APHYOSEMION CAUVETI, A NEW SPECIES OF KILLIFISH (CYPRINODONTIDAE) FROM GUINEA, WEST AFRICA

by

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ABSTRACT. - *Aphyosemion cauveti*, a new species, belongs to the subgenus *Scriptaphyosemion*. This species is distinguished from its closest geographical relatives by a vivid red pigmentation on the flanks and the lowest number of chromosomes (2n = 36) among the representatives of *Scriptaphyosemion*. From present observations, *A. cauveti* shows a restricted distribution in a tributary of the Kolenté river near the town of Kindia in Guinea. A phylogenetic analysis shows the relationships between subgenera of *Aphyosemion* west of Ghana where the *Callopanchax* subgenera is the most primitive one from which others have derived.

RÉSUMÉ. - Une nouvelle espèce de Cyprinodontidae (*sensu* Myers, 1924), *Aphyosemion cauveti*, est décrite de la région de Kindia en Guinée. *A. cauveti* se différencie des autres espèces du sous-genre *Scriptaphyosemion* par une coloration rouge vif et un faible nombre de chromosomes (2n = 36). D'après nos données actuelles, *A. cauveti* présente une distribution géographique restreinte à un affluent du fleuve Kolenté des environs de la ville de Kindia. Une analyse phylogénétique montre les relations entre les sous-genres d'*Aphyosemion* situés à l'ouest du Ghana. *Scripaphyosemion* et *Archiaphyosemion* dérivent du sous-genre *Callopanchax* qui est le plus primitif.

Key-words. - Cyprinodontidae, *Aphyosemion cauveti*, Guinea, Taxonomy, New species.

Some tropical fishes may present interesting adaptations to abiotic factors such as periodic alternation of rainy and dry seasons. Some species belonging to the family Cyprinodontidae (*sensu* Myers, 1924), usually called killifish, are well adapted to such changes (Simpson, 1978; Romand and Broche, 1983). Besides this ecological adaptation, several species are promising for biological control of mosquitoes because they live in very small biotopes of shallow water where mosquitoes tend to proliferate (Romand, 1985; Pandaré and Romand, 1989). Therefore it is well worthwhile finding out more information of various kinds concerning these fish. One of the first step is to make a survey of these fish in different tropical countries. Our efforts to study more specifically the Cyprinodontidae in Guinea began in 1979 with a scientific trip across the Fouta Djalon and the coastal region (Romand *et al.*, 1979), followed by several others in different regions which enabled the first author to find several original populations of fish (Romand, 1981, 1982, 1994), and gain a better knowledge of their distribution (Lévêque *et al.*, 1989; Romand, 1992). In this report we describe a new species of *Aphyosemion* found around Kindia in Guinea.

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MATERIALS AND METHODS

Data are based on the holotype, the allotype and 8 paratypes from the type locality: 8 km from Kindia on the road to Télimélé. This material is preserved in the Muséum National d'Histoire Naturelle (MNHN), Paris. This original population was found the 28th of November 1993 by C. Cauvet, J.-M. Hervieux and R. Romand, in a small brook running from a dam funded by a French province, the "Loire Atlantique" and additional material from a neighboring location called Siramousaya, 11 km from Kindia.

Cytogenetic study was made on live specimens of the new species and on a neighboring species, *Aphyosemion guignardi* (Romand, 1981). Fish were injected with 0.05 ml of a 0.2% colchicine solution. Ninety minutes after the injection, kidney, intestines, spleen and gills were removed and, after washing with a Hanks solution, they were dissociated in a KCl solution of 0.075M, then left 20 min. in a hypotonic solution at 37°C, followed by fixation three times in a Carnoy solution. The dissociated tissue fragments were spread on slides and then stained with Giemsa.

Morphometric measurements were obtained with a dial caliper to the nearest 0.5 mm. They are expressed in percentage of the standard length (SL) or the head length. Fin-ray and scale counts were made using a dissecting microscope with light transmitted through the fins, and include all discernible fin-rays. The range is given, followed by the mean and the standard deviation in brackets.

APHYOSEMION CAUVETI N. SP.

Material studied

Holotype. - MNHM 1995-14, adult male, 32 mm SL, 41 mm TL, Guinea: a brook after a small dam 8 km after the town of Kindia on the road to Télimélé (Fig. 1A).

Allotype. - MNHN 1995-15, adult female, 28 mm SL, 36 mm TL, from the same locality (Fig. 1A).

Paratypes. - MNHN 1995-16, 8 specimens, 25-36 mm SL, same data as holotype and allotype; MNHN 1995-17, 5 specimens, 23.5-31 mm SL, small brook, 11 km after Kindia on the road to Télimélé, close to the village of Siramousaya.

Additional material from 10 adult specimens from Siramousaya kept by the first author was also studied.

Diagnosis

Aphyosemion cauveti is a member of the *Scriptaphyosemion* subgenus. Members of the *Scriptaphyosemion* subgenus share the following characters: large red spots and stripes on the flanks and the unpaired fins over a blue pigmentation, no dark cross bars present on the flanks (Romand, 1992). The male of this new species presents the most conspicuous red pigmentation on the flanks of all the representatives so far observed of this subgenus (Fig. 2A). This species is easily distinguished from *A. geryi* by its color pattern with very large vivid red markings on the flanks and the lack of yellow pigmentation on the unpaired fins, and a quadrangular caudal fin compared to the biacuminate caudal fin of *A. geryi* (Fig. 2B). *A. guignardi* differs from *A. cauveti* by a blue greenish pigmentation with red chevron shaped markings on the flanks; both species lack yellow pigmentation (Fig. 2C). The female of *A. cauveti* retains a red reticulation on the flanks (Fig. 2A) which is absent in females of *A. guignardi* and *A. geryi*.

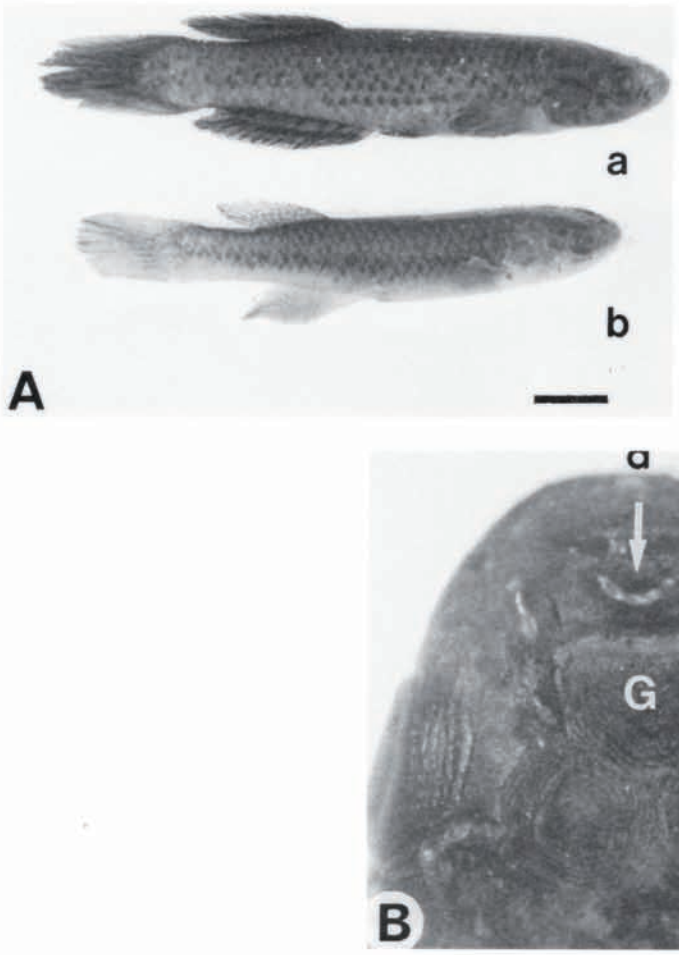
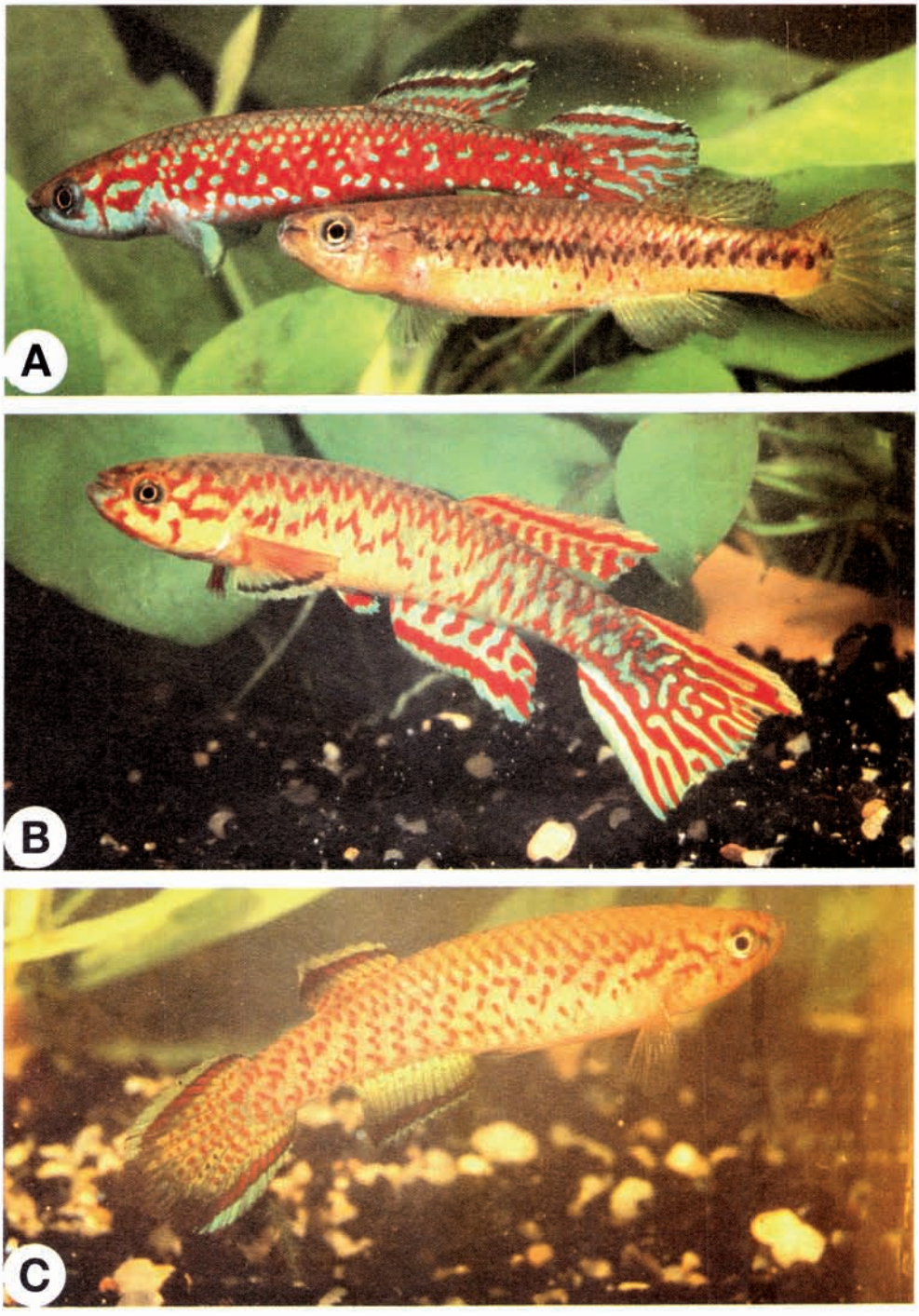


Fig. 1. - A: Photographs of the male used as holotype (a) and the female as allotype (b) Scale bar = 5 mm. B: Frontal squamation of G type (G) without H scale. The lateral line organ is divided into three parts: the frontal anterior canal (a) localized on the most anterior part of the head with two neuromasts; two supra-orbital canals (b) along the eyes and two other post-orbital canals (c) behind each eye. Scale bar = 1 mm.

Morphometry and meristic characters

Based on specimens from two population: the "Loire Atlantique" dam and Siramousaya, the general appearance and body shape is shown on figures 1 and 2. Morphometric and meristic data are as follow:

Measurements related to standard length. - Total length (%), 123.7-135.2 (128.6±3.2); height of the body at origin of the anal fin, 15.0-21.8 (18.4±1.8); length of head, 22.5-29.4 (26.8±1.9); distance from the tip of snout to insertion of pelvic fins, 44.2-52.9 (48.2±2.5); tip of snout to insertion of anal fins, 55.0-66.1 (62.0±3.2); snout to insertion of dorsal fin, 63.4-73.5 (68.2±3.0).


A
B
C

Measurements related to the head length. - Interorbital length (%), 40.0-57.8 (45.3±5.9); distance from tip of snout to orbit, 25.0-35.5 (33.6±2.8); eye diameter, 23.5-33.3 (27.5±2.8).

Meristic values (Fig. 3). - The following meristic counts were made: caudal rays, 28-31 (29.2±1.0); dorsal rays, 12-15 (13.0±0.8); anal rays, 16-18 (16.9±0.5); juxtaposition of the dorsal and anal fin, given by the number of anal rays anterior to the first dorsal fin ray, 6-8 (6.6±0.7). Number of scales from the upper edge of gill opening to caudal peduncle, 33-36 (34.4±1.0). The number of scales around the body at the origin of the anal fin, 19-21 (20.4±0.8).

The number of rays for the caudal and anal fins is very similar between the two populations studied (Fig. 3), where no statistical difference was found, although the dorsal and pectoral fins present a statistical difference ($p > 0.002$, Students-t-Test). This meristic difference is not important enough and should correspond to variations between populations since color patterns between the two populations are exactly the same.

Frontal scale pattern and lateral line organ

One can distinguish three head canals as described for the *Aphyosemion* genus by Clausen (1967): the frontal anterior canal localized on the most anterior part of the head with two neuromasts; two supra-orbital canals along the eyes and two other post-orbital canals behind each eye. The supra-orbital and post-orbital canals possess three neuromasts each (Fig. 1B). Every scale of the head or each row of scales is given a letter (Hoedeman, 1958). The pattern of head squamation between the canals is characterized by the particular scale which overlies the others. In *A. cauveti*, the scale pattern is of type G without H scales.

Description of color patterns

Color pattern of live male. - The body and fins present only two pigments, vivid red and blue. The side shows a conspicuous red pigmentation irregularly spotted with blue markings, which are larger and more numerous on the anterior part of the body (Fig. 2A). In the dorsal part of the flanks, blue markings are aligned forming 2 or 3 lines from the dorsal fin to the beginning of the head.

All fins except the pectoral ones present a red and blue coloration with three stripes localized in the marginal border in the following sequence: blue, red and blue for the most marginal stripe. Between the flank and the three stripes, there is a more or less complicated intrication of red and blue pigmentation.

Color pattern of live female. - The body is less colored than that of the male. The flank is brownish, the lower half from the pelvic to the caudal fins is brownish-yellow while the upper half is darker with a light red reticulation and some red spots extending to the lower half of the flank. In the middle of the side, a dark band may be visible depending on the behavioral state of the fish (Fig. 2A). Small red dots are visible on the anal and dorsal fins. Light blue pigmentation can be observed on the anal fin.

Fig 2 - **A** Pair of *Aphyosemion cauveti* from Siramousaya **B**: *Aphyosemion geryi*, male from a tributary of the Tominé river close to the town of Gaoual **C**: *Aphyosemion guignardi*, male from Santou Photos C Cauvet

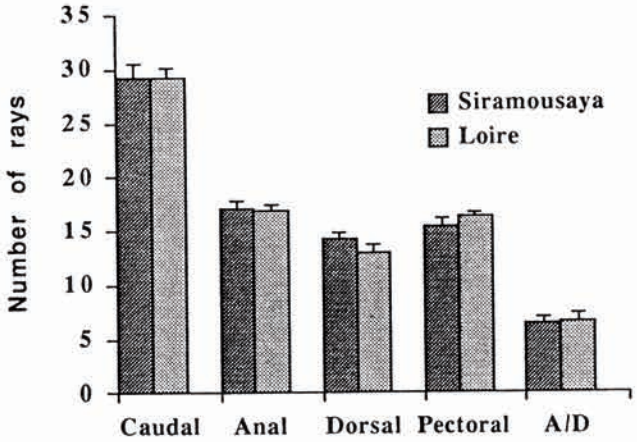


Fig. 3. - Comparison of meristic values between the two populations studied from 10 specimens each. The number of rays for the caudal and anal fins is very close between the two populations where no statistical difference was found, although the dorsal and pectoral fins present a statistical difference ($p > 0.002$, Students-t-Test). "Loire" corresponds to the original population of *A. cauveti*. Siramousaya is a neighboring population 3 km away from the type locality.

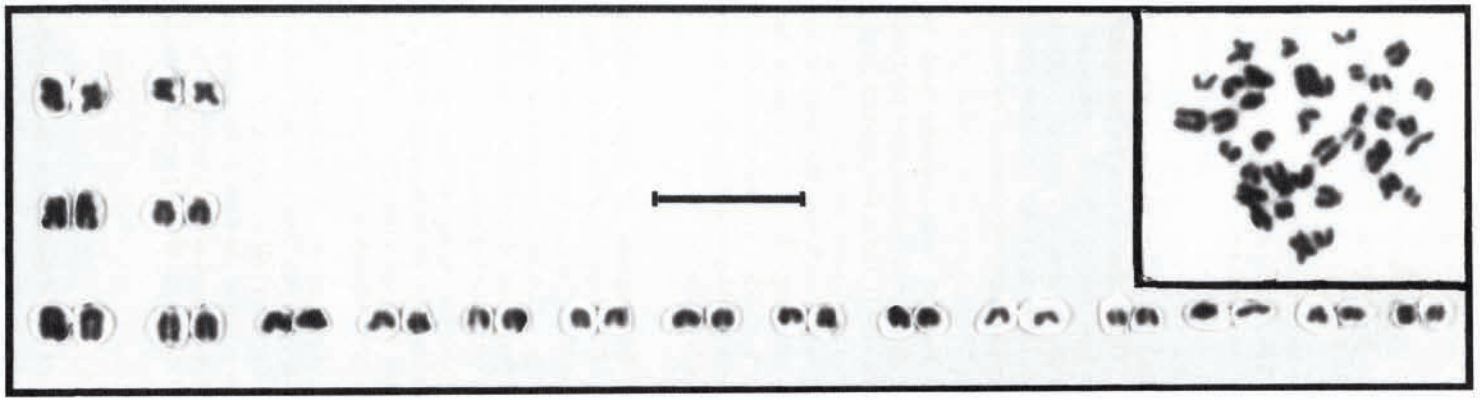


Fig. 4. - Karyotype of *Aphyosemion cauveti* from a male specimen from the "Loire Atlantique" dam. Scale bar = 8 µm.

Cytogenetics

Aphyosemion cauveti presents 2n = 36 chromosomes with a fundamental number of 44 considering the subtelocentrics as biarmed chromosomes. The karyotype formula comprises 4 metacentric (m), 4 subtelocentric (st) and 28 acrocentric (a) (4m+4st+28a) (Fig. 4). The karyotype of *A. guignardi* is different although the fundamental number 44 is the same. This last species shows a higher number of chromosomes (2n = 40) with a different formula (2m+2st+36a). The subtelocentric pair presents the largest size followed in decreasing size by metacentric and acrocentric chromosomes. Observations made in the two species from tens of mitosis from both sexes show no polymorphism in the chromosome number and the formula.

Distribution

So far this new species has only been found in two places, 8 and 11 km west of Kindia on the road to Télimélé (Fig. 5). Apparently, the small brooks where these two populations have been found flow into the Santa river which is a tributary of the Kolenté river. Several tributaries of the Kolenté river were surveyed in 1979, and only *A. geryi* was found. Two rivers flow parallel on each side of the Santa river; the one 30 km north-east of Kindia is the Kolenté river and the other 15 km south-east is the Kilissi river, a tributary of the Kolenté river and several populations of *A. geryi* have been collected in these rivers (Fig. 5).

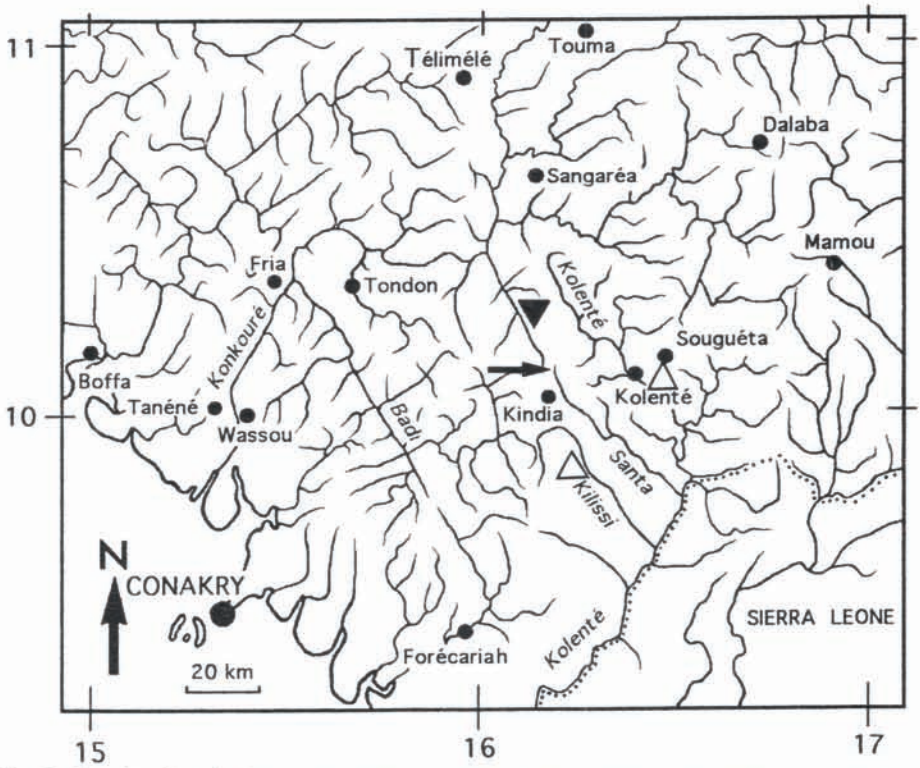


Fig. 5. - Type locality of *Aphyosemion cauveti* (arrow) and the closest neighboring localities where *A. geryi* (white triangles) and *A. guignardi* (black triangle) have been collected.

Twenty km after the type locality of *A. cauveti* in the direction of Télimélé another species of *Aphyosemion* was collected, *A. guignardi,* that belongs to the Konkouré upper and middle drainage (Romand, 1981, 1992). From our present observations in the field, it seems that this new species is localized to a small area around Kindia, and may be restricted to the upper Santa river. Further prospections in this region might give more information on the exact geographic distribution of this species.

Etymology

Named for Christian Cauvet who first brought attention to this original population several years ago and helped to collect specimens used in this description with J.-M. Hervieux and the first author.

DISCUSSION

This new species belongs to the *Scriptaphyosemion* subgenus which groups species of *Aphyosemion* with prominent red spots and stripes on the flanks and the caudal fins over a blue pigmentation without dark cross bars on the flanks (Romand, 1992). Representatives of this subgenus are localized between Liberia and Senegal, extending north toward Burkina Faso. This new species with the most conspicuous red pigmentation on the flanks and fins from all the representatives so far observed corresponds well to this subgenus.

From caryotypic observations, *A. cauveti* can be well differentiated from geographic neighboring species, *i.e.*, *A. geryi* and *A. guignardi*. These two last species present 2n chromosomes = 40, while *A. cauveti* only has 2n = 36, although the fundamental number (44) is the same for the three species, considering the subtelocentric pair of *A. geryi* as biarmed chromosomes (Romand, 1981). It is interesting to point out that the karyotype of *A. guignardi* is stable between populations as published earlier (Romand, 1981). The population studied here for comparison is from south of Mamou, several hundred km from the original population studied which was around Labé (Romand, 1981). The study of fish karyotypes, which is useful in phylogenetic analysis, shows a general trend towards a reduction in chromosomes (Ohno, 1970). The primitive karyotype is characterized by large number of small chromosomes, so *A. cauveti* would be the most derived karyotype for the *Aphyosemion* genus west of the Côte d'Ivoire. In the *Callopanchax* subgenus, all species display 2n = 46 small chromosomes, whereas the species of the *Scriptaphyosemion* have 2n = 40-42 and 2n = 38-42 for the *Archiaphyosemion* species (Scheel, 1972; Grimm, 1972; Douchement, 1983). By including *A. cauveti* in the *Scriptaphyosemion* subgenus, this species is thus the most derived species. This subgenus now includes 8 species with a chromosome distribution between 36-42 if we accept that *A. nigrifluvi* is a synonym of *A. guignardi* (Etzel and Berkenkamp, 1989).

From recently summarized observations on the *Aphyosemion* of West Africa (Romand, 1992), it is possible to confirm the cladogram of hierarchic representation obtained with a cladistic methodology put forward for the study of *Aphyosemion* of Liberia (Romand, 1986), based on color pattern, cytogenetics, genetics and behavior (Fig. 6). For the *Aphyosemion* species west of Ghana, except *A. walkeri*, three subgeneras are recognized at the present time, *i.e.*, *Callopanchas* Myers, 1933, *Archiaphyosemion* Radda, 1979, and *Scriptaphyosemion* Radda & Pürzl, 1987.

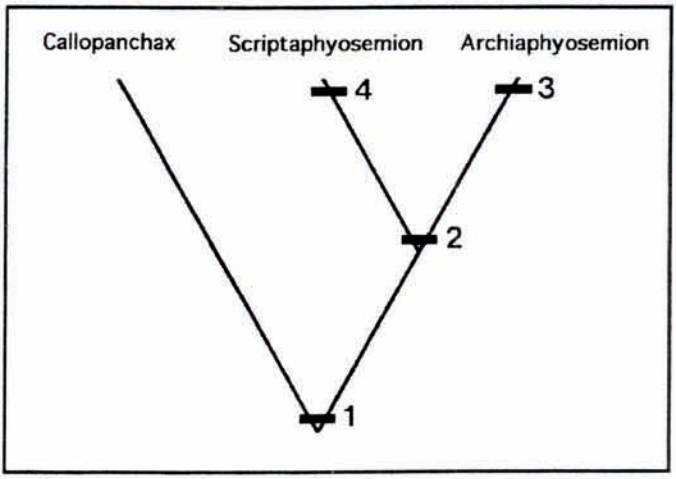


Fig. 6. - Possible cladogram of relationships of *Aphyosemion* species west of Ghana, except *A. walkeri*, based on meristic characters, color pattern, cytogenetics, genetics, behavior and biology. Modified from Romand (1986). Node 1: dorsal origin in front of anal origin, extensive red pigmentation, large number of chromosomes, agressive, annual. Node 2: dorsal origin posterior to anal origin, less red pigmentation, karyotype with 2n: 36-42 chromosomes, less aggressive, non-annual. Node 3: dark crossbars often present on the side of the body, no yellow pigmentation on fins, few red pigments. Node 4: no dark crossbar, red pigments well represented, yellow pigmentation often present on fins.

It was suggested that *Callopanchax* was the most primitive subgenus of *Aphyosemion* (*sensu* Myers, 1924) from which most other *Aphyosemion* of West Africa derived. The derived subgenera, *Archiaphyosemion* and *Scriptaphyosemion* are characterized by a lower number of chromosomes, marked genetic differentiation (Douchement *et al.*, 1984; Agnèse *et al.*, 1987) and differences in behavior and biology (Douchement, 1983).

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