

What are today's biggest challenges for a better knowledge of Killifish (oviparous Cyprinodontiformes)? Part Three.

Dr Jean H. Huber

25- *Aphyosemion ferranti*, *lujae*, *Epiplatys multifasciatus*:

This is an old case since the 3 names were described from the same locality (near Kondué, Kasai, Congo (today Zaïre) {4.983S;23.300E}); to collect there would allow a proper identification of the 3 phenotypes, an assignment to a phylogenetic group for *ferranti* and a new detailed study of the *multifasciatus* superspecies; and, by the way, another series of live discovery is to be found not "far" for the first time: *Hypsopanchax jubbi* (Near Zambezi source, Mwinilunga, Zambia {11.117S;24.117E}) and *H. jobaerti* (Lula, Mosanji river, S.W. Zaïre {7.217S;23.117E}), plus *Nothobranchius* species, *N. (Zono.) brieni* (Bukama, Shaba Province, S.E. Zaïre {9.208S;25.850E}), *N. (Zono.) malaissei* (1.5 km E. Kabiashia, S. Lake Moero, S.E. Zaïre {10.267S; 28.133E}), *N. (Zono.) polli* (Near Mwadingusha, Shaba, S.E. Zaïre {10.750S;27.250E}); really an undeserved situation ...

26- *Pterolebias bokermanni*, *luelingi* and the rediscovery of *longipinnis*:

Indeed a strange case that shows how things may change unexpectedly; since Thomerson [1984. *Rivulichthys luelingi*,

a junior Synonym of *Pterolebias longipinnis* (Pisces: Rivulidae). Copeia, (2): 528-529, fig.] the status of *luelingi* is fixed as a synonym; and since Costa [1988a. A new Species of the neotropical annual Fish Genus *Pterolebias* (Cyprinodontiformes, Rivulidae), from Brazil. J. Zool. Soc. London, 215: 657-662, fig.] *bokermanni* is also fixed as a synonym of *longipinnis*; however, Staack [1994b. Die Killifische Amazoniens. Aquar. Terr. Zeit. (D.A.T.Z.), 47 (11): 692-696, figs.], Huber (1995), Lazara (2001), Costa (2003), following collections in Brazil, Paraguay, Bolivia and Argentina and the observed variations in morphology and colour pattern, began to suspect that there may be more than one species there; *bokermanni*, described in 1955, from Rio Guajara-Mirim, Guaporé, W. Brazil {10.910S;65.150W} and *luelingi* described in 1969, from Rio Chapare, PK4 Todos Santos, Bolivia {16.830S;65.170W} might not be synonyms each other (*bokermanni* is anyway the older name) and above all, may well be distinct from the unknown live and very distant *longipinnis*; first step to prove it: the rediscovery of *longipinnis* at Santarém, Amazon river, Pará (state), Brazil {2.420S;

54.730W}, with as a bonus the simultaneous re-discovery of *Rivulus xanthonotus* at Obidos, near Santarém; a fascinating DNA sampling and morphological diagnosis are on the agenda, from lower Amazon to northern Argentina, over thousands of kilometres ...

27-melantereon: *Scriptaphyosemion* vs. *Epiplatys*:

This case is old and un-settled; *melantereon* has been described by Fowler [1950. Some Fishes from Liberia, West Africa, with Descriptions of two new Species. Notulae Naturae, 225: 8 pp., 2 pls., 11 figs.] from Robertsport, Liberia, collected by Charles R. Matlock Jr (1946) together with the types of *matlocki*, an acknowledged synonym of *Epiplatys fasciolatus* (and also coastal species such as *Pseudepiplatys annulatus*, *Poropanchax normani*, *Aplocheilichthys spilauchen*; the study of the types (juveniles) of *melantereon*, reported in Huber [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. Herpétol., 5: 1-29, 39 figs., 6 maps.], pushed to position the taxon in *Scriptaphyosemion* and then by zoogeography as a junior synonym of *liberiense*, and discards its placement in *Epiplatys*; however, Wildekamp [1996. A World of Killies. Atlas of the Oviparous Cyprinodontiform Fishes of the World. Vol. 3. Amer. Killifish Assoc. Publ.: 330pp,

figs.] still places the name in *Epiplatys*, as a nomen dubium (a doubtful name); then, the renewed study of the material in Philadelphia museum would be the simple answer, easy if only the types were fully adult fish...

28- *Lacustricola atripinna* and *bukobanus*:

This is a forgotten, but important case (*bukobanus* is the type species of the subgenus *Cynopanchax*); since Wildekamp [1995b. A World of Killies. Atlas of the Oviparous Cyprinodontiform Fishes of the World. Vol. 2. Amer. Killifish Assoc. Publ.: 384pp, figs], *Lacustricola atripinna* (*ex-Aplocheilichthys*) described from Busisi, southern banks of lake Victoria, Tanzania {2.733S;32.867E} is hypothesized to be a senior synonym from *bukobanus*, from Bukoba, also in Tanzania {1.333S;31.817E}; a simple, but unavoidable comparative study of the types of the 2 taxa, both in Berlin Museum, is a prerequisite before in-depth live collections...

29- *Fundulus kansae* and *zebrinus*:

This case is recent and emerged from the DNA evidence that the fish populations over the huge range may correspond to 2 distinct species (northern populations assigned to *kansae*, southern populations to *zebrinus*); both names have no serious type locality, though: *kansae*, Kansas state (without details), U.S.A. and *zebrinus*, between Fort Defiance (35.75N;109.11W) and Fort Union (35.92N;105.03W), (east-

ern) New Mexico state (probably in an upper tributary of Rio Grande del Norte or of Rio Brazos), U.S.A. (by the way, let's not forget the similar case of *sciadicus*, with Platte river, Nebraska, U.S.A., a very long river indeed, for type locality); hence, there is an urgent need for a proper systematic re-definition of these 2 taxa of the subgenus *Planterus*; it requires "old fashioned" ichthyologists who can carefully study very old publications and museum files in the USA and all are aging now...

30- *Aphyosemion exiguum* and *Epiplatys nyongensis*:

This case would have been anecdotal, only, a few years ago; both names are stable, systematically speaking : *exiguum* is a well know valid species, and *nyongensis* is an acknowledged junior synonym of *sangmelinensis*; the type locality (Nyong river, without detail) is identically labelled for *A. exiguum* and for *Ep. nyongensis*, but the collectors are not the same and the collections are not dated from the same year; Wildekamp [1993a. A World of Killies. Atlas of the Oviparous Cyprinodontiform Fishes of the World. Vol. 1. Amer. Killifish Assoc. Publ.: 311pp, figs.] did give geographical coordinates for the type locality of *exiguum*, but these correspond to the mouth of Nyong river into the Atlantic ocean : a very minor error, but unfortunate for this plateau-dwelling species; regarding *nyongensis*, it may end up into a problem too; Amiet has collected a strange distinctive *Epiplatys* species [pers. comm. and

Vandersmissen, J.P. 2003. Le Groupe *Epiplatys sangmelinensis*. Assoc. Killiphile Francophone de Belgique, Killi Contact, 30 (5-6): 1-24, figs, map.] that is less deep than *sangmelinensis*, with some resemblance to the *bifasciatus-chevalieri* superspecies at Andjeck, not far from the upper Lobo river, the type locality of *sangmelinensis* : the single type of both *nyongensis* and *sangmelinensis* should then be re-studied to clarify this point; another difficult (not anecdotal any more!) task for "old fashioned" (also aging) ichthyologists, but this time in London and Berlin and a necessary comparison with topotypic live material ...

31- Some disturbing *Aplocheilus* issues, *blockii*, *panchax*, *siamensis*, *andamanicus*:

The taxonomic situation is indeed below standard; most names have been described during the second half of the 19th century probably from colonial harbours (but without certainty) or from aquarium imports without precise origin (and often types are missing in addition); a dozen of names, most probably synonyms, then the stake is not major (*rubrostigma*, *vittatus*, *buchanani*, *chrysostigmus*, *kuhlui*, *melanotopterus*, *melastigmus*, etc.); the issue should at least be tackled for valid or maybe invalid names, though: *Aplocheilus panchax*, the oldest taxon (1822) with a complete re-definition and a precise type locality (Bengal, Ganges river basin, without details, India); *Aplocheilus blockii*, with a neo-type to be designated from Cochin,

Kerala, India, *Aplocheilus panchax andamanicus*, with the first live discovery and a neotype to be designated from Port Blair, Andaman Island, off Burma, India {11.670N;92.730E; *Aplocheilus panchax siamensis* with the disclosure of the precise origin (somewhere in Thailand of this distinctively patterned population) and a renewed live collection ...

32- The unsatisfactory situation of *Orestias*, intra-lacustrine speciation or not: this case is indeed an undeserved picture, with the genus *Orestias* being neglected despite its very high interest (the parallel situation of the Rift Valley Cichlids is strikingly opposite); the issue for these Andean fishes that have been uplifted by 4000 meters with the upheaval of the South American Cordillera, some 30 million years ago is: speciation (like in the Rift Valley lakes) or not? According to Parenti's morphological and osteological study [1984a. A taxonomic Revision of the Andean Killifish Genus *Orestias* (Cyprinodontiformes, Cyprinodontidae). Bull. Amer. Mus. Nat. Hist., 178 (2): 109-214, figs.], there are over 40 species, most of them being endemic to lake Titicaca; while according to crossings, morphological virus-induced variations and pattern variability, there are only 4 to 6 valid species in Villwock [1986. Speciation and adaptative Radiation in Andean *Orestias* Fishes. In: Vuilleumier, F. & Monasterio, M. (Eds). High Altitude tropical Biogeography .Oxford University Press & American Museum

of Natural History, New York: 387-403, figs.], Sienknecht [1992. Das Phänomen der Speziation in der Gattung *Orestias* aus dem Altiplano Südamerikas. Eine kritische Auseinandersetzung mit der Zuerkennung des Art-Status. Unveröff. Staatsexamensarbeit, Fach. Biol. Univ. Hamburg : 97 pp.], and Villwock [1993. Die Titicaca-See-Region auf dem Altiplano von Peru und Bolivien und die Folgen eingeführten Fische für Wildarten und ihren Lebensraum. Naturwissenschaften, 80 (1), Januar: 1-8, fig.]; in-depth collecting of material for a DNA study by Incas tourist aquarists (at least) is eagerly expected.

33- The numerous names with missing types or undisclosed type material:

This case is multiple and solving this case may be a prerequisite to further steps in research; first, localisation of *Aphanius* types in Turkey (plus other countries): despite the fact that Turkey is a country with stable Institutions and its Cyprinodont fauna is well known, type material of many species have not been located; such as Aksiray's taxa (mostly synonyms) plus others (maybe elsewhere): *aksaranus*, *altus*, *burdurensis*, *burduricus*, *flavianalis*, *fontinalis*, *iconii*, *litoralis*, *lykaoniensis*, *maeandricus*, *meridionalis*, *obruken-sis*, *parvus*, *venustus*, *sureyanus*, *transgrediens*, *alexandri*, *boulengeri*, *mentoides*, *orontis*, *similis*, *splendens*, or *anatoliae* (probably in Budapest), or *lineatopunctatus*, *macrogaster*, *nanus*, *sarda*, *thermarum*, *timidus* (all of them

described from various parts of the Mediterranean basin); second, important valid species with missing types or undisclosed types following Eschmeyer's Catalogue of Fishes: undisclosed holotypes of *Fundulus chrysotus*, *catenatus*, *floridensis*, *Cyprinodon riverendi* and *Lucania affinis*, no types "known" for *Fundulus het. macrolepidotus*, *diaphanus diaphanus*, *dia. menona*, *majalis*, *luciae*, *notatus*, *Cyprinodon rhomboidalis*, *variegatus variegatus*, var. *rivenrendi*, or *Aphanius fasciatus*; third, no more types (they are reported to be lost in MNHN) for *Valencia hispanica*: a neo-type from Cataluña should be designated; fourth, no types disclosed for *Fundulus badius*, *craticula*, *ornatus*, *swampinus*, *viridescens*, *multifasciatus*, *formosus*, *Fundulopanchax rubrofasciatus*, *Leptolebias fluminensis*, *L. sandrii*, *Leptolucania manni*, *Micropanchax keilhacki*, *Profundulus mexicanus*, *Orestias lastarriae*; this is a situation that is not acceptable and does not bear comparison with other groups of fishes [see Eschmeyer, W.N. 1998. Catalogue of Fishes. Calif. Acad. Sci. Publ., vol. 1: 1-958 (species A-L), vol. 2: 959-1820 (species M-Z), vol. 3: 1821-2805 (genera, species & genera in classification, bibliography) and online <www.calacademy.org>]; let's end this list of challenges, mostly very difficult to solve, by a call to join our forces and soon clean in front of our door ...

When these 33 challenges are resolved, a magnificent improvement will be achieved... but, sure, new chal-

lenges will arise !

III. Diagnostic challenges

The next challenges are certainly to build up more solid diagnoses or even to propose a first diagnosis for many valid Killifish species.

What is a diagnosis?

It is a definition, a statement that allows separation (from "dia", a Greek word) of knowledge (from "gnosis", a Greek word) ; with a diagnosis, a name at the species or at the genus level is defined as single, unique, in comparison to other, possibly related, names. With a diagnosis, the major issue is not to describe, but to separate.

Is it absolutely necessary ?

Yes, for 3 main reasons: first, a diagnosis is compulsory according to ICZN, the International Commission of Zoological Nomenclature (since 1930) ; second, a diagnosis is very useful and even unavoidable to build up knowledge on a given group (progress requires a step-by-step strategy), third, a diagnosis is today the major resource in building the systematic matrix of data that enables to develop phylogenetic trees with computer programmes.

Why are there diagnoses currently missing ?

The present unsatisfactory situation may originate from very old taxa (before 1930), from recently described taxa (by neglecting authors), from new data that change the composition of a group (new species of a known group, undisclosed data on live colour pattern

or ecology (etc.) ; besides, DNA results have reshuffled several of our "certainties"), from the first live collections of old taxa, etc.

Are diagnoses difficult to write ?

Yes and no. Obviously for a unique species, it is easy (*Adamas formosus* is the single Killifish "with a heart-shaped white blotch on front") for immediate characters (but other characters of that species, such as the faint dark vertical bar on eye or its larger eye or its unique behaviour, may not be easily disclosed); for a cryptic species, it may be very difficult, or said differently, it may need a detailed step-by-step analysis; a typical diagnosis must list a number of characters (live pattern, preserved pattern, juvenile pattern, mood-driven pattern, bones, rays, micro-morphological features, etc.) that are shared with other names or alternatively that are not shared with comparative names; and a character can be anything, such as the upper margin of the male Caudal fin, or the presence of a black spot in juveniles, or the shape of the Anal fin in adult female, etc. Today everybody has become familiar with this process, thanks to computer technology. Then, for a name, think of a simple character and answer yes (= "0") or no (= "1") for it and the related names : this is the beginning of your diagnosis... not easy to start, but after the initial effort, it is just a brain exercise !

What are the critically missing comparative diagnoses for oviparous Cyprinodonts?

1.the *Epiplatys fasciolatus-olbrechtsi*

superspecies, with more than 10 names and many that are difficult to set apart

2.the separation of *Kryptolebias marmoratus* and *ocellatus*, synonyms, subspecies or distinct species and their comparison with *caudomarginatus* and *brasiliensis*

3.the re-definition of all components of *Fundulopanchax gardneri-mirabilis* (more than 10 names)

4.the separation of all components of the *Rivulus urophthalmus* superspecies (more than 10 names)

5.the re-definition of the components of the *Cyprinodon variegatus* superspecies

6.the re-assignment of the Uruguayan populations of *Austrolebias adloffi* to Costa's new names

7.the comparative re-definition of the components of the *Nothobranchius guentheri* or *korthausae* superspecies

8.the comparative re-definition of the components of the *Micropanchax loati/kingii* superspecies

But this list is only an appetizer: actually most groups of Killifish would require a new diagnosis !

Who can help in securing and actually producing new diagnosis ?

Although the author's opinion may not be shared by all scientific schools, it appears that expert aquarists, notably those members of specialised study groups, have a lead on the issue. For several reasons: they own the live fish, they can observe their fish for long periods and at the various stages of their lives, they can compare related species by putting them close to each other (or, for males only, mixed togeth-

er in a single aquarium), they can exchange their findings with other experts, they can help scientists in producing their matrix of data to improve knowledge. These expert aquarists are able to write articles on breeding and maintenance, with a fine and detailed description of their fish: for them, to add a diagnosis to their article will require a more rational approach (is that character of species "x" also found in species "y", "z", is that difference between "x", "y", "z", stable or not, etc.?)... After a first experience, it will be considered as very attractive and more useful than just a detailed description! Notably, if it is undertaken within a local group meeting.

IV. Aquaristic challenges

Co-operation from aquarists is also questioned from the interior, i.e. by the aquarists themselves: "what can I do to help?" is a very common question.

Standard contributions are obviously welcome, but for experts, aquaristic challenges are to be targeted in priority.

What are the requirements ?

The requirements are obviously scientific, not in terms of education but in terms of spirit.

- * To be serious and curious, with modesty.

- * To observe without any "a priori" and repeatedly (at least twice the same observation).

- * To generate experimental observations, facts, and deductions without emotion.

Let's propose 4 candidate profiles,

according to age, experience, owned devices and funds.

The first challenge concerns documentary. The first requirement to improve knowledge is obviously to know and acknowledge what others previously published. The issue is not to write a witnessing report, but to report on the current state of the art, then to separately bring new data by forwarding new observations, by discussing and criticizing old observations (by the way, present times push us to forget everything: who can scrutinize old aquarium literature to report on first breeders for Killifish species - most data are missing ? ... It is a necessity -a "devoir"- of remembrance for those elderly aquarists who brought so much in the past).

The second challenge concerns collecting trips (if political conditions permit, obviously) : in this case, the issues are well known and are listed in Killi-Data books and online (where to go, when to go, the key success factors). With in addition, a kind request : to deliver findings (collecting localities, ecological observations and measurements) to others by publishing them and to keep material for researchers (only one specimen poured alive in 95% ethyl alcohol is enough to study genes and 2-3 specimens are minimum to study morphology and osteology... not a big burden). Sadly, many collecting trips have never been reported and all this knowledge is lost.

The third challenge concerns breeding: obviously the crossing experiments are never ended, most of the

results have been produced by Scheel and collaborators, several decades ago (and since then, few reports) and for obscure reasons some people erroneously discourage amateurs by saying that crossings are not useful any more (by the way, how many crossings have been undertaken between recently described South American annuals? None !). If crossings sound outdated, then why not tackle the embryology issue? It requires the purchase of a small microscope (priced today, less than 100 Euros or USDollars) and a strong curiosity: it is amazing how many details are available on the Killifish egg membrane, variably designed according to groups of species and how informative are the development steps of the embryo.

The fourth challenge concerns behaviour. Like for the today affordable microscope, this requires a lot of time and new equipment that aquarists may already have purchased for their family: a simple digital video camera. Only 2 years ago aquarists could not have imagined how they could bring value added on behaviour, but since then, the major contributions by the Brazilian Drausio Belote have been published [Boletim-do-Museu-Nacional-Rio-de-Janeiro-Zoologia 2002 28 Outubro; 489: 1-10, Reproductive behaviour patterns in the Neotropical annual fish genus *Simpsonichthys* Carvalho, 1959 (Cyprinodontiformes, Rivulidae): Description and phylogenetic implications / Boletim do Museu Nacional, Nova Série, Rio De Janeiro - Brasil, Zoologia N° 514, 10 de Fevereiro

2004, 5 Figures, Reproductive Behavior Patterns in three Species of the south American annual Fish Genus *Austrolebias* Costa, 1998 (Cyprinodontiformes, Rivulidae) / Archivos Do Museu Nacional, Rio De Janeiro, 61 (4): 241-244, 6 Figures, 2003, Reproductive Behavior of The Brazilian annual Fish *Cynolebias albipunctatus* Costa & Brasil, 1991 (Teleostei, Cyprinodontiformes, Rivulidae): a new Report of sound Production in Fishes / Boletim do Museu Nacional, Nova Série, Rio De Janeiro - Brasil, Zoologia N° 515, 19 de Fevereiro 2004, 1-7, 4 Figures, Reproductive Behavior Patterns in the Brazilian annual Fish *Plesiolebias glaucopterus* (Costa & Lacerda, 1988) (Cyprinodontiformes, Rivulidae, Plesiolebiatina)]. These articles open a vast and promising new field of observations for all Killifish.

V. Conclusion

There are no minor contributions and no minor co-operation. Co-operation, according to each one's capacities, is open to all who want to know more, to understand more and to share their findings.

Future success is in front of us... even if complexity is very high with Killifish.

Hopefully these systematic, diagnostic and aquaristic challenges will be a boost to our community and a spur to speed up knowledge progress on Killifish !

Paris, August 2003 - September 2004 (first available online on March 9. 2004, as Killi-Data newsletter "Infoweb 8", then enlarged to the aquaristic challenges for the present purpose)