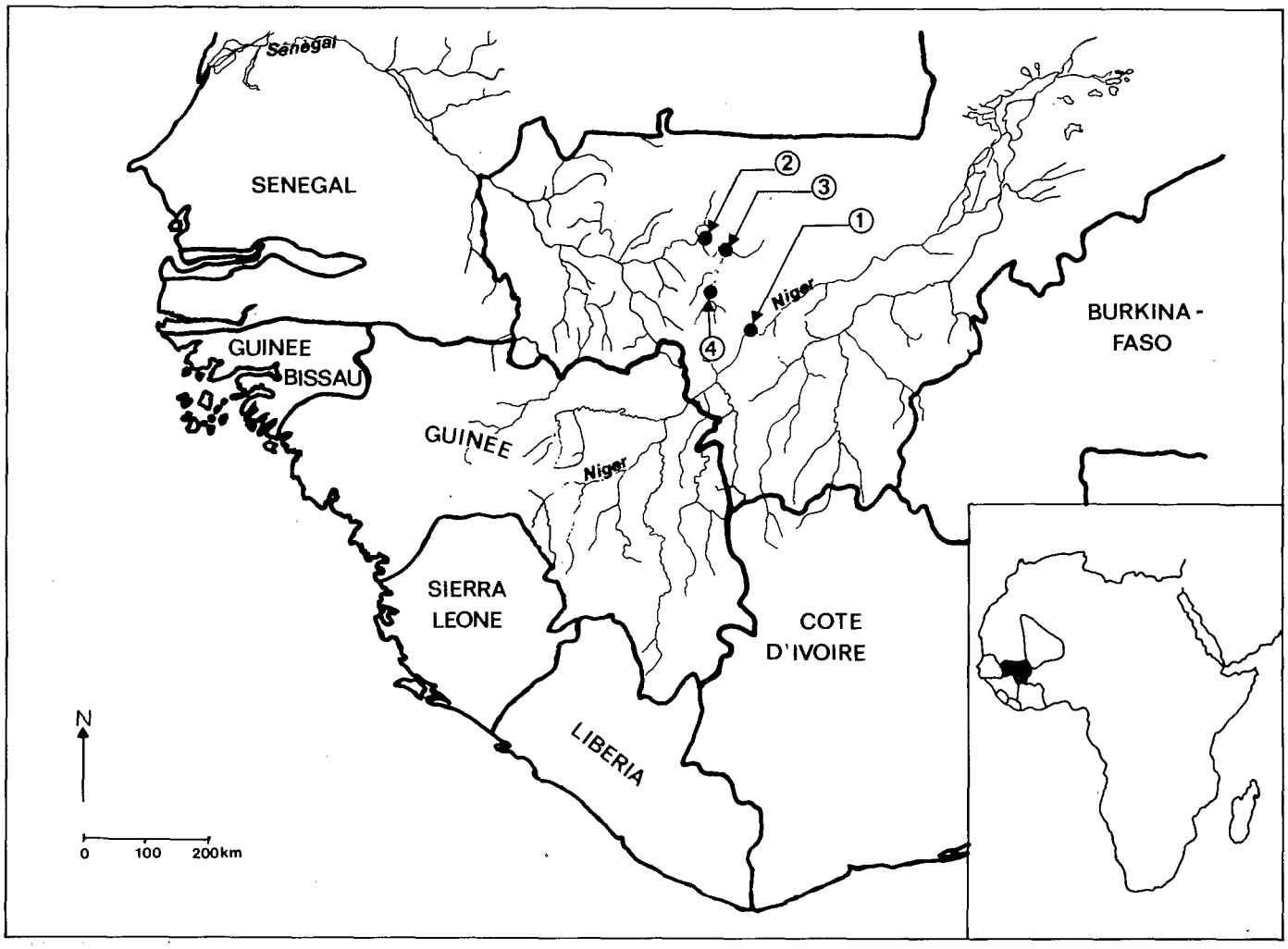

FIG. 1. Known geographical distribution of *Labeo roseopunctatus*. 1, the Niger River at Bamako; 2, the Baoulé River at Missira; 3, the Baoulé River at Konidié; 4, the Baoulé River at Dlaba.

and electrophoresis of muscle tissue. The karyotypical results were inconclusive but the parasitological and electrophoretic data indicate that the specimens represent a new species, the fourth to be recorded from the Sahelian zone.

Materials and methods

Most fish were first examined morphologically; branchial parasites were then collected and identified, and finally, pieces of muscle and liver were preserved for electrophoresis. Additional specimens were processed for the sole purpose of retrieving monogean parasites or for electrophoretic or morphological studies. The holotype and paratypes deposited in the Muséum national d'Histoire naturelle in Paris (MNHN) were, however, preserved intact. As far as possible, fishes were examined from all of the sites where they are known to occur, using all three methods of investigation.

Morphological measurements were taken with dial calipers, and coloration and (or) markings were noted for each fish. For the most effective comparison, we aimed to take measurements and counts on fishes (*L. coubie*, *L. senegalensis*, and the new species of *Labeo*) caught sympatrically.

For parasitological investigations, usually only the left gill arches were removed from the fishes to minimize damage. Following extraction, the gills were put into pipes (Eppendorf type) and frozen in liquid nitrogen. After this "field phase," the pipes were taken out of liquid nitrogen and frozen (−20°C) inside a block of ice. Samples were then transported from Mali to France in an ice chest. In the laboratory, each gill arch was washed in water and examined under a binocular microscope. Monogenea were collected, fixed, and then set between slides, using Malmberg solution (ammonium picrate and glycerin). The haptorial pieces and sclerites of the copulatory organ of the parasites were drawn via a drawing tube. The numbers and names of the haptorial pieces are those adopted during the International Congress of Parasitology (ICOPA) IV conference (Euzet and Prost 1981). Measurements of hamuli were taken via guidelines proposed by Gussev (1962). All parasite species found were described or redescribed (Guégan *et al.* 1988, 1989).

Six specimens of the putative new species of *Labeo* were collected for karyological examination from the Baoulé River at Dlaba. The captured fishes were maintained for a few days in an aquarium prior to processing. Chromosomes were prepared via the technique of De Bazignan and Ozouf-Costaz (1985), with the following modifications: fish kidney was dilacerated in the hypotonic solution, fixation times were reduced to 10 min, and all manipulations were executed at room temperature (25°C). To determine the diploid chromosome number ($2N$) for each species, well-spread metaphases were counted until consistent results were obtained.

For electrophoretic studies, specimens of each species of *Labeo* were captured in the Niger River at Bamako (*L. senegalensis*, $N = 6$; *L. coubie*, $N = 13$) and in the Baoulé River at Dlaba (*L. senegalensis*, $N = 10$; *L. coubie*, $N = 5$; new species of *Labeo*, $N = 8$) and immediately dissected. Pieces (1 cm^3) of skeletal muscle were stored in liquid nitrogen until analyzed. Homogenates were prepared, and analyzed by horizontal starch gel electrophoresis, following Pasteur

TABLE 1. Host specificity of Monogenea parasites from three sympatric species of *Labeo* in western Africa

	Labeo roseopunctatus	*Labeo senegalensis*	*Labeo coubie*	Source
Dogielius sp. 1			x	Guégan *et al.* 1989
Dogielius sp. 2			x	Guégan *et al.* 1989
Dogielius sp. 3			x	Guégan *et al.* 1989
Dogielius sp. 4			x	Guégan *et al.* 1989
Dogielius sp. 5			x	Guégan *et al.* 1989
Dogielius tropicus		x		Paperna 1969
Dogielius sp. 6		x		Guégan *et al.* 1989
Dogielius sp. 7	x			Guégan *et al.* 1989
Dactylogyrus digitalis			x	Paperna 1969
Dactylogyrus decaspirus			x	Guégan *et al.* 1988
Dactylogyrus oligospirophallus			x	Paperna 1973
Dactylogyrus retroversus			x	Guégan *et al.* 1988
Dactylogyrus titus			x	Guégan *et al.* 1988
Dactylogyrus falcilocus			x	Guégan *et al.* 1988
Dactylogyrus jaculus			x	Guégan *et al.* 1988
Dactylogyrus cyclocirrus		x		Paperna 1973
Dactylogyrus senegalensis		x		Paperna 1969
Dactylogyrus labeous		x		Paperna 1969
Dactylogyrus rastellus		x		Guégan *et al.* 1988
Dactylogyrus tubarius		x		Guégan *et al.* 1988
Dactylogyrus nathaliae	x			Guégan *et al.* 1988

et al. (1987). The gel and electrode buffer systems employed were as follows: (*i*) TC 6.7 (continuous Tris-citrate, pH 6.7) for separating adenylate kinases (AK), aspartate aminotransferases (AAT), malate dehydrogenases (MDH), 6-phosphogluconate dehydrogenases (6PGD), and superoxide dismutases (SOD); and (*ii*) TM 6.9 (continuous Tris-maleate, pH 6.9) for separating esterases (ES), glyoxalases (GLO), and malic enzymes (ME). Genetic distances between species were calculated using the Nei index (1972).

Results

Parasitological studies reveal 8 species of *Dogielius* and 13 of *Dactylogyrus* on the gills of the three sympatric *Labeo* species (Table 1). Fifteen parasites were new (7 *Dogielius* and 8 *Dactylogyrus*) and these have been described elsewhere by one of us (Guégan *et al.* 1988, 1989). Five *Dogielius* and seven *Dactylogyrus* were found in *L. coubie*. Two species of *Dogielius* and five of *Dactylogyrus* parasitized *L. senegalensis*. The new species of *Labeo* had only one species of each genus. None of the *Labeo* harboured monogenean species found in other hosts.

Karyotypic studies showed that the three *Labeo* species have the same modal diploid number, $2N = 50$ (Table 2), which, according to Vasiliev (1985), is the most common diploid number in the Cyprinidae. However, a careful study of the chromosome morphology, possibly using banding techniques, might disclose some karyologic differences.

In both *L. senegalensis* and *L. coubie*, no significant difference in allele frequencies was found between samples from the Niger or Baoulé rivers. In addition, each sample presented no deviation from the Hardy–Weinberg equilibrium. Samples of these two species were therefore pooled for comparisons with the new species of *Labeo* (Table 3). This species has four loci homozygous for alleles that do not exist in either *L. senegalensis* or *L. coubie*. This indicates that *L. roseopunctatus* n.sp. is sexually isolated. It is also well differentiated genetically from the other two species, as shown by Nei's genetic distances: $D = 0.453$ between *Labeo roseopunctatus* n.sp and *L. senegalensis*; $D = 0.645$ between *Labeo roseopunctatus* n.sp and *L. coubie*; and $D = 0.227$ between

TABLE 2. Frequency distribution of diploid chromosome counts in well-spread metaphase cells of three species of *Labeo*

	2N							
	46	47	48	49	50*	51	52	Total
L. roseopunctatus		1	2	1	15			19
L. senegalensis	1		1	1	24	1		28
L. coubie		1	1		14		1	17

*Fundamental number.

TABLE 3. Allele frequencies observed on 13 loci of three sympatric species of *Labeo* from West Africa

Locus	Allele	*Labeo roseopunctatus*	*Labeo senegalensis*	*Labeo coubie*
Aat	110	1	0	0
	120	0	1	1
Ak	100	1	0	0
	110	0	1	1
Es	100	1	1	1
Glo	100	0	1	0.50
	120	1	0	0.50
Ldh-1	100	1	1	1
Ldh-2	100	1	1	0.88
	105	0	0	0.12
Mdh-1	100	1	1	1
Mdh-2	100	1	1	1
Me	90	0	1	0
	110	1	0	1
6Pgd	95	0.50	0.50	1
	100	0.50	0.50	0
Pt-1	80	1	0	0
	100	0	0	1
	110	0	1	0
Pt-2	100	1	1	1
Sod	90	1	0	0
	110	0	1	1

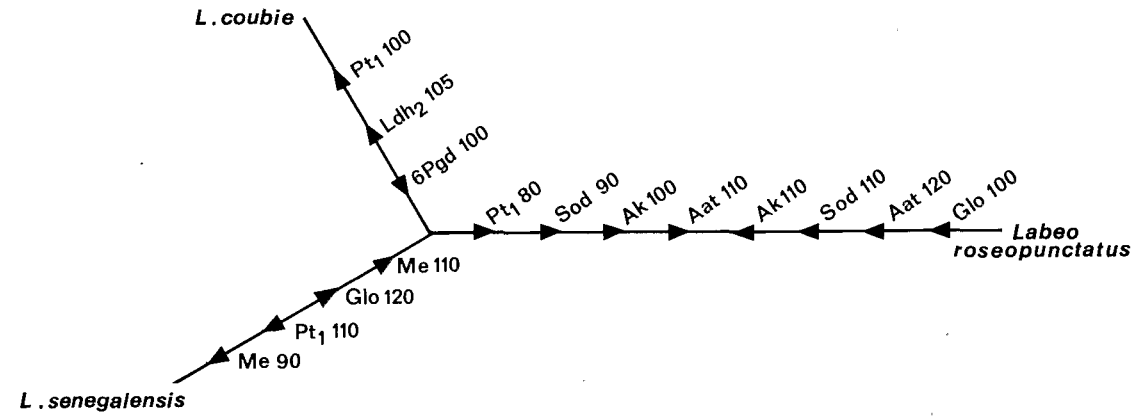

FIG. 2. Unrooted tree using the 15 alleles which are absent in at least one species. For each allele, the arrow points toward the species in which it was observed.

L. senegalensis and *L. coubie*. This indicates stronger genetic similarity between *L. senegalensis* and *L. coubie* than between these two species and *Labeo roseopunctatus* n.sp. This is further confirmed by an unrooted tree based upon 15 alleles absent in at least one species (Fig. 2).

Discussion and interpretation

According to Bykhowsky (1957), 74% of known species of Monogenea are found in a single host species. Most of the remaining 26% may be complexes of host-specific parasites difficult to identify by means of morphological characters. Euzet and Combes (1980) define three categories of host specificity: (*i*) strict specificity (oioxen): a parasite species living only in one host species; (*ii*) narrow specificity (stenoxen): a parasite species living in several host species having close phyletic relationships; (*iii*) wide specificity (euryxen): a parasite species living in host species with ecological similarities rather than any demonstrated systematic affinities.

Euzet and Suriano (1977, cited in Euzet and Combes 1980) described 12 species of *Ligophorus* (Ancyrocephalidae) parasitizing five species of Mugilidae in the Mediterranean Sea. The strict specificity of these parasites to their respective hosts was evaluated by determining infestation of *Liza aurata* with oncomiracidia (larvae) or eight species of *Ligophorus*. Results show that tests are positive only for specific parasites of *L. aurata* (Euzet and Combes 1980). Recently, Euzet *et al.* (1988) showed a total agreement between parasitological and genetic investigations on *Chrysichthys*, using a double-blind study. They found platyhelminths to be good "biological tags" of *Chrysichthys* species, as are the allozymes. In their studies on the Monogenea of European cyprinid fishes, Lambert and Romand (1984) identified *Dactylogyrus* species having oioxenic versus stenoxenic specificity, which seemingly indicates a narrow phyletic relationship between their hosts. Dupont and Crivelli (1988) showed that the natural hybrid *Alburnus alburnus* × *Rutilus rubilio* of Lake Mikri Prespa (northern Greece) was parasitized almost exclusively by the parental *Dactylogyrus*. It follows that *Dactylogyrus* are excellent "biological markers" of hybridization.

In our studies of sympatric Cyprinidae in western Africa, the strict specificity of *Dogielius* and *Dactylogyrus* is confirmed. This oioxenic specificity, defined according to Euzet and Combes (1980), of *Dogielius* sp. 7 and *Dactylogyrus nathaliae* allows us to easily separate *Labeo roseopunctatus* n.sp. from *L. coubie* and *L. senegalensis*. Moreover, *Labeo roseopunctatus* n.sp. has a low number of monogenean species compared with the other two species. The difference in parasitic richness alone is not, however, sufficient as a criterion for specific diagnosis. So, in a paper in preparation, we propose a hypothesis that may explain this heterogeneity of Monogenea which has also been observed in other African fishes (Birgi 1987).

Mayr (1974) questioned the value of parasite specificity as a diagnostic criterion for any host species. He did distinguish, however, between two *Octopus* species (Cephalopoda) through specific Dicyemidae. In the previous example, as well as in our model comparing the three sympatric species of *Labeo*, the strong host specificity of parasites is likely a reflection of the absence of gene exchange between reproductively isolated host taxa. The initial hypothesis considering the new *Labeo* species as a hybrid of *L. coubie* × *L. senegalensis* is rejected, in part because it has its own specific parasites. We consider the new species of *Labeo* to be a valid species, characterized by its two specific Dactylogyridae, *Dogielius* sp. 7 and *Dactylogyrus nathaliae*.

From the genetic data on the three *Labeo* species, we conclude that *Labeo roseopunctatus* n.sp. is sexually isolated from *L. coubie* and *L. senegalensis*. A phenetic approach (examining genetic distances and allelic characters), indicates that *L. coubie* and *L. senegalensis* are phylogenetically related, having a common ancestor that they do not share with *L. roseopunctatus*.

As indicated above, we had some doubts about the status of the new *Labeo* species, and initially considered it to be a hybrid of *L. coubie* × *L. senegalensis*. Certainly, this "new form" shares a few characters with the other two species. Faced with the difficulty of providing a trenchant morphological answer, we decided to employ other approaches. We chose to utilize genetics and parasite specificity as complementary "diagnostic tools." These two independent approaches support the same conclusion, namely that our doubtful *Labeo* is in fact a valid new species.

Description of *Labeo roseopunctatus* n.sp. (Fig. 3)

Measurements were taken on 14 specimens (13 from the Baoulé River and one from the Niger River). Gill rakers were counted on seven additional specimens from these two rivers (SL, standard length; TL, total length).

HOLOTYPE: MNHN No. 1989-97, 137.5 mm SL (183 mm TL). Baoulé River (Upper Senegal) at Missira (Mali), 84-12-05, collected by D. Paugy.

PARATYPES: MNHN No. 1989-98, 7 specimens (113–203 mm SL). Baoulé River (Upper Senegal) at Missira (Mali), 84-12-05, collected by D. Paugy; MNHN No. 1989-99, 3 specimens (111–119 mm SL). Baoulé River (Upper Senegal) at Konidié (Mali), 84-12-07, collected by D. Paugy; MNHN No.

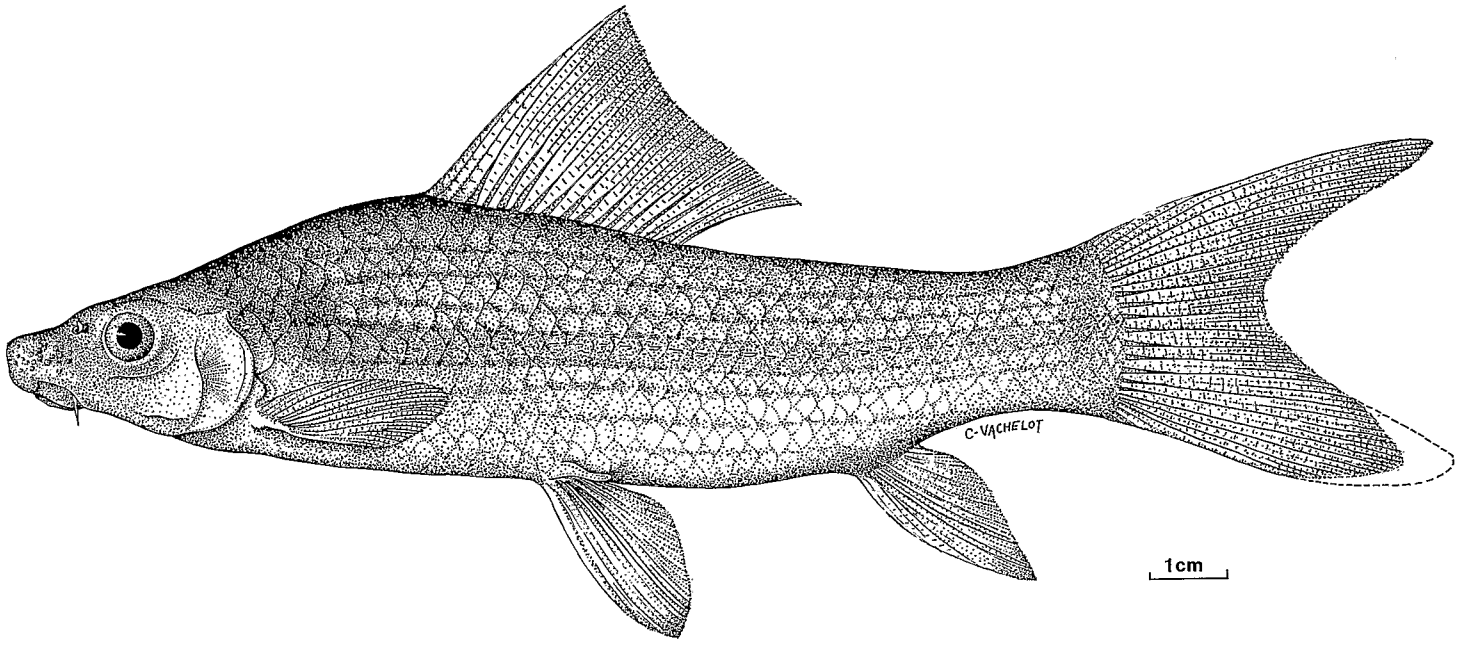

FIG. 3. *Labeo roseopunctatus* n.sp. Holotype from the Baoulé River (Upper Senegal) at Missira (Mali) (MNHN No. 1989-97).

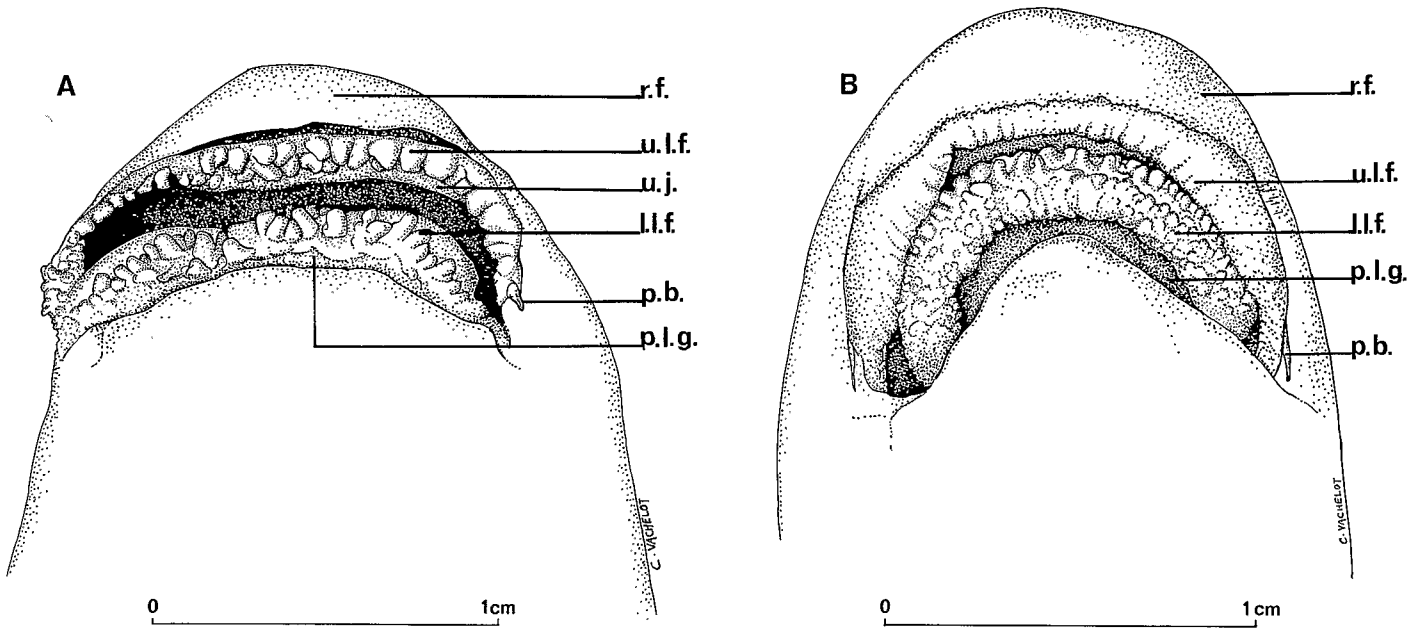

FIG. 4. Generalized view of ventral mouth region of two African *Labeo* species. (A) *L. niloticus*-group (*L. senegalensis*): (B) *L. coubie*-group (*L. roseopunctatus*). *l.l.f.*, lower labial fold; *p.b.*, posterior barbel; *p.l.g.*, postlabial groove; *r.f.*, rostral flap; *u.j.*, upper jaw; *u.l.f.*, upper labial fold.

1989-100, 2 specimens (123–135 mm SL). Baoulé River (Upper Senegal) at Dlaba (Mali), 88-03-31, collected by D. Paugy; MNHN No. 1989-101, 1 specimen (115 mm SL). Niger River at Sotuba near Bamako (Mali), 85-01-31, collected by D. Paugy. Morphometric measurements and meristic counts are given in Table 4.

The inner surface of the upper lip (labial fold) bears transverse folds (Fig. 4B). There are no papillae on the upper lip border in either young or adult specimens. A pair of short posterior barbels is more or less covered in a fold situated on the lateral border of the mouth. Anterior barbels seem to be absent. The head is approximately twice as long as it is wide. Head length is equal to that of the dorsal fin base. The dorsal fin in straight or convex and is situated just in front of the pelvic fins, which are inserted in the middle of the body (standard length). The caudal peduncle is deeper than it is long, except in young specimens (SL ≤120 mm), in which we observed the contrary (see Table 4). The number of gill rakers increases with body length (Fig. 5).

Coloration

In life the color is silvery, bright, bronzy or greenish above and silvery white beneath. Scales, situated in five or six rows on either side of the lateral line are coloured with salmon-pink –

TABLE 4. Comparison of morphometric, meristic, and color characters of three sympatric species of *Labeo* from West Africa

	L. roseopunctatus holotype	*L. roseopunctatus* paratypes (n = 13)		*L. coubie* (n = 8)		*L. senegalensis* (n = 6)	
		Range	Avg.	Range	Avg.	Range	Avg.
% standard length							
Body depth	27.20	25.56–30.30	27.80	28.79–33.29	30.42	26.18–28.99	27.17
Head length	24.29	22.16–26.87	24.58	25.11–29.08	27.16	23.39–25.00	24.14
Dorsal fin length	25.09	22.59–27.34	25.25	22.42–29.24	25.44	24.21–27.63	25.36
Predorsal distance	41.60	38.92–44.64	41.98	41.47–46.39	43.77	43.39–45.19	44.16
Prepelvic distance	50.84	46.97–53.44	50.33	49.18–54.12	52.76	49.62–52.61	51.54
Preanal distance	79.35	75.57–80.91	78.26	76.90–80.61	78.95	76.18–81.55	79.58
Longest dorsal fin ray	26.55	24.24–32.69	27.16	32.60–35.63	34.60	26.34–32.82	29.61
% head length							
Head width	57.19	57.47–63.90	58.38	54.75–66.03	59.62	54.44–61.88	58.20
Interorbital distance	41.32	39.58–46.65	42.03	42.74–53.62	47.13	40.40–47.43	44.43
Snout length	44.01	38.89–44.28	41.75	42.32–52.70	45.98	37.16–46.11	40.90
Postorbital distance	42.81	37.99–44.44	40.76	37.45–42.41	39.64	37.16–40.61	39.10
Eye diameter	20.06	19.87–24.07	22.55	15.98–23.57	19.86	21.39–24.32	23.02
Dorsal fin length	103.29	85.20–119.02	103.16	80.52–110.52	93.93	98.06–117.76	105.14
Longest dorsal fin ray	109.28	64.56–130.21	110.29	121.58–135.31	127.80	105.45–139.89	122.87
% head width							
Eye diameter	35.08	31.29–44.81	38.82	25.07–43.06	33.59	34.85–42.35	39.60
% snout length							
Interorbital distance	93.88	90.34–108.70	100.77	81.10–125.91	103.21	93.98–121.32	109.13
Postorbital distance	97.28	87.74–108.47	97.78	74.80–99.60	86.59	85.54–103.54	95.98
Eye diameter	45.58	44.88–61.90	54.19	30.31–53.45	43.51	46.39–65.44	56.69
% interorbital distance							
Eye diameter	48.55	42.59–60.75	53.84	30.87–50.41	42.36	45.32–58.33	51.97
% postorbital distance							
Interorbital distance	96.50	93.75–111.61	103.23	108.42–126.42	118.84	109.86–121.32	113.72
Eye diameter	46.85	42.59–60.75	55.46	39.02–62.00	50.30	54.23–65.44	58.97
% predorsal distance							
Dorsal fin length	60.31	51.87–67.78	60.26	50.35–66.91	58.21	54.73–62.55	57.42
% prepelvic distance							
Predorsal distance	81.83	79.61–93.69	83.43	80.00–87.35	82.97	83.52–87.44	85.71
% preanal distance							
Predorsal distance	52.43	51.16–57.79	53.62	52.93–58.17	55.43	53.69–58.80	55.54
Prepelvic distance	64.07	61.68–68.04	64.31	62.76–69.72	66.83	61.43–67.46	64.79
% longest dorsal fin ray							
Predorsal distance	94.52	79.73–104.07	92.87	63.61–85.84	74.72	77.04–97.41	86.06
% caudal peduncle length							
Caudal peduncle depth	104.40	86.34–119.64	101.61	98.52–125.42	116.64	101.58–134.52	115.99
Scales around caudal peduncle	16	16		16–18		16	
Lateral-line scales	40.00	38–40		37–38		37–39	
Scales above lateral line	$7\frac{1}{2}$	$7\frac{1}{2}$		$6\frac{1}{2}$		$6\frac{1}{2}$	
Scales under lateral line	$7\frac{1}{2}$	$7\frac{1}{2}$–$8\frac{1}{2}$		$7\frac{1}{2}$–$8\frac{1}{2}$		$6\frac{1}{2}$	
Gill rakers on 1st epibranchial		11–17		11–18		10–19	
Gill rakers on 1st ceratobranchial		33–50		36–49		42–65	
Dorsal fin rays	IV–14	IV–14–15		IV–12		IV–13	
Color							
Body	Silvery bright	Silvery bright		Dark–dull		Silvery bright	
Spots on scales	Salmon-pink/orange	Salmon-pink/orange		Purple/orange		absent	
Stripes	Dark	Dark		Absent		Dark	
Fins	Greyish	Greyish		Blackish		Pink	

orange spots. The border of these scales is darkened with melanophores. Along the sides of the body are dark longitudinal lines. The dorsal fin is brownish pink, the caudal fin is wine colored – pinkish, the anal fin is also pinkish but less so than the caudal fin, and the pelvic and pectoral fins are dark pink or slightly orange. There is a pale humeral spot and another spot at the end of the caudal peduncle just before the fin (this mark is clearer on young fishes).

In preserved specimens the color is more uniform and duller because of the loss of the colors present in life. Nevertheless, the dark longitudinal stripes persist. All the fins become more or less pale greyish in colour. A 1 cm wide dark stripe appears along the lateral line as a preservation artefact. The orange spots on the scales disappear entirely.

Etymology

The name *roseopunctatus* characterizes the coloration of this new species when alive; it has lines of pink–orange (*roseo*) spots (*punctatus*) on scales situated on both sides of the lateral line.

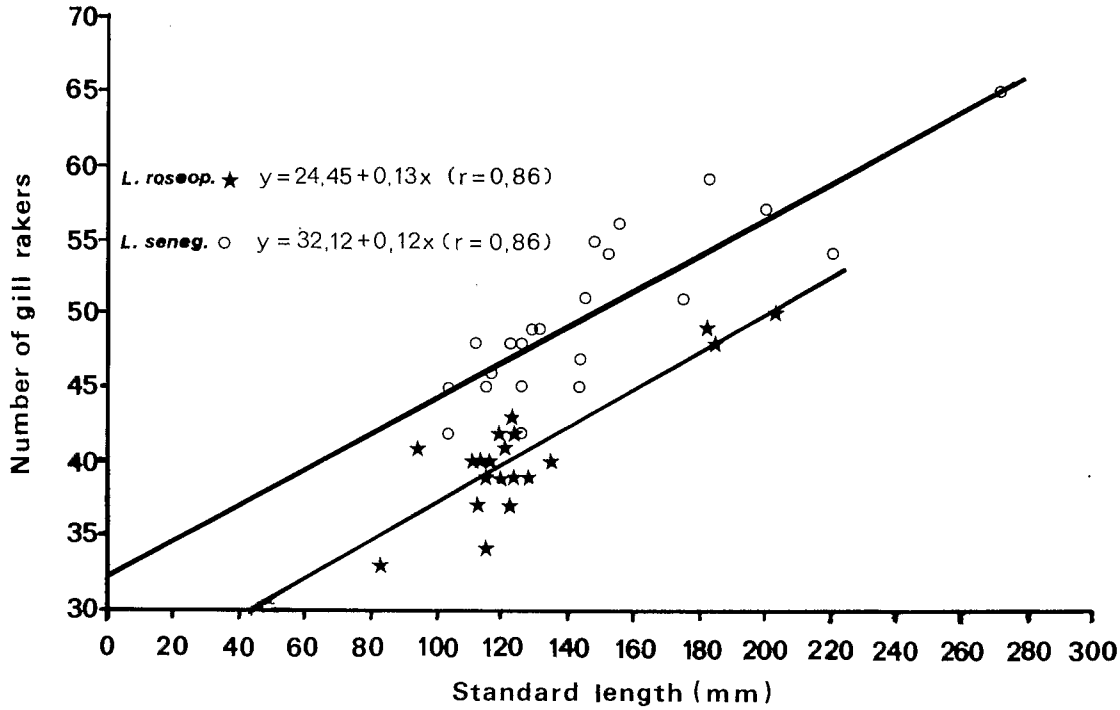

FIG. 5. Positive correlation between the number of gill rakers on the lower part of the first arch and standard length for *Labeo roseopunctatus* and *L. senegalensis* from western Africa.

Affinities

At first glance, *L. roseopunctatus* may be mistaken for *L. senegalensis* because of its silvery color. However, in contrast to *L. senegalensis*, *L. roseopunctatus* has no papillae on the upper labial fold, and its inner surface has well-developed transverse striae or "costae" which are not present in *L. senegalensis*. In this character, *L. roseopunctatus* is allied with the *L. coubie*-group in opposition to the *L. niloticus*-group to which *L. senegalensis* belongs (Fig. 4) (Reid 1985). All specimens of *L. roseopunctatus* observed have the transverse scale count formula $7\frac{1}{2}/7\frac{1}{2}$–$8\frac{1}{2}$. Under sympatric conditions all *L. senegalensis* and *L. coubie* have transverse scale count formulae of $6\frac{1}{2}/6\frac{1}{2}$ and $6\frac{1}{2}/7\frac{1}{2}$–$8\frac{1}{2}$, respectively. *Labeo roseopunctatus* has a greater number of dorsal fin rays (IV-14–15) than *L. senegalensis* (IV-13) and *L. coubie* (IV-12). It also has a lower number of gill rakers and *L. senegalensis* (Fig. 5). While pattern of the salmon-pink – orange spots on the flank scales resemble that in some *L. coubie* specimens, the general delineation is closer to that of *L. senegalensis*. Furthermore, the fin coloration is intermediate between that of *L. senegalensis* (pink) and *L. coubie* (dark grey). Finally, we did not compare our new species with *L. niloticus* (which also sports a similar color pattern) because, according to Reid (1985), this species occurs only within the Nile River basin, records from West Africa being considered dubious.

We should caution about some meristic variations reported in the literature for *L. senegalensis*. It is possible that previous reports of *L. senegalensis* were based on mixed samples of *L. senegalensis* and *L. roseopunctatus*, especially where preserved specimens were involved.

Information about the ecology of *L. roseopunctatus* is rather limited. The species apparently has a preference for rocky substrates in deep and quiet water. It seems that the maximum length reached by *L. roseopunctatus* is less than that of *L. senegalensis* and *L. coubie*. We have captured mature specimens, which allows us to affirm that reproduction takes place during the wet season (August to September).

Key to *Labeo* from Niger River and Senegal River basins

1. 12–14 scales around the caudal peduncle ..... *L. parvus*
   16 scales around the caudal peduncle 2
2. Labial fold with papillae and with its internal surface smooth, save at the angles to the jaw ..... *L. senegalensis*
   Labial fold without papillae but with the internal surface having transverse ridges or costae 3
3. Preserved coloration uniformly dull and dark, fins uniformly grey; IV-12 dorsal fin rays ..... *L. coubie*
   Preserved coloration uniformly bright and pale, fins brownish pink; IV-14–15 dorsal fin rays ..... *L. roseopunctatus*

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