

Scheel, J.J. (1972): The killifishes of Rio Muni. -Adv.Aquar.Mag. [AAM] Atlanta (8): 6-8.

THE KILLIFISHES of RIO MUNI

By Joergen J. Scheel, Reprinted from ANCHOR, May, 1972

Rio Muni, formerly Guinea Continental Espanola, makes together with the islands of Fernando Poo, Annobon, Corisco and some other small Islands the present Republica de Guinea Ecuatorial. Rio Muni comprises the major portion of this country although it measures only 26,000 square-kilometers. It is situated just north of the Equator, north of Gabon and south of East Cameroon. The climate is hot and humid and most parts of the country are covered by forests. The majority of the soils of Rio Muni belong to the basement complex with granites in the east and south and gneiss in the western and northern part. The sedimentous soils, so important for certain types of freshwater fishes in this part of Africa are almost absent in the area around Bata (the capital of Rio Muni) and are rather limited in the north western and south western parts of the country. I measured the total hardness, temporary hardness and pH in eleven localities in the western part of the country and I was much surprised to realize that the freshwaters, up to 20 kilometers east and south of Bata, were rather alkaline and quite different from what should be expected on the basis of the geological map (Bosquejo Geologico de la Guinea Continental Espanola; 1:400,000; J. de Lizaur, 1946). Indeed the freshwaters near Bata by their composition resemble the waters of the volcanic soils in Fernando Poo (see ANCHOR, Vol. II, No. 9, September, 1968 for Col. Scheel's article "The Killifishes of Fernando Poo") and in West Cameroon. Geological maps do not indicate the presence of volcanic soils in Rio Muni. I found a total hardness 1 to 3.5, temporary hardness up to 12.5, and pH often above 7.6 near Bata. In these alkaline waters I found almost no fishes and no killifishes at all. Further inland and southwards from Bata I found more normal waters with total hardness from zero to about half a degree and pH 5.6 to 6.5 and in these waters I found the killifishes I was searching for.

Since Boulenger published his famous catalogs, in 1915-16, there appear to have been no reports concerning fishes from Rio Muni. I have hesitated to write about my results because I was informed that Dr. Benigno Roman, Director de la Estacion de Investigaciones Marinas de Margarts, Venezuela, was about to prepare a review of the fishes of Rio Muni. Roman's book (296 pages, 118 figures, 13 in colour) now has been published, in Barcelona, Spain, and a review of the killifishes of Rio Muni is possible.

I visited Rio Muni early in 1968 to study the distribution of killifishes and to delimit the geographical distribution of Aphyosemion bivittatum, the major object of my biological study of cyprinodont fishes. Only three days were available for fishing.

Three major faunas of cyprinodonts are represented in Rio Muni, i.e., the fauna of the island plateau, with five major phenotypes, and the northern (Nigerian) and the southern (Gabonian) faunas of the western lowland, with six and eight major phenotypes respectively. Four major phenotypes (zoological species or superspecies) are common to the two faunas last mentioned. The delimitation of these three faunas is not quite distinct, however. They grade into each other in certain geographical areas.

The fauna of the inland plateau has four phenotypes of Aphyosemion, one of Aplocheilus (Epiplatys) and nil of procatopodines in Rio Muni. The corresponding fauna of East Cameroon has one less phenotype of Aphyosemion and one more of procatopodins.

Aphyosemion cameronsense (Boulenger) is endemic to the forests of Central Africa. It does not occur west of the Cameroon Mountains. From East Cameroon two subphenotypes have been reported. The nominal phenotype seems to be restricted to the forests south of the Nyong River being replaced north of this river by A. obscurum (Ahl). The latter seems to be absent in Rio Muni, but a very similar phenotype occurs in northern Gabon. I found the nominal phenotypes very close to the coast in Rio Muni. Live material from two populations (EC: Rio Ecucu, 37 kms from the coast and BE: Rio Benito, 53 kms from the coast) was brought to Copenhagen. Hybrids were feeble and sterile. The two strains differed by the colour of the dorsal fin. The upper part of this fin was a deep orange to golden in both sexes of the EC and uncoloured in the other strain. The chromosome complement with seventeen haploid elements appeared to be similar in the two populations. The nominal phenotype also occurs in northern Gabon according to Lambert & Gery (1967).

Aphyosemion exiguum (Boulenger) undoubtedly occurs in Rio Muni, in the eastern part of the country at least. I took it right up to the border of Rio Muni in southern Cameroon in 1966. Roman reported this phenotype from Rio Muni, but the locality appears to fall outside the natural range of A. exiguum and the specimens may belong to A. ahli, which is rather similar. A. exiguum occurs in northern Gabon (Lambert & Gery, 1967).

Aphyosemion batesii (Boulenger) lives in swamps in East Cameroon and is replaced by the very similar A. splendidum (Pellegrin) in similar biotopes of the inland plateau in northern Gabon and in the adjacent parts of Brazzaville Congo. Roman reported three specimens from Ebeyin of north eastern Rio Muni. These specimens differ rather much from Cameroonian A. batesii by meristics: D. 11-12, A. 13-14, Sq-I. 30-31 versus D.14-17, A. 16-18, Sq-I. 32-35 in twenty-four specimens from East Cameroon. These counts are even higher in A. splendidum, i.e., D. 15-18, A. 16-19, Sq-I. 34-39 according to Lambert & Gery and my own study of the types. Roman's specimens appear to belong to a third and unnamed component of the A. batesii group.

Aphyosemion species: Roman reported an unidentified species of the genus Aphyosemion from the central part of extreme eastern Rio Muni (Mongomo, Rio Kie). D. 12-14, A. 14-17, Sq-I. 30-33. The male resembles those of A. gardneri and A. calliurum and has a submedian red band in the anal fin and a row of large red spots just below the root of that fin. Roman's fish may be identical with the one reported from Garabinzam, Brazzaville Congo by Lambert & Gery under the name A. calliurum ahli.

Aplocheilus (Epiplatys) sangmelinensis (Ahl) inhabits the forests of the inland plateau in East Cameroon and a very similar form was identified as A. (E.) ansorgii (Boulenger) by Lambert & Gery from northern Gabon. Roman reported this phenotype from two affluents of the Ntem River in north eastern Rio Muni.

There are no reports of procatopodine forms from eastern Rio Muni and northern Gabon. One small form which resembles Aplocheilichthys normani Ahl is rather common on the inland plateau in East Cameroon and may be present also in the eastern Rio Muni. This form is undescribed presently.

Some of the phenotypes of the rich fauna of killifishes of the Niger delta in southern Nigeria expand eastwards and southwards into the Cameroon's and some reached Rio Muni, Gabon and the Congo.

Aphyosemion bivittatum (Lönnerberg) ranges from southern Togo to Rio Muni. In Togo, Dahomey and Nigeria the populations are restricted to the soils of the sediments, being replaced on the soils of the basement complex by A. gardneri (Boulenger). In the Cameroons this major phenotype lives on all types of soil, but A. gardneri and its allied forms are absent. In southern Cameroon most populations are found on the basement complex. (The sedimentous soils are reduced to a narrow rim very close to the coast.) These populations and those of Rio Muni belong to the A. loennerbergi (Boulenger) subphenotype. The nominal subphenotype which ranges from Togo to the Kribi area of East Cameroon differs from the A. loennerbergi subphenotype by the pattern of red pigments of the anal fin of males. In A. bivittatum there is one row of red spots just below the root of this fin and a submarginal red band. In the A. loennerbergi male the whole anal fin is covered by a regular pattern of red spots or, more often, short vertical streaks. A similar pattern develops, however, in males of the unnamed subphenotype which lives on the alkaline volcanic soils in West Cameroon. I brought back, from the Rio Muni, live material from the Eucu River and from the Benito River. In the river first mentioned A. loennerbergi was sympatric with A. camerunense and not with A. calliurum, its usual partner in Nigeria and the Cameroon's. Such mixing of elements of the inland and the coastal faunas occurs also in some parts of East Cameroon (Eseka area) where A. obscurum lives together with populations of A. bivittatum which are rather intermediate to the A. loennerbergi and A. riggenbachi subphenotypes. My two strains of A. loennerbergi from the Rio Muni differed markedly by the chromosome complements. The EC population had thirteen, the BE population seventeen haploid elements. Hybrids were completely sterile in both sexes. The BE population lives south of the Rio Benito and seems to be the southernmost population of A. bivittatum in Africa. Like the other subphenotypes of A. bivittatum, A. loennerbergi is composed of a number of zoological species (sibling species) which cannot be separated on the base of the phenotype and my EC and BE strains represented two of these zoological species.

Aphyosemion calliurum (Boulenger) ranges from southwestern Nigeria to the Lower Congo and in the northern part of its range it usually lives together with A. bivittatum and the other components of the

Nigerian fauna of the lowlands. In Nigeria it is restricted to the sedimentous spoils being replaced on the basement complex by A. gardneri. In the Cameroons, it follows A. bivittatum and inhabits the soils of the basement complex and the alkaline volcanic soils. The known populations of East Cameroon and Rio Muni belong to the A. pascheni (Ahl) subphenotype, which differs from the other subphenotypes by the thin vertical red or brown lines on the hindmost part of the side. These lines may be absent in some males of a given population and are often absent in females. In most populations the anal fin has a submarginal red band which separates the golden, yellow or white colour of the edge from the dark colour of the upper part of the fin. The lightly collared margin is very narrow in males from Rio Muni and, by this trait, these males resemble the hybrid from crossings of the southern A. australe to Cameroonian strains of A. pascheni which was attached to specimens from Longji, north of Kribi. I have kept specimens from the type locality and they agree with A. ahli by the phenotype. The A. pascheni subphenotype of A. calliurum is composed of a large number of zoological species with different chromosome complements. Even in a restricted part of the western lowlands of East Cameroon the haploid number varies between ten and twenty and several intermediates are known. My Rio Muni material originated from the area north of the mouth of the Rio Benito and had thirteen chromosomes. Hybrids with Cameroonian strains and with A. australe were sterile. In Gabon, the A. calliurum group is represented by A. australe, but the group appears to be absent in the lowlands of Rio Muni south of the Rio Benito, and to be replaced by the phenotype next to be mentioned.

Aphyosemion striatum (Boulenger) was described from the Abanga River, a northern affluent of the Ogowe. Roman referred his material from the western lowlands of southern Rio Muni to A. s. ogoense (Pellegrin), a fish from southern Gabon and the Congo. The A. ogoense phenotype is well known to aquarists and was introduced into the United States in 1961 by La Corte. First the name A. lujae was attached to it, later on the name A. striatum also was used. La Corte's fish originated from the Central Congo, more than 1,000 kilometers from southern Rio Muni. Roman figured the male in color and his fish appears to correspond to La Corte's fish in most details. Roman's fish also corresponds to A. escherichi (Ahl) from Attogondama, just south of Rio Muni. The latter name is older than the name A. ogoense and may be the right name for Roman's fish, if it is different from A. striatum. The "striatum-escherichi-ogoense" group appears to represent an important major phenotype, endemic to the western part of Central Africa, south of Cameroon. I have studied the chromosomes of La Corte's fish and realized that the complement was more basic or ancient than any further complement of the genus Aphyosemion in Central Africa and Nigeria. Only A. occidentale Clausen and A. petersii (Sauvage) have similar complements. A fish close to La Corte's strain may indeed be the ancestor of most major phenotypes of the genus Aphyosemion.

Aplocheilus (Epiplatys) sexfasciatus Gill ranges from eastern Ghana to Gabon. It is a common fish in the western lowlands of Rio Muni. The males from this country are very colourful and corresponded to those of the Lobe River, near Kribi, East Cameroon. North of the Lobe the colourful form is replaced by a less colourful phenotype. The chromosome complements with twenty-four elements is highly specialized and remains stable from Ghana to Rio Muni.

Aplocheilus (Epiplatys) grahami (Boulenger) appears to be more common in Rio Muni than in the Cameroon's. The phenotype seems to be unchanged from the eastern part of the Niger delta to Rio Muni. This phenotype usually is restricted to certain swamp-like biotopes, but south of Rio Benito it is rather common in the hills and A. (E.) sexfasciatus is absent. The A. (E.) grahami major phenotype ranges from south western Nigeria to the mouth of the Congo and has several subphenotypes. The one which is present in the Rio Muni is A. (E.) nigromarginatus Schultze. The chromosome complement of the populations of Rio Muni corresponds to that of A. (E.) sexfasciatus in all details. Those of material from East Cameroon are more specialized.

Aplocheilichthys spilarchus (Dumeril) ranges from the Senegal to the Congo River and generally inhabits brackish water. Roman reported this species from the mouth of the Rio Benito and from a locality, 12 kms from the coast, within the Utonde drainage.

Aplocheilichthys macrophthalmus Meinken ranges from southern Togo to Rio Muni. In the western part of the range, this phenotype appears to be restricted to the sedimentous soils and to pure freshwater. In the western part of West Cameroon populations inhabit brackish water and are absent from pure freshwater. It is absent in other parts of West Cameroon and in East Cameroon north of the Lobe River in the south. The subphenotype A. m. scheeli Roman ranges from the Lobe River, E.

Cameroon to the Rio Ecucu, Rio Muni. It differs from the other subphenotypes by the long and pointed ventrals in the male. It corresponds to A. rancureli Daget in this respect. Roman also reported the nominal subphenotype A. m. macrophthalmus from the Rio Muni and separated the two subphenotypes not only on the basis of the length of the ventrals in males but also in meristics. Sq-I. 27-29 in A. m. m. and Sq-I. 24-27 in A. m.s. The nominal subphenotype was reported from southern Rio Muni, from a locality which appears to be within the Utonde drainage, where A. m. s. also is present and from Ebebiyin of the extreme north eastern part of the country. The report last mentioned deserves further study because one should not expect to find A. macrophthalmus in this part of Rio Muni.

The genus Procatopus seems to be absent in Rio Muni. This genus ranges from south western Nigeria to southern Cameroon and populations may be present in the north western part of the country, within the drainage of the Ntem River.

Plataplochilus cabindae (Boulenger) has been reported from southern Angola, from Cabinda and from the southern affluents of the Ogowe River in Gabon and the adjacent part of Congo. It is a large and robust form which frequently has been imported for the aquarium. Roman found it in the Utonde drainage, north of Rio Benito.

Plataplochilus chalcopyrus Lambert inhabits the lowlands of the Lower Ogowe. Roman found it near the mouth of the Rio Benito. The male resembles the male of Procatopus nototaenia Boulenger by the long fin streamer in the upper corner of the caudal fin. The latter phenotype lives just north of Rio Muni.

Plataplochilus mimus Lambert inhabits the lowlands just south of Rio Muni. Roman found it in south western Rio Muni. It resembles P. chalcopyrus but has more dorsal finrays (10-12 versus 6-10) and less scales along the sides (27-29 versus 29-33).

The fauna of cyprinodonts of the inland plateau offers no serious problems in Rio Muni. The major phenotypes correspond to those of East Cameroon and northern Gabon. A different ion into separate subphenotypes occurs in Aphyosemion batesii and perhaps in Aplocheilus (Epiplatys) sangmelinensis. The southern limit of this particular fauna is not known, but it is absent in the Central Congo.

The richest fauna of killifishes in Africa inhabits the Niger Delta area. Six of the major phenotypes of this area tend eastwards and southwards into the Cameroon. The all reach the southern part of East Cameroon, but only three of the sic phenotypes reach Gabon. Procatopus is arrested just north of Rio Muni. Aphyosemion bivittatum reaches the southern bank of Rio Benito in an area which probably does not permit any further expansion towards the south. Aplocheilichthys macrophthalmus almost reaches Gabon. Aplocheilus (Epiplatys) sexfasciatus reaches the Ogowe drainage in northern Gabon, and seems to be replaced by A. (E.) multifasciatus or other allied forms further south. Only Aphyosemion calliurum and Aplocheilus (Epiplatys) grahami reaches the Lower Congo.

The southern or "Congolese" fauna of killifishes of the lowlands or sedimentous soils is not well known presently. Except for the genus Plataplochilus which recently has been studied by Lambert, very little information concerning the other fauna elements have been published. For Plataplochilus and Aphyosemion striatum, Rio Muni represents the northernmost part of the range. The geographical distribution of the different subphenotypes of A. striatum does not indicate that this phenotype is restricted to any type of soil. Its occurrence in southern Rio Muni may result from the absence of A. bivittatum and A. calliurum in this particular area. Like A. camerunense (Eseka area, E. Cameroon) it enters into the lowlands when the ecological counterparts are absent.

A faunal break exists, to some extent, in Rio Muni and may have developed there because the inland plateau is very close to the coast particularly in the Bata area. The occurrence of highly anomalous types of water, in the geographical area last mentioned, may have been important too. Large rivers probably are prime barriers which hinder the expansion of killifishes, rivulins in particular. Rio Benito, which does not develop any delta, probably is the most important barrier for killifishes in Rio Muni.

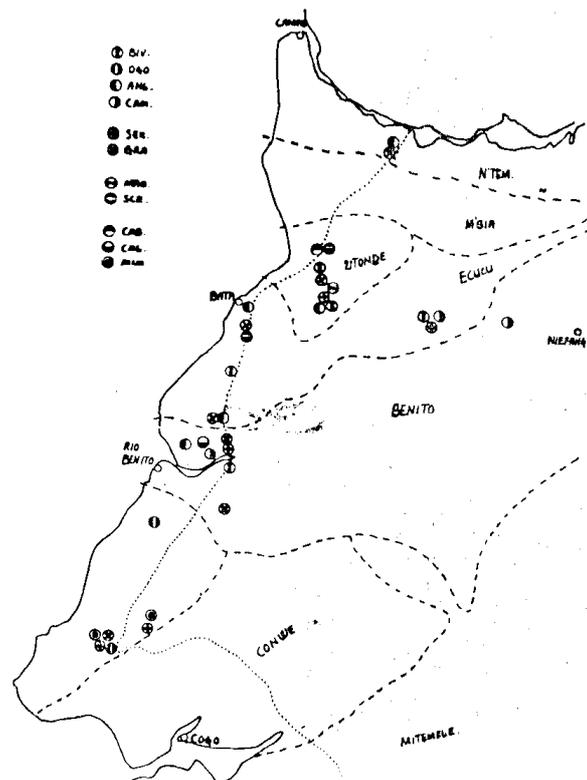
The direction of expansion of the various killifishes mentioned above is formal and probably does not reflect the expansion which in reality took place. Chromosome conditions, to some extent, are indicative of the direction of evolution at the level of the phenotype. In A. bivittatum the most basic, or

ancient, population inhabit the southern part of East Cameroon. The populations of Rio Muni, and other parts of the Cameroon's and East Nigeria, are more specialized.

Another ancient group of populations, which seems not to be closely related to the Rio Muni-Cameroon-East Nigerian group, lives in south western Nigeria. In the Cameroon's the direction of expansion is from the south towards the north and northwest. The conditions in A. calliurum seems to be rather similar, but much more complicated. The most basic and ancient populations live in the central part of East Cameroon within the drainages of the Nyong (most ancient), Sanaga, Dibamba and Wuri. North and south of this area we find highly specialized forms, but the subphenotype is unchanged. The populations in Rio Muni are less specialized than those of southern Cameroon, but probably more specialized than those of Gabon (A. australe). Nigerian forms, although not well studied, again are less specialized but not generalized. Compared to the closely related A. calliurum, the populations of A. camerounense in Rio Muni and the Cameroon's are intermediate to the extremes observed in the former, but highly specialized forms occur in certain areas (Lolodorf Hills, E. Cameroon). The centre of the distribution of A. camerounense probably is situated south in the Cameroon's.

The Western half of Rio Muni. The border between the sediments and the basement complex (gneiss) is indicated by a row of dots. The borders between the important drainages are indicated by rows of short streaks.

DIV: Aphyosemion bivittatum
 OGO: A. ogoense
 AHL: A. ahli
 CAM: A. camerounense
 SEX: Aplocheilichthys (Epiplatys) sexfasciatus
 GRA: A. (E.) grahami
 MAO: Aplocheilichthys macrophthalmus macrophthalmus
 SCE: A. m. scheeli
 CAB: Platoplochilus cabindae
 CAL: P. chalcopyrus
 MIM: P. mimus



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