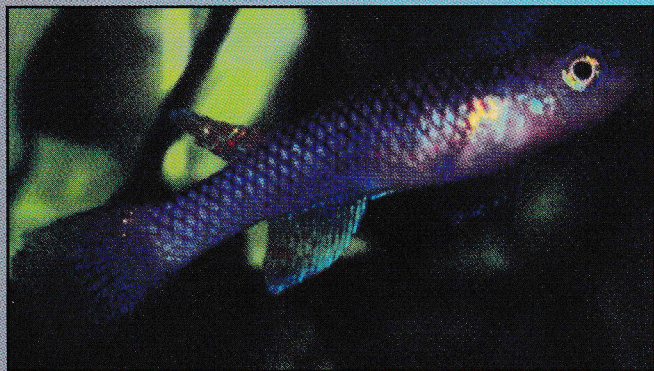


# Description Of A New *Aphyosemion* Species From Congo, *A. plagitaenium* n.sp., Exhibiting A Probable Intra-Generic Color Convergence With Oblique Bars



*Aphyosemion plagitaenium* n.sp., female from Epoma, type locality, aquarium bred. Photo Maurice Chauche.



*Aphyosemion plagitaenium* n.sp., male from Epoma, type locality, aquarium bred. Photo Maurice Chauche.



*Aphyosemion* sp. Kisangani (HZ85/8, *A. castaneum* s.s., "christyi" in the present sense), male, aquarium bred. Photo Maurice Chauche.



*Aphyosemion* sp. aff. *elegans*., male from Bombala, aquarium bred. Photo Maurice Chauche.

## Abstract

Following DNA evidence and recent live collections in upper Zaïre between Kisangani and Bafwasendé, in northwestern Congo and southwestern Centrafrique, the 18 known components of the *Aphyosemion elegans* superspecies has been reviewed, including 1 taxon with a distinct color pattern made of oblique bars that is described as new as *A. plagitaenium* from northeastern Congo.

## Résumé

Suite aux travaux de biologie moléculaire et aux récentes récoltes vivantes du Haut Zaïre, du Congo nord-occidental et du Centrafrique sud-occidental, les 18 composants connus de la superespèce *Aphyosemion elegans* ont été revus, y compris 1 taxon au patron original avec des barres obliques qui est décrit comme nouveau, *A. plagitaenium* du Congo nord-occidental.

## I. INTRODUCTION

The killifish species of the *elegans* superspecies belonging to the genus *Aphyosemion* (Cyprinodontiformes: Aplocheilidae) and living in the Congo cuvette and its belts are the most difficult to study overall, together with those belonging to the genus *Rivulus* in the Amazon cuvette in South America, probably for similar eco-palaeogeographical reasons (Huber, 1998) and for parallel historical reasons:

- biographically speaking, their biotopes have been changing during the past million years from semi-

## By Dr. Jean H. Huber

Museum national d'Histoire naturelle,  
43 rue Cuvier, 75231 Paris Cedex 05, France.

desertic isolated remnant pools to a huge overflooded "lake" with a boundary of over 5000 km; consequently, within the present cuvette of intermediate status, this today produces a patchwork of species with standard distribution, intricated with often genetically isolated "spotty" populations that replace each other with little rationale

- historically speaking, many taxa have been described since long, between 1899 and 1924, and are still



*Aphyosemion kunzi* s.s. (GBL85/18), male, aquarium bred. Photo Maurice Chauche.



unknown as live fish, with possible misidentifications based on aquarium strains, collected away from the type localities.

Indeed, the major constraint in the systematics of the *elegans* superspecies is palaeogeographical.

Like the Amazon basin, the Congo basin is a cuvette that experienced climatic hiccups during its history and notably since the Pleistocene (2.5 Million Years Ago): the landscape varied from dried savannahs with few aquatic remaining waters (except in refugia where speciation is high, like near lake Tumba, not far from Bikoro, a type locality of the species *A. elegans*!) to a fully overflowed forest ("the hypothetical gigantic lake"). This explains why only the belts (the plateau) of the cuvette encompass species with rational distribution pattern and standard vicariance speciation. In the cuvette itself (the lowlands), the situation is opposite and complex with apparently little rational distribution and the occurrence, sometimes sympatrically, of spotty distinct phenotypes in line with the big "reshuffles" of the climatic hiccups that endured the fishes (and it is not known with our present limited collections whether this un-rational distribution is a consequence of the mixing of populations due to climate variations or the consequence of the major genetic drifts and of local speciation). This translates into a very complex puzzle for the systematic researcher and thus our present identifications of the phenotypes of the *elegans* superspecies tend to be limited to the color pattern of the living male. This is only practical because the biological complexity is even greater and the results of karyotypes have shown that live color patterns do not always correspond with named species phenotypes.

Fortunately the first preliminary results of molecular biology (mitochondrial genes, Murphy & Collier, 1999) are in line with our understanding of species names, based on male color patterns (a few discrepancies have been noted in "*elegans*" and "*decorsei*" sensu Murphy & Collier, but these correspond to minor misidentifications by the 2 authors).

Besides, the low number of collecting spots of live material since 20 years in the cuvette and surroundings (political instability in that part of the world being the major reason) does not help to uphold our difficulties.

- in 1983, a French young aquarist, Christophe Moreau, visited a single locality within the northwestern part of the cuvette in Congo, at Bombala, near Impfondo (RPC 1983/2)
- in 1985, three renown aquarists, Winfried Stenglein, Jan Pap and Wolfgang Grell, collected live, for the first time, Killifish species from the northeastern cuvette and its belt in Zaïre (*the country name "Zaïre" is still used, and not the official new name of "Democratic Republic of Congo", to easily differentiate it from Congo, officially the "Popular Republic of Congo"*), especially near the type localities of *christyi*, *castaneum* and *margaretæ*: unfortunately, their findings have not been covered scientifically, except for a putative revalidation of *margaretæ* (Stenglein, 1987a, b)
- in 1991, three other aquarists, Paul De Wageneer from Belgium, Leen Van Den Berg and Bas Vlijm from Holland, re-collected along the same road of northern Congo as the author did in 1978: they were able to record at least 3 new collecting localities for *Aphyosemion chauchei* (Obeya, Ottende? and Oyoué), thus extending the distribution of the species and to discover a new atypical population that remained un-studied and is described herein as a new species

- in 1994, a French herpetologist, Laurent Chirio, brought back a single population from the primary forest of southwestern Centrafrique (northwestern belt of the cuvette), in Lobaye river, that was sympatric with a, probably new, component of the *wildekampi* superspecies; this strongly red-punctuated population may be related to the unidentified populations of the primary forest in the northwestern belts of the cuvette, West-Mokéko (1978 localities JH141/142/156)
- in 2002, the ichthyologist, Uli Schliewen, from Munich Museum made a collecting trip to the Bandundu Province of west central Zaïre and recorded 4 new collecting points in the cuvette itself.

The study of the material of these new collections induces several novelties concerning the *elegans* superspecies that change our knowledge and definition of some components of the superspecies since the author's previous studies on the group (Huber, 1978, Huber & Scheel, 1981 for all then known taxa; Huber, 1994 for *decorsei* only, Huber, 2001-2004). The results are published into 2 independent papers, one with the description of the new species, the other with the study of material and the comments on the validity of the components of the *elegans* superspecies.

Our 2 papers are limited to those novelties and do not propose a full revision of the *elegans* superspecies, because another researcher, Jouke van der Zee, has undertaken (pers. comm.) a complete review of the huge collections of preserved material recorded in Tervuren Museum and will publish it as soon as possible.

Notably, in 1915 and 1920, the descriptions of 2 taxa by the same author (Boulenger), namely *christyi* and *schoutedeni* and in 1924 and 1936, the descriptions of 2 additional taxa from the same region, namely *castaneum* and *margaretæ* poured a lot of confusion in the systematics of the *elegans* superspecies in northeastern Zaïre: up to 1985 and the upper Zaïre collections, an easy solution was to consider all of them (with some variation, depending on authors) as junior synonyms of *christyi*, the oldest name.

However, the 1985 expedition has reshuffled the cards by showing that in the area of Bafwasendé, the type locality of *christyi*, 2 geographically-scattered phenotypes are present, one similar to *margaretæ* (many small dots longitudinally on sides and thin short red flames in posterior Caudal fin, forming an outer broken vertical bar), the other with a (broken) red median line on male Anal fin, similar to the fish from Kisangani, the type locality of *castaneum* (and Zee, pers. comm., has confirmed that this phenomenon might also be seen after preservation in the syntypes series of *christyi*); the situation is even more complicated by the fact that the description of *schoutedeni* does not present any diagnostic pattern characters (except the vague statement that punctuations of *schoutedeni* are small, while the contrary would be expected in comparison to *christyi* from type locality!)

Hence, Zee will have the following, very difficult, threefold choice to decide and select upon for the northeastern Zaïre taxa (at least):

- conservative (designate, if possible, a lectotype with a red median, continuous or broken, line on Anal fin and assign the alike western Bafwasendé, including Kisangani, material to *christyi*, then revalidate *margaretæ* for the eastern populations and leave untouched the synonymy status of *castaneum* and *schoutedeni*),
- pro-active (assign the Bafwasendé material to a *margaretæ*-like fish, named *christyi*, *margaretæ*



being its junior synonym, consider *schoutedeni* topotypic material as identical to the Kisangani fish—like Poll did—and then revalidate *schoutedeni* with a different definition than today, with *castaneum* as its junior synonym),

- disruptive (same as pro-active, but alternatively consider *schoutedeni* as more likely related and a junior synonym of *decorsei*, then revalidate *castaneum* for the Kisangani fish and restrict the name *christyi* to populations from Bafwasendé and eastwards, with *margaretæ* as its junior synonym).

Before his decisions, it is better not to change the current systematics and in this paper, patterns similar to the fish from Kisangani (today named *christyi*) will be referred as sp. Kisangani-like (*castaneum* in a strict sense).

As a result, 14 out of 18 available taxa may be considered as distinctly diagnosed species (with their validity being discussed in Huber, in press) according to the historical order of description (aquarium populations are listed between "[ ]" and diagnosis and alternative naming are also given):

1. *Aphyosemion elegans* (Boulenger, 1899) [Boendé, Bombala (aff.), Ignoli, Maindombe (aff.)]: red bars on posterior sides of male, plus a broad dark red line on mid part of Dorsal fin (Lambert's present sense: the diagnosis may be changed according to the first rediscovery of topotypes)
2. *Aphyosemion decorsei* (Pellegrin, 1904) [unknown live]: few red spots on male sides, notably arranged into 2-3 anterior longitudinal series; red margins on Dorsal and Caudal, but not Anal in male (hypothesized from well preserved subadult types); *Aphyosemion polli* Radda & Pürzl, 1987, from an isolated region about 1000 km away, presents a very similar diagnosis and may or may not be distinctive
3. *Aphyosemion ferranti* (Boulenger, 1910) [unknown live]: a single longitudinal red line on male sides and short red flames in unpaired fins of male (hypothesized from well-preserved types)
4. *Aphyosemion lujæ* (Boulenger, 1911) [unknown live]: a ladder-like red pattern on male Anal fin, made of a broad red inner line and red flames towards base; a

red-flamed Caudal fin in male (hypothesized from well preserved types)

5. *Aphyosemion* sp. Kisangani [to be assigned to *A. christyi* (Boulenger, 1915) as per Zee's option 1, to *A. schoutedeni* (Boulenger, 1920) as per Zee's option 2 or to *A. castaneum* Myers, 1924 as per Zee's option 3]: a median red, continuous or broken, line on male Anal fin and few rather large spots scattered on male sides
6. *Aphyosemion* sp. Epulu and east of Bafwasendé [to be assigned to *A. margaretæ* Fowler, 1936 as per Zee's option 1, to *A. christyi* as per Zee's options 2 and 3]: a red closed pattern at male Caudal and many small red dots, longitudinally arranged on male sides
7. *Aphyosemion congium* Ahl, 1924 [Gembo, Kenge, Takundi, Vue River]: broad dark margin at male Dorsal fin, and at upper Caudal fin, together with variably numerous red spots on yellow-brown sides (alternative name: *Aphyosemion melanopteron* Goldstein & Ricco, 1970)
8. *Aphyosemion cognatum* Meinken, 1951 [Bandundu, Djoué, Kimuenza, Kinsuhka, Kintepé, Kisantu, Lake Fwa, Madimba, Mbanza-Ngungu, N'galiema, Ngangalingolo, Nyangu-Cugolo]: narrow white (or pale blue) margin and red submargin on Dorsal and Caudal fin of male, red margin in Anal; very numerous red dots (irregularly or in longitudinal series, not vertically arranged) on male sides
9. *Aphyosemion lamberti* Radda & Huber, 1977 [Abeilles, Booué, G80/5, Koulamoutou, Lekoko, Okondja]: red flames on all unpaired fins of male and scattered speckles on sides over a blue background
10. *Aphyosemion rectogense* Radda & Huber, 1977 [Bongoville, East Franceville, Léconi]: red flames near base of all unpaired fins in male, followed by a broad yellow submargin and a red margin, plus speckles regularly and longitudinally on sides over a yellow background
11. *Aphyosemion chauchei* Huber & Scheel, 1981 [Obeya, Oltombo,

Oyoué]: deep orange (not yellow and thin) marginal broad zone in Anal fin and red, vertically oblong, numerous spots on blue sides and inner fins of male

12. *Aphyosemion schioetzi* Huber & Scheel, 1981 [Kellé, Kinkala, Kounga, Linzolo, Loutoko, Mgondé, Mindouli, Missafou, Mokedo, N'kenni, Ngombe, PK50 Luozi, Taba, Voka, Voula]: yellow marginal thin zone in Anal fin (with or without dark edge) and red, vertically oblong, numerous spots on yellow sides and inner fins of male
13. *Aphyosemion lefiniense* Woeltjes, 1984 [La Léfini]: yellow margin (not red) and broad red submargin on all fins of male (i.e., a reversed, symmetrical pattern)
14. *Aphyosemion plagitaenium* Huber, 2004 (hereby described) [Epoma]: red chevrons or oblique lines (not bars) on posterior sides and red blotches near the basis of the Anal fin of male over a yellow/blue background.

This paper is intently published in an aquarist magazine, to acknowledge the crucial role aquarists have on the conservation of species, on the availability of new populations by actually collecting them themselves and on the maintenance of species, notably the Epoma strain since 1991, including in USA through the American Killifish Association (A.K.A.). On the other side, researchers are faced with an incredible biological complexity and have to sort out messy decisions in previous very old descriptions, because of the good, but sometimes uncomfortable-to-apply rules of the code of the International Commission of Zoological Nomenclature (ICZN) on historical priority, on type material and on type locality. Should name changes arise, as it will be in this case in Zee's coming publication, this is our kind request to genuine aquarists to understand our difficulties.

## II. DESCRIPTION OF *APHYOSEMION PLAGITAENIUM* N.SP.

### *Aphyosemion plagitaenium* n.sp.

**Holotype:** MNHN 2004-1288, male 38.6mm SL, 45.9mm TL. Epoma (RPC91/1, also named Opouma), N.E. Congo, 0.476°N 15.351°E, 393m altitude. Paul De Wageneer, Leen Van Den Berg and Bas Vlijm, leg. August 1991.



	D	A	D/A	LL	TRAV	CIR	vertebrae	SL (in mm)	TL*	PD*	PA*	PV*	height at anal fin*	head*	inter- orbital*	eye diam.*	snout*
Holo.	9	14	8	30	8	12	13+17	38.6	118.91%	65.28%	57.51%	46.89%	18.39%	23.83%	10.10%	4.66%	5.70%
Para.(m)	9	13	8	29	7	14	12+17	35.6	119.94%	67.98%	58.99%	48.31%	18.26%	23.88%	11.52%	5.62%	5.90%
Para.(m)	9	13	7	29	8	14	13+17	35.8	125.98%	70.67%	55.59%	45.25%	18.16%	25.42%	12.29%	5.87%	2.79%
Para.(m)	9	13	7	30	8	13	12+17	39.1	125.58%	65.98%	59.85%	51.41%	14.83%	25.06%	12.53%	5.12%	5.37%
Para.(m)	9	14	8	29	8	13		37.2	130.38%	65.86%	59.14%	45.70%	15.86%	23.92%	11.02%	5.38%	5.38%
Para.(m)	8	13	8	29	7	14	12+17	22.4	127.23%	70.54%	61.61%	49.11%	16.07%	25.89%	12.50%	5.36%	5.80%
Para.(m)	10	14	8	30	7	13	13+17	19.1	125.13%	69.63%	57.59%	51.31%	18.32%	23.56%	11.52%	5.76%	6.28%
Para.(f)	10	14	8	29	7	13		30.1	125.91%	70.43%	55.81%	45.51%	17.94%	25.91%	11.63%	5.98%	6.31%
Mean	9.1	13.5	7.8	29.4	7.5	13.3	12.5+17		124.88%	68.30%	58.26%	47.94%	17.23%	24.69%	11.64%	5.47%	5.44%
Std Dev.	0.6	0.5	0.5	0.5	0.5	0.5	0.4		2.87%	1.97%	2.02%	2.47%	1.33%	0.93%	0.54%	0.29%	1.12%

Other characters: Ventral fins reaching Anal fin insertion, in both sexes; tip of Dorsal fin hardly reaching Ventral fins insertion.

**Paratypes:** MNHN 2004-1289, 6 specimens (1 female, 3 adult males, 2 subadult males), ZSM (München, Deutschland) 31148, registration through Uli Schliewen, 2 male specimens, BMNH (London, UK) 2004.7.29.1, 1 male specimen, registration through Oliver Crimmen and James MacLaine, all types are aquarium bred specimens offspring from wild parents. Types (7) from MNHN and BMNH have been measured and radiographed.

**Description:** a member of the *Aphyosemion elegans* superspecies, as defined above.

**Diagnosis:** A small species, with a slightly more slender morphology in the *Aphyosemion* subgenus and with a unique color pattern on male posterior sides made of oblique red lines, sometimes fusing to form chevrons ("<<<", as seen starting from head) and with red blotches near the base of Anal fin. The new species is probably more related to *elegans* (in Lambert's present sense) than to any other component of the superspecies, but it is easily separated from it by the oblique pattern (no vertical bars, like in *elegans*) on male sides and by the color pattern of Anal fin base. Besides the new species is genetically distinct from *elegans*, according to DNA experiments.

#### Color Of Live Fish:

**Male:** The basic color of the flanks and the interior of the caudal, anal and dorsal fins is yellow with a blue metallic shining. Belly is somewhat lighter. The red opercular shield on head is well characterized. On sides, after 2-3 short red longitudinal lines, the diagnostic pattern of oblique lines and chevrons starts and becomes more and more conspicuous. Unpaired fins are marked by a red margin, except Anal where it is replaced by a faint yellow marginal band, and by numerous irregular red spots innerly, except again in Anal where red blotches along the basis replace them. Paired

fins are yellow and a little red dotted.

**Female:** The dichromatism is very marked: the body is beige brown without markings, except the light dark reticulation on sides, typical of the subgenus, and named the "net." The unpaired fins are little spotted: red spots are more conspicuous on entire Dorsal fin and on upper Caudal fin, over a yellow tone.

#### Color In Alcohol:

**Male:** oblique red markings become darkish after preservation, while red spots on anterior sides and fins become whitish; and all yellow and blue tones disappear; gray areas become visible on outer regions of unpaired fins and on anterior upper sides.

**Female:** identical to the pattern in life, with the "net" becoming more conspicuous.

#### Size, Proportion And Formulae:

About 50mm total length, as a maximum, for the male, somewhat less for the female (45mm), measuring aquarium-bred specimens.

**Micromorphological characters:** Frontal scalation is regular, 'G' type; the frontal neuromasts are standard for the subgenus (open type for the anterior pair, 3 pairs in 2 parallel channels for the supraorbital series); ctenoidy is scarce; teeth, sharp and monocuspid, are well recurved, like its congeners (food: ants).

The morphological and meristic data of the 8 types in MNHN and BMNH (holotype first and in bold type; abbreviations explained in Huber, 1992; refers to "in % of SL") are, after radiophotographic confirmation, as shown in the chart.

#### Phylogenetic Relationships:

According to meristics, *plagitaenium* is more separated (with a lesser number of rays) from its southern neighbor *chauchei* than its northern neighbor, *elegans*. This is confirmed by the DNA analysis

(Murphy & Collier, 1999) that demonstrates that *plagitaenium* belongs to a related, but strongly distinct line of evolution than *elegans* (in Lambert's present sense).

**Color convergence:** on male sides, the new species shows a striking resemblance with the populations of the subgenus *Raddaella* collected in northeastern Gabon and identified as *A. kunzi* (see illustration): same pattern of oblique lines and chevrons, notably on the rear part; this pattern is not seen in *Raddaella* populations living in the Congo cuvette, that are punctuated (like standard populations of the *elegans* superspecies), besides.

#### Biotope:

The new species is dwelling primary forest creeks in the plateau (above 350m altitude) with slightly cooler waters than in the cuvette.

**Sympatric species:** *Epiplatys phoeniceps* (and in addition *Hylopanchax stictopleuron* is likely to be found in the type area); the key issue is to disclose whether the phenotype with chevrons in the subgenus *Raddaella*, namely *A. kunzi* s.s., is also sympatric or not with *plagitaenium*, more westerly; if not, i.e., in case of vicariance, then *plagitaenium* and *kunzi* would be another example of frontier species.

#### Distribution:

*A. plagitaenium* is only known from the type locality. Epoma is situated at an altitude of 393m, just southerly to higher hills (which may have acted as a micro-refugium during the "LGM", Last Glacial Maximum).

It has been mentioned (but not confirmed by the collectors) that *Epiplatys nigricans* (a junior synonym of *chevalieri*, or its subspecies, or a full species, depending on authors) is sympatric with *plagitaenium*.

Based on our experience of color convergence and of frontier species, its distribution is likely to lie west



northwest of the type locality, in a primary forest area of the cuvette belts, in the direction of the Ivindo basin where *kunzi* is distributed. However, the putative sympatry with *nigricans* pushes to the contrary since that *Epiplatys* species typically inhabits the Congo cuvette.

#### Derivatio nominis:

The species name, *plagitaenium*, means with an oblique (from Greek: plagos) band (from Greek: tainia), in reference to the oblique — not vertical — red lower lineated pattern on male sides, sometimes forming a "chevron" pattern with upper sides; it is an adjective.

**Important note:** this name has already been used once by the author and unfortunately published (Huber, 1980) as a bare name (nomen nudum) under a color photo, due to an error by the printer. However, from p. 111 of the Code of Nomenclature (glossary): "A nomen nudum is not an available name, and therefore the same name may be made available for the same or a different concept; in such a case it would take authorship and date [Arts. 50, 21] from that act of establishment, not from any earlier publication as a nomen nudum." According to ICZN rules, it is then possible to use *plagitaenium* for a different purpose: the new species belongs to the same genus (but not the same subgenus) and bears some similarity in pattern with the older unavailable name. The risk of confusion with the older acceptance is acknowledged, but very limited because the nomen nudum has been only quoted twice, since its first appearance in 1980, to simply mention its status.

#### In the Aquarium:

Like other components of the *elegans* superspecies, *plagitaenium* is bred without strong difficulties because the species male is peaceful with the female (incubation of the 1.2mm egg lasts about 3 weeks at 20-24°C); however, egg productivity is poor and sex ratios are often dis-equilibrated in favor of males so that the conservation of the strain requires patience and perseverance.

#### III. TEMPORARY CONCLUSIONS

After all, the paucity of our knowledge for this group remains: only time will help, together with an improvement of the political situation and with better roads in the — huge —

cuvette to allow in-depth collections. The scope is immense, but first of all, the task should commence by the live rediscovery and study of topotypes of the first historically described species, *elegans*, *decorsei*, *lujae*, *ferranti*, *schoutedeni*. Before this important step, it is the author's opinion that there is little interest to describe new taxa from the cuvette itself, even if they may be distinctive such as the present Oyo population, on the basis of a single location.

Our level of knowledge of the *elegans* superspecies in the cuvette remains desperately poor and only detailed sampling may help understanding the very complex systematic status of these fishes, together with the live re-discovery of older taxa at their type locality, to use them as the basis of re-diagnosis of more recent taxa.

This is the best optimistic message for a very pessimistic picture!

#### IV. ACKNOWLEDGEMENTS

This study would not have been possible without the kind encouragements of dedicated specialists of this group, Maurice Chauche, Heinz Ott, Axel Schwekendiek, Peter Tirbak, Ruud Wildekamp, Jouke van der Zee, and of Susan Steele, FAMA Assistant Editor.

Patrice Pruvost (MNHN, Paris), Oliver Crimmen and James MacLaine (B.M.N.H., London), and Uli Schliewen (ZSM, Munich) were helpful in managing the loans and in cataloguing the material. Ms. Hauteceur (MNHN, Paris) has kindly processed the radiographs for the study. Jeremy Smith and Dr Andrew Polaszek, members of the ICZN staff, were very kind and cooperative on the nomen nudum issue. Maurice Chauche has kindly offered his photos. Bill Gallagher, during my visit to San Francisco with my son Nicolas in 2002, was instrumental in attracting my interest on the Epoma fish in his aquariums. Heinz Ott was instrumental in friendly obtaining material to serve as types of the new species.

#### V. BIBLIOGRAPHY

Huber, J.H. 1978. Contribution à la Connaissance des Cyprinodontidés de l'Afrique Occidentale: Caractères taxonomiques et Tentative de Groupement des Espèces du genre *Aphyosemion* (Cyprinodontidés). Rev. fr. Aquariol., 5 (1): 1-29, 9 figs., 30 photos, 6 maps.

Huber, J.H. 1980. Rapport sur la deuxième Expédition au Gabon (Août 79). Etude des Cyprinodontidés récoltés. Rev. fr. Aquariol. Herpétol., 7: 37-42, 9 figs., tab., map.

Huber, J.H. 1992. Review of *Rivulus*. Ecobiogeography — Relationships. *Cybiu Suppl., Soc. fr. Ichtyologie Publ.*: 586 pp., 40 pls., 85 figs, 8 tabs, 13 maps.

Huber, J.H. 1994. *Aphyosemion passerai*, Espèce inédite du Gabon Sud-oriental, au Patron de Coloration unique et Description complémentaire de *Aphyosemion decorsei* Pellegrin. Rev. fr. Aquariol. Herpétol., 20 (1993): 77-79, 1 fig.

Huber, J.H. 1998. A Comparison of Old World and New World Tropical Cyprinodonts. A parallel Outlook of similar and distinctive Characteristics regarding Distribution, Evolution, Ecology, Behavior, Morphometrics, Genetics and Color Pattern. Soc. fr. Ichtyologie: 109 pp., 17 figs.

Huber, J.H. 2001 — 2004. Killi-Data online <<http://www.killi-data.org>>. A global Website dedicated to Oviparous Cyprinodontiformes or Killifish, with a Data Base on all known Taxa (files of the *elegans* superspecies: dated January 1, 2001).

Huber, J.H. in press. Identification of a small Collection of *Aphyosemion* from Zaïre in the Munich Museum (Z.S.M.), with further Comments on the Validity of the known Components of the *elegans* Superspecies.

Huber, J.H. & J.J. Scheel. 1981. Revue systématique de la Superespèce *Aphyosemion elegans*. Descriptions de *A. chauchei* et *A. schioetzi* n. sp. Rev. fr. Aquariol. Herpétol., 8: 33-42.

Murphy, W.J. & G.E. Collier. 1999. Phylogenetic Relationships of African Killifishes in the Genera *Aphyosemion* and *Fundulopanchax* inferred from mitochondrial DNA Sequences. Mol. Phylogenetics and Evol., 11 (3) (April): 351-360, 5 figs.

Stenglein, W. 1987a. Haut Zaïre 1985 — Reiseergebnisse. D.K.G. (Deutsche Killifisch Gem.) J., 19 (1): 10-16, 6 figs., map.

Stenglein, W. 1987b. Killifischbiotope in Nordost-Zaire. Aquar. Terr. Zeit. (D.A.T.Z.), 40 (11):481-484, fig.

Wildekamp, R.H. 1993. A World of Killies. Atlas of the Oviparous Cyprinodontiform Fishes of the World. Vol. 1 Amer. Killifish Assoc. Publ.: 311 pp, figs.

Paris, May 2003-August 2004

