What are todays biggest challenges for a better knowledge of Killifish (oviparous Cyprinodontiformes)? Part One.

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Abstract

Techniques and approaches in Systematics have strongly evolved in recent years for fishes and notably Killifishes (Pisces: oviparous Cyprinodontiformes) follow these trends. Thanks to computer software, researchers have become more analytical, bringing more sharply defined or extracted data from their observations. This concerns not only molecular techniques (DNA, RNA, from nucleus or mitochondria) obviously, but also morphology, osteology and lately behaviour. As a result of the availability of more numerous and sharpened data, systematics tend to split more and more, with the limit of differentiation being at the level of human eye, at least within the Linnaeus binominal nomenclature. To progress towards this asymptotic limit, 33 "biggest challenges" in terms of systematics are listed that remain unresolved for older names and an urgent call is given to win another challenge concerning "missing comparative diagnosis". Finally another type of challenge is proposed for action to expert and/or curious aquarists, according to 4 perspectives of cooperative contributions: documentary, collecting trips, breeding and behaviour.

I. Introduction

Techniques and approaches in Systematics have strongly evolved in recent years in biology. Fishes and notably Killifishes follow these trends.

Historically the first change towards more clear-cut criteria began with cladistics (www.cladistics.org), where any character is given a primitive status or a derived status, while only derived characters are considered to group related taxa with synapomorphies (common derived characters).

Thanks to computer software, such as PAUP, TNT, Hennig86, PHYLIP or NONA, researchers have become more analytical, bringing more sharply defined or resolved data from their observations. And the constraint of only considering derived characters has been levied while phylogenetic trees are computed no matter how is assigned each character (even in recent years software were able to compute with more than 2 states of characters, not only '0' for primitive, or '1' for derived, i.e. up to 5 states, plus an uncertain state labelled as '?'). Besides the computation became more and

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more easy and quick with processors speeding over 1 GHz and the matrix of characters could encompass several hundreds of them.
While the first computations were mainly addressed with limited osteological data -the backbone of cladistics- the technique today boosts not only molecular techniques (DNA, RNA, from nucleus or mitochondria) obviously (with at least 400 genetic characters per matrix), but also independently morphology, osteology and lately behaviour.
Today a matrix of a hundred morphological characters for members of a genus is not unachievable. We were even able to go beyond for a larger scope on upper level groups and superspecies [Huber, J.H. 1998d. A Comparison of Old World and New World Tropical Cyprinodonts. A parallel Outlook of similar and distinctive Characteristics regarding Distribution, Evolution, Ecology, Behavior, Morphomeristics. Soc. fr. Ichtyologie Ed., Paris (Oct. 10): 109 pp., 17 figs.].

However soon problems became apparent and the biological complexity of Killifish ironically jumped again on those who felt that computers and molecular technology were there for an ultimate answer. First, character states cannot be considered in absolute terms, but relatively to each analysed clade. Second, the main problem with the external morphology approach (and also with the osteological and molecular approaches) concerns frequent homoplasies (convergence and reversion), i.e. "faked" data. Third, the major objective of phylogenetic reconstruction -to recognize synapomorphies at nodes of each group- often meets proper difficulties with Killifish, because of their morphological uniformity and because of the limited options combined ad libitum by these fishes (and molecular data did not solve the issue).
Anyway, as a result of the availability of more numerous and sharpened data, systematics tend to split more and more, with the limit being at the level of human eye, at least within the Linnaean universe (binominal names and types in Museum Institutions).
And conversely the need for new data (= new characters, or redefined characters, or new states) has become overwhelming to feed matrixes and computer sessions, and produce new phylogenetic trees and iteratively new knowledge and new unresolved issues.

This is the whole story of necessary data (brand new, updated, or missing data) and obviously of Killi-Data online (www.killi-data.org) with the important additional remark that nobody is today able to produce alone enough new data (new characters, new states) to feed the matrixes and the computer sessions. Hence cooperation is imperious ! This means cooperation between everybody, both serious and curious, between professional researchers (who have the educational format) and amateur researchers (who have the dedication) and aquarists (who have time to observe their fish

alive, passion and funds to go collecting). Sharing is becoming the master word and aquarists within Killifish Association fit perfectly into that frame, obviously.

To progress towards this asymptotic limit of knowledge fulfilment, 33 "biggest challenges" in terms of systematics are listed that remain unresolved for older names and an urgent call -the diagnostic challenges- is given concerning "missing comparative diagnosis". Finally other challenges -the aquaristic challenges- are proposed for action to expert and/or curious aquarists, according to 4 perspectives of cooperative contributions : documentary, collecting trips, breeding experiments and behaviour.

Future success, if we are able to develop more and more the potentials of the cooperative platform that was created by Killi-Data online, is at our thresholds.

II. Systematic challenges

What are, according to the author, the 33 biggest systematic challenges regarding knowledge of Killifishes ?

1. *Rivulus micropus*
2. *"Cyprinodon" martae*
3. *Fundulopanchax spoorenbergi*
4. *Pachypanchax nuchimaculatus*
5. *Rivulus xanthonotus* and a final status for *Aphyosemion trilineatum*
6. *schreitmuelleri* : *Megalebias* vs. *Austrolebias*
7. *Cynolebias porosus*
8. *Laciris pelagica* and *Aphanius apodus*
9. *Pantanodon madagascariensis* and *Millerichthys robustus*
10. *Rivulus obscurus* and *ornatus*
11. *Aphyosemion bualanum*
12. *Aphyosemion escherichi* vs. *A. microphtalmum* issue (linked to *Plataplochilus ngaensis*)
13. *Fundulopanchax deltaensis, gularis, fallax, kribianus, schwoiseri*
14. *Fundulopanchax walkeri* and/or *spurrelli*
15. *Fundulopanchax powelli*
16. viviparous *Epiplatys bifasciatus /spilargyreius*
17. *Epiplatys lokoensis*
18. *Nothobranchius mkuziensis, orthonotus* and *rubroreticulatus*
19. *Poropanchax normani* and the Angolan lampeyes
20. *Rivulus holmiae* and *lanceolatus*
21. *Aphyosemion elegans* and *decorsei*
22. *Aphyosemion splendidum, batesii, kunzi*
23. *Hylopanchax silvestris* and *stictopleuron*
24. *Epiplatys nigricans* and *chevalieri*
25. *Aphyosemion ferranti, lujae, Epiplatys multifasciatus*
26. *Pterolebias bokermanni, luelingi* and the rediscovery of *longipinnis*
27. *melantereon* : *Scriptaphyosemion* vs. *Epiplatys*
28. *Lacustricola atripinna* and *bukobanus*
29. *Fundulus kansae* and *zebrinus*
30. *Aphyosemion exiguum* and *Epiplatys nyongensis*
31. Some disturbing *Aplocheilus* issues for *blockii, panchax, siamensis,* and *amanicus*
32. The unsatisfactory situation of

Orestias, intralacustrine speciation or not

33. The numerous names with missing types or undisclosed type material

These 33 systematic challenges are all thorny questions that remain in front of us, and now that the cooperative community of Killi-Data is a fact, not an idealistic dream, it is achievable... provided of course that political conditions in the concerned country are stable and health issues are secured, in case of needed new fish collections.

1- *Rivulus micropus*:

Since Huber [1992. Review of Rivulus. Ecobiogeography - Relationships. Cybium Suppl., Société Française d'Ichtyologie Publ.: 586 pp., 40 pls., 85 figs., 8 tabs, 13 maps], the status of that very old name (Steindachner, 1863), even older than *urophthalmus* described in 1866, is a major problem ; its type locality is so imprecise ("Rio Negro", a large river, more than 2000 kilometres long) and the morphology of the single type is so average (actually close to *urophthalmus / rubrolineatus* or to *limoncochae/iridescens*) that it seems a desperate case ; only, the study of old manuscripts at the Vienna Museum or the analysis of the specimens that were collected on the same day (by Natterer, in 1830 !) might provide with a clue regarding the exact type locality ... but then how to decide for a senior synonymy with *urophthalmus/rubrolineatus* (precisely, compressus has been described from the surroundings of Manaus) or with the fish with half the number of lines near Caudal peduncle (referable to aff. *limoncochae*) available in the Rio Negro, too... unless a consensus is raised among Cyprinodontiformes researchers to request ICZN to suppress the taxon *micropus* ...

2- "*Cyprinodon" martae*:

This question is currently under study by the author, after a first publication in 2000 [On nomina oblita among Cyprinodont Species. J. Amer. Killifish Assoc., 33 (2): 43-51] ; the single type clearly does not correspond to a Cyprinodon fish, but instead, it may be an annual form belonging to a new distinctive genus, according to the photograph. Pending the actual report on the study of that specimen by the author, the challenge lies in rediscovering the living fish near Santa Marta {11.250N;74.200W}, near the mouth of the Río Magdalena, in northeastern Colombia and at the same time, collecting fish corresponding to 2 names that may have been considered synonyms too quickly : *Austrofundulus myersi* and *Rachovia splendens* (both described by Dahl from Sincelejo {9.420N;75.720W}, northern Colombia) ; and, parallely, in assigning a precise type locality for the 2 older valid names, *Austrofundulus transilis* from Guarico State (without details), Orinoco basin, Venezuela and *Gnatholebias zonatus* from Guarito county (without details), Orinoco basin, Venezuela ...

3. *Fundulopanchax spoorenbergi*:

This case is apparently very simple, the name was described after an import from unknown origin (probably near the boundary between southeastern Nigeria and northwestern Cameroon, between Calabar and Mamfé) and the challenge is restricted to re-discover the fish ; however the original import brought 2 colour phases, apparently sympatric fishes, the other one being more closely related to a gardneri type [see Wildekamp, R.H. 1996. A World of Killies. Atlas of the Oviparous Cyprinodontiform Fishes of the World. Vol. 3. Amer. Killifish Assoc. Publ.: 330pp, figs.] ; if the sympatry is confirmed, then are there 2 distinct species or is it only polymorphism, and how should be re-evaluated the case of *Fp. obuduensis* [Wright, F. & J. Jeremy. 1974. *Aphyosemion gardneri obuduense*. A Description of a new *Aphyosemion gardneri* Subspecies from Nigeria. British Killifish Ass. Publ., Separatum, 103: 4 pp., fig.]? Another reason for in-depth collections in southeastern Nigeria and around...

4- *Pachypanchax nuchimaculatus:*

A difficult case, because the single type, rather distinctive [Huber, J.H. 1998a. Miscellaneous Notes on some Systematic Difficulties Regarding old World Cyprinodonts. J. Amer. Killifish Assoc., 31 (1): 3-17, 28-32] is from an unknown locality in Madagascar that is not a small island; however, the diagnostic character (at the origin of the name : marking on neck) and the recent knowledge that *Pachypanchax* is not present in the southern part of the island open the possibility of solutions, with necessary in-depth collections...

5- *Rivulus xanthonotus* and a final status for *Aphyosemion trilineatum*:

These 2 cases are rather similar, although they concern very distant fishes; both fishes have been described from aquarium imports without certain origins, but while the former has since long been considered as valid (with a lectotype in Berlin Museum), the latter is not seen the same by all researchers; *Rivulus xanthonotus* has its type locality as "Amazonas", however Hoedeman has restricted it to Obidos (but without evidence), near Santarem, lower Amazon, Brazil, i.e., not far from the type locality of *Pterolebias longipinnis,* another difficult case,

Aphyosemion trilineatum has its type locality in "Cameroon" (without details) ; Lazara, K.J. [1984. Killifish Master Index. 3rd Edition. Amer. Killifish Assoc. Publ.: 295 pp.] considers it as a possible junior synonym of *Aphyosemion cameronense,* while Wildekamp [1993a. A World of Killies. Atlas of the Oviparous Cyprinodontiform Fishes of the World. Vol. 1. Amer. Killifish Assoc. Publ.: 311pp, figs.] considers it as a nomen dubium (a doubtful name); to tackle again the issue means analysing closely the German aquarium magazines and German Aquarium Associations leaflets between 1920 and 1935 and pinpoint any new data : a frustrating, but necessary assignment.

(to be continued)