



Killi-Data Wassup n°5

Overview of Killifish research output

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Editor: Jean H. Huber (editor@killi-data.org)

EXCEPTIONAL EDITORIAL : a dedicated interview on annual-killi-dispersal

With Killi-Data Wassup n°5, this editorial is exceptional because it is a list of present questions and answers (not a real interview) between the editor (J.H.) and Martin Reichard (M.R.) after he, as a co-author, publishes a pioneering article on possible fish dispersion of *Austrolebias* sp. via swan faeces (or feces, or poops), herein also analyzed in the selection of publications [ref. Silva, G.G., V. Weber, A.J. Green, P. Hoffmann, V.S. Silva, M. Volcan, Lanés, L.E.K., C. Stenert, M. Reichard & L. Maltchik. 2019. Killifish Eggs can disperse via Gut Passage through Waterfowl. Ecology (The Scientific Naturalist), <https://doi.org/10.1002/ecy.2774>]:

(J.H.) What would you think be the possible individual scenarios of expansion (dispersion) for annual killifish (living in typical marginal niches that are seasonal), i.e. vicariance progressive invasion, flood exceptional events hazard expanded drops, river tectonics, bird transfers (including your evidence), storm transfers (thru sky), etc. and a word for each as reasoned probability?

(M.R.) It is important to stress that dispersal in waterfowl faeces is just one additional way to disperse and by no means we assume this is the major route that killifish travel. Vicariance, floods and tectonics remain main sources of ecological (lifetime) and biogeographical (population or species level) dispersal. At ecological scale, individuals are often dispersed by floods and this is how populations exchange genes and remain coherent (species unit). At evolutionary scale, a vicariance event, including tectonics, divides species ranges and make it possible for a new killifish species to become isolated and evolve. We may discuss whether this is mainly by adaptation to diverging environment or by genetic drift (random changes as time passes), but it is certainly a decent combination of both for the killifish (and especially for annual species). Birds, storms and similar routes for dispersion are additional level. They may explain some unexpected records but certainly do not drive biogeography. If we contrast vicariance and bird faeces dispersal, there is a good way to separate them using genetic data. Let's take a hypothetical example of population on a much higher altitude than the rest of the species. Such isolated population may have recently colonized the pool or area (for example via waterfowl faeces) or be ancestral population that sourced all lower altitude populations by flood-related dispersal. The two scenarios predict different variation of that population, even if the ancient population was repeatedly down to small population size (years with little success leading to few adults). There are relatively straightforward population genetic tests that can tell between the two scenarios, pending you have genetic samples from that and other populations.

(J.H.) Your results come up with 1 [hatched] egg out of a hundred, it is difficult to speak of 1% even if it speaks by itself, then how would you go further, to come closer to a more solid statistic value?

(M.R.) One percent value is given, because 5 eggs survived gut passage and four of them died only by fungal infections during incubation (2 eggs) or by injuries to their shell during manipulation (another 2 eggs) -but they were not harmed by swan digestive tract -we recovered them alive and developing. It was just suboptimal incubation because the eggs were inspected too often. Five out of 650 is not exactly 1%, I agree, but we round

that up from 0.8% as requested by editor and referees. I personally think that this survival rate is actually relatively (and surprisingly) high. My guess is that survival of killifish adults taken by flooding is similar.

(J.H.) If 1% is considered do you think it is enough or sufficient to open the opportunity to derive from it a stable strain in the field then after a period (of local competition, etc) and further either a distinct species or a population that will meet with other distant populations thence extending the range of the species?

(M.R.) The fate of egg-dispersed population would be the same as any other population founded by dispersing individuals. Most often, they will fail - for example not finding a mating partner, not reaching adulthood, not being able to compete with locally existing species etc. In some cases, new (unoccupied) pool can be colonized this way, in others new and existing species can coexist for a long term. And in some cases, a new species can replace the old one, of course. Community structure is dynamic, irrespective of the mode of dispersal. Again, flood-related dispersal would produce similar scenarios.

(J.H.) Then how could be found a fingerprint of such dispersions in present ranges (or is it that our knowledge of killifish range dispersions is totally insufficient... with present drainages (your previous paper with *Nothobranchius*) or past palaeo-drainages (my 'rearview' analysis [Ref.: 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. Société française d'Ichtyologie (S.F.I) Ed. : 109 pp., 17 figs.]?)

(M.R.) I keep re-iterating that nobody has ever suggested that waterfowl-assisted dispersal is a major way of colonization. It is, to our surprise and obviously also to surprise of others, a valid possible way. We know that plant seeds (and small seedlings!), live snails or other less protected invertebrates are quite commonly dispersed by birds. It was not expected that vertebrates can do the same, but we found that it is a viable option. Coming back to our *Nothobranchius* studies you refer to [Ref.: Bartakova, V., M. Reichard, R. Blazek, M. Polacik & J. Bryja. 2015. Terrestrial fishes: Rivers are Barriers to gene flow in annual fishes from the African Savanna. *Journal of Biogeography*, 42 (10) (October): 1832-1844, and Bartakova, V., M. Reichard, K. Janko, M. Polacik, R. Blazek, K. Reichwald, A. Cellerino & J. Bryja. 2013. Strong Population genetic structuring in an annual fish, *Nothobranchius furzeri*, suggests multiple Savannah Refugia in southern Mozambique. *Journal of Evolutionary Biology*, 13: 196-211, 4 figs., 4 tabs.], there are populations of *Nothobranchius pienaarri* and *Nothobranchius orthonotus* in Kruger National Park, much higher {altitude-wise} than the closest populations in Mozambique. They may be ancient populations or travelers that colonized the pools in Kruger anytime over the last few glacial cycles. Given that we do not possess permits to sample in Kruger, unfortunately we do not know. We have no genetic samples from those populations and we cannot use captive populations for that reason. But I can imagine it is a candidate story. Still, they may be the most ancient populations – they are two hypotheses that can be tested.

(J.H.) Then why are the present ranges of killifish not much more complicated (e.g. a patchwork of discontinuous distribution) than what we presently see (except the dreadful situation of the area concerned by *Austrolebias* and *Cynopoecilus*, or *Phalloceros* with huge speciation)?

(M.R.) This is because that mode of dispersal is rare. It is quite telling that you specifically mention *Austrolebias* and *Cynopoecilus* – the two genera that we confirm to be potentially dispersed that way! It could be that their protective layers are especially well prepared for surviving swan ingestion. Or maybe coscoroba swan is ideal disperser as it feeds on debris from pool bottom and this dispersal is only possible in regions where coscoroba swans live. Just think about the contrast in bottom layers in killifish pools of Africa (soft mud, often anorganic layer) with Brazilian and Uruguayan pampa (plant debris). I assume that in Africa, no waterfowl is keen on ingesting soft smelly mud while, in Brazil coscoroba swans may like to feed on plant material on the bottom.

(J.H.) Then why are the present sympatry of killifish not much higher than what we presently know (although 5 annual species together at the same spot may be considered as already high but it seems to be a maximum rare case)?

(M.R.) In addition to what I have said so far, there is a limit in ecological niches (ways of life how a species can survive in a long term) in small marginal habitats. Five species is a lot, and it is difficult to imagine long-term coexistence of more killifish species in a small pool. So, to sum up the main points I wanted to make relate to the fact that nobody argues that this mode of dispersal is common. It does happen and adds to the possible ways to colonize new habitats, especially in remote places. Remember, mutations are also rare but we know they happen. More importantly, we also know that they may be a kind of 'targeted' dispersion, similar to what we see in coscoroba swans. As they travel between water bodies, they defecate more often in target habitats for killifish egg dispersal than elsewhere.

{warmest thanks to Martin Reichard, for dedicated time, cooperation and support}

VIEW FROM THE CHAIR

Killi-Data Wassup n°5 contains several features that push to some comments raised from some of the selected publications in view of the translation of their results into Killi-Data, and not as opinions or judgments on the quality of those research papers.

First, a breakthrough paper in understanding genetic differentiation with short life span in African strict annuals (vs. non annuals and semi-annuals). Results show that genome-wide relaxation of selective constraints dominates evolution of short lifespan in African killifishes ; the paper is based on full genomes (not short sequences only) and concerns a wide selection of species in *Nothobranchius* (obviously), *Pronothobranchius*, *Fundulosoma* (all strict annuals), *Fundulopanchax*, *Callopanchax*, and , as non-annuals, *Aphyosemion*, *Archiaphyosemion*, *Scriptaphyosemion*, and *Epiplatys* ; in short, accumulation of deleterious gene variants affects lifespan and aging ; from those results which tend to disclose another evidence of {still not clear cut} differentiation between annuals and non-annuals (besides, egg development, behavior, etc.), a series of question can be raised to go further (transversal thinking) : (1) the authors do not analyze or refer to previous evidence that *Austrolebias* sp. have large genomes, putatively due to genome instability (including genome enlargement and rearrangements) and this may have something to do with burst speciation [ref.: Garcia, G., V. Gutiérrez, N. Rios, B. Turner, F. Santinaque, B. Lopez-Carro & G. Folle. 2014. Burst speciation processes and genomic expansion in the neotropical annual killifish genus *Austrolebias* (Cyprinodontiformes, Rivulidae). *Genetica*, 142 (1): 87-98, 4 figs.] and it is not known if there might be a link with present results ; (2) in non-annuals too, some of the results of that paper could apply to any species ; there are so called long-term 'bottleneck' species that bear some analogy with the present evidence (accumulation of deleterious alleles) ; for example, *Cyprinodon diabolis*, with its extremely small population size, may be declining because of mutational load resulting from relaxed selection relative to genetic drift ; weak natural selection relative to the strength of genetic drift would promote accumulation of minor deleterious alleles ; this could explain the difficulty in culturing the species in laboratory (compared to other congeners) and the drastic decline in population size that occurs since 1996 ; for example, in *Xiphophorus malinche* (viviparous Cyprinodontiformes), another bottlenecked population from highlands in Mexico, a much lower genetic diversity than their lowland counterparts is observed, and fish are difficult to keep alive in the lab too (*Nothobranchius furzeri* from the dry highland region also needs quite some attention to keep well in the lab) ; for example (more speculatively), it would be interesting to study whole genomes of intralacustrine burst speciation in highlands for *Orestias* (40+ species) and in lowlands for the Chichancanab sp. flock (7+ sp.) in *Cyprinodon* (more standard, apparently) (note : many thanks are due to Rongfeng Cui and Tony Echelle, for discussions and valuable comments).

Second, a remarkable thesis by Brazilian Ywamoto on *Rivulus santensis* s.s. {in *Atlantirivulus*, subgenus of *Rivulus* or full genus depending on authors}, widely distributed along the coastal drains of São Paulo, Brasil, based on detailed morphological analyses (with variability data) and molecular analyses (short sequences, DNA Barcoding) for 9 populations {which shows the high requirements to obtain such a degree today} ; the 9 groups of populations are packed into 3 tree branches of phylogenetic clusters and according to the author, some of them may possibly be considered as new species in the future ; the distribution of the 3 clusters (first, Peruíbe, Pedro de Toledo {presumably type locality after neotype designation by Huber (1992)} and Itanhaém, the second from Santos, itself, Mongaguá and São Paulo, and the third from Maresias, Bertioiga and Ubatuba) is detailed and distribution boundaries are proposed with closely related *Rivulus simplicis* (North to Paraty, Rio de Janeiro state) and *Rivulus ribeirensis* (from Juquiá,-Sao Paulo state, more southerly).

Third, a twinned article and submission to ICZN ruling by Laan & Nieuwerkerken (an entomologist) and by Laan alone concern (1) family Rivulidae, a name that is disclosed as preoccupied by Laan, Eschmeyer & Fricke (2014) and (2) the spelling of various family-group names (FGN) of lower ranks built upon the old name *Lebias* ; for the former, ruling requests to keep Rivulidae for the fish (and killifish) and to change the moth name to Rivulainae, even if it is more senior, and it appears the best solution in terms of conservative principles because the (killi)fish FGN is universally used and accepted ; because the paper is co-signed by an entomologist, it is likely that no contradiction shall arise and the decision will be considered as settled in say 1-2 years {but if an author contradicts the request, then a full formal vote and decision will be necessary by ICZN commissioners, then several more years will be needed} ; for the latter, ruling for FGN linked to *Cynolebias*, *Plesiolebias*, *Pterolebias*, *Leptolebias*, *Spectrolebias*, *Aphyolebias* requests that good spelling as published by Huber (2005) is used, e.g., for *Cynolebias* derived FGN, as Cynolebiinae, and not the erroneous Cynolebiatinae, and not Cynolebiasinae, still correct, but a late comer (and likewise for the other concerned FGNs) ; the author then proposes to other authors part of the killifish community to be clear and homogenous for everybody (at least in terms of communication), but do not tackle the case of Kryptolebiatinae because that name, published in 2004, follows the new ICZN code since 2000 and cannot be changed, even if erroneously rooted... unless the ICZN Commission, within its plenary power, decides to change it to Kryptolebiinae and clears out everything altogether {for all those cases with bad spelling, time will tell, nothing is sure based on Anablepsidae experience}.

SELECTION OF PUBLICATIONS

- Innal, D., S.S. Güçlü, M.C. Ünal, B. Dogangil & D. Giannetto. [Innal et al. report on LHT (age structure and length-weight relationship) of 4 threatened *Aphanius* sp., *iconii*, *saldae*, *sureyanus*, *transgrediens*, native to a relict lake area, named Lake District, in southwestern Turkey, characterized by several saline and freshwater lakes ; Geiger et al. (2014) report 14 species of *Aphanius* from Turkey, most of them endemic only to a single or a few basins ; specimens are sampled by a shore seine net from Lake Egirdir (*iconii*), Lake Salda (*saldae*), Lake Burdur (*sureyanus*) and Lake Acıgöl (*transgrediens*) during 2014-2015 ; they are grouped in 4 classes of age ; maximum age for *iconii*, *saldae* and *sureyanus* is 4 years and for *transgrediens* is 5 years ; a new maximum total length of 6.1 cm for *transgrediens* is documented ; overall sex ratios (female:male) are distinctive: 0.76 for *iconii*, 0.17 for *saldae*, 2.39 for *sureyanus* and 1.84 for *transgrediens*. 2019. A.Z.B., <http://www.acta-zoologica-bulgarica.eu/downloads/acta-zoologica-bulgarica/2019/71-2-211-217.pdf>] {Jean Huber, 6-July-2019}
- Cui, R., T. Medeiros, D. Willemsen, L.N.M. Iasi, G.E. Collier, M. Graef, M. Reichard & D.R. Valenzano. [Cui et al. show genome-wide relaxation of selective constraints points evolution of short lifespan in strict annuals ; highlights: (1) whole-genome sequences of 45 African killifish species, (2) relaxed selection leads to larger genomes in short-lived annual killifish, (3) population bottlenecks affect the distribution of aging variants in fish and humans, (4) natural polg {a modulating gene} variants in annual killifish cause high rate of

mtDNA mutations ; results, in short, show accumulation of deleterious gene variants affects lifespan and aging ; in studied annual species, genetic drift leads to the expansion of nuclear and mitochondrial genomes and causes the accumulation of deleterious genetic variants in key life-history modulating genes such as mtor, insr, ampk, foxo3, and polg. 2019. Cell, [https://www.cell.com/cell/pdf/S0092-8674\(19\)30632-4.pdf](https://www.cell.com/cell/pdf/S0092-8674(19)30632-4.pdf)] {Jean Huber, 28-June-2019} <°))>< <°))>< <°))><

- Burg, G.C., J. Johnson, S. Spataro, A. Okeefe, N. Urbina, G. Puentedura, M. Heuton, S. Harris, S. D. Hillyard & F. van Breukelen. [Burg et al. report on 9 years of lab maintenance of *Cyprinodon diabolis* and *Cyprinodon nevadensis mionectes* with preferred 28°C and plant coverage ; the experiment concerns the optimum water temperature between 28°C or 33°C, both ecologically relevant and the interest or not of coverage ; fish acclimated to both temperatures prefer 28°C (fewer eggs at 33°C) suggesting native habitats such as Devils Hole are not optimal {but this is not modifiable in Devils Hole} ; in lab, providing cover with aquarium plants and carpet squares increases egg deposition and larval survival (less newly hatched larvae and egg cannibalism) ; besides, in the wild, the decline of native population of *diabolis* coincides with a change in algal community from mats of green algae to sheet forming cyanobacteria, and according to the authors, restoring such cover in Devils Hole should have a major impact on enhancing survivorship. 2019. E.B.F., <https://rd.springer.com/article/10.1007%2Fs10641-019-00887-2>] {Jean Huber, 23-June-2019} <°))>< <°))>< <°))><
- Silva, G.G., V. Weber, A.J. Green, P. Hoffmann, V.S. Silva, M. Volcan, Lanés, L.E.K., C. Stenert, M. Reichard & L. Maltchik. [Brazilian-Czech team demonstrates first that *Austrolebias minuano* eggs digested in swan feces are still viable and can hatch dispersed kilometers away ; this is the first experimental evidence that dispersal to remote locations can be facilitated by water birds, but that dispersal is not due, here, to eggs trapped in bird feet or feathers {as rationally anticipated} but to ingested killifish eggs, inadvertently or not, via faeces, and when released the concerned eggs are capable of continuing their development ; the case of 1 egg out of about one hundred ingested, for *Austrolebias minuano*, is reported as hatched after spending over 30 h inside a swan ; then it should probably be a rare event compared to standard dispersal ways, but with the huge scale of the wild (in terms of birds and eggs), it is not negligible {note : a didactic article for lay public is published by the New-York Times at <https://www.nytimes.com/2019/06/14/science/killifish-eggs-swan-poop.html>}. 2019. Ecol., <https://esajournals.onlinelibrary.wiley.com/doi/10.1002/ecy.2774>] {Jean Huber, 15-June-2019} <°))>< <°))>< <°))><
- Lucon-Xiccato, T., Anastasia, N., Mazzoldi, C. & M. Griggio. [Lucon-Xiccato et al. show in mixed-sex pairs and familiar pairs of *Aphanius fasciatus* that larger fish follow as much as smaller ; living in a group of fish offers the chance to follow the choices and the behaviors of other individuals, with possible fitness advantages such as better access to food led by dominant and or experienced specimens in group ; the herein experiment focuses on pairs of *Aphanius fasciatus*, exploring a new environment, and records whether the rear fish follows the front fish when the latter changes swimming direction ; results reveal that decisions to follow or not by rear fish are determined by the size of the individuals, their level of familiarity, and their sex (e.g., in female and male pairs and in unfamiliar pairs, smaller fish are more likely to follow the directional change of the larger fish than vice versa). 2019. SciNat, <https://link.springer.com/article/10.1007/s00114-019-1630-0>] {Jean Huber, 14-June-2019} <°))>< <°))>< <°))><
- Bertoli M., P.G. Giulianini, J. Chiti, M. De Luca, P. Pastorino, M. Prearo & E. Pizzul. [Bertoli et al. report on life history traits of 8 northern populations of *Aphanius fasciatus*, near Venezia ; 5 age classes are determined with no significant differences for total length and weight between sexes ; sex ratio as 2.37 favors females {but reversed observations have been published by other authors} ; no significant differences on 7 meristic characters are disclosed between sexes, except for the number of vertical side bars in 0+ and 1+ age classes ; gonadosomatic index points out maximum values in June for females (11.44

%) and in July for males (5.74 %) and minimum value in late August for females (0.42 %). 2019. T.J.F.A., http://www.trifas.org/uploads/pdf_1440.pdf] {Jean Huber, 11-June-2019} <°))>< <°))>< <°))><

- Vrtilek, M., J. Zak, M. Polacik, R. Blazek & M. Reichard. [The Reichard team confirms population density negatively impacts maximum body size in sympatric *Nothobranchius furzeri*, *pienaari*, *orthonotus*. 2019. JFB, <https://onlinelibrary.wiley.com/doi/abs/10.1111/jfb.14052>] {Jean Huber, 23-May-2019} <°))>< <°))>< <°))><
- Passos, C., N. Vidal & A. D'Anatro. [Passos et al. show in *Austrolebias reicherti* male selection for larger female as attributable to her higher reproductive success. 2019. J.Eth., <https://link.springer.com/article/10.1007/s10164-019-00601-w>] {Jean Huber, 23-May-2019} <°))>< <°))>< <°))><
- Ywamoto, E.V. [Ywamoto segments *Atlantirivulus santensis* {K-D maintained in *Rivulus*}, in 3 groups of populations with mit-DNA, from South Paraty to Juquia. 2019. Ph.D., https://repositorio.unesp.br/bitstream/handle/11449/181900/ywamoto_ev_me_bot_par.pdf] {Jean Huber, 8-May-2019} <°))>< <°))>< <°))><
- Laan, R. van der. [Laan submits to ICZN correction ruling FGN linked to *Cynolebias*, *Plesiolebias*, *Pterolebias*, *Leptolebias*, *Spectrolebias*, *Aphyolebias* ; the purpose of this application under Article 78.2.3 of the Code is to stabilize the spelling of various junior subjective synonyms of the fish family Rivulidae proposed before 2000 ; the confirmation of -lebi- as the correct genitive stem under the Code for fish genera with names ending in -lebias is requested. 2019. BZN, <https://biotaxa.org/bzn/article/view/50649>] {Jean Huber, 6-May-2019} <°))>< <°))>< <°))><
- Laan, R. van den & E.J. van Nieuwerkerken. [Laan+Nieuwerkerken submit to ICZN ruling junior preoccupied FGN Rivulidae be maintained and senior name in moths be changed to Rivulainae ; the purpose of this application, under Articles 55.3.1 and 78.2.3 of the Code, is to resolve the homonymy between the family-group names Rivulini Grote, 1895 in Lepidoptera and Rivulini Myers, 1925 in Pisces ; it is proposed that the stem of the generic name Rivula Guenée in Duponchel, 1845 be emended to Rivula-, so as to change the spelling of the moth family-group name, currently as the subfamily Rivulainae, while leaving the fish family-group name unaltered. 2019. BZN, <https://biotaxa.org/bzn/article/view/50643>] {Jean Huber, 2-May-2019} <°))>< <°))>< <°))><
- Macaya, C., N. Lam, N. & I. Vila. [Macaya et al. detail 21 stages in egg development of *Orestias ascotanensis*, as a partial spawning species (at least with hormone therapy). 2019. EBF, <https://rd.springer.com/article/10.1007%2Fs10641-019-00859-6>] {Jean Huber, 11-April-2019} <°))>< <°))>< <°))><
- Ouanko, A.D.K., B.G. Goore, T.M. Kamelan, M. Bamba & E.P. Kouamelan. [Ouanko et al. separate *Nimbapanchax petersi* {K-D maintained in *Archiaphyosemion*} and *Epiplatys sheljuzhkoii* on ecology of Banco River (National Park of Banco) in 4 populations where they can be sympatric ; according to the authors, *Epiplatys chaperi sheljuzhkoii* selects habitats with mud, clay and deadwood-foliage mixture while *Archiaphyosemion petersi* target rocky and more oxygenated environments {which are unexpected results}. 2019. JAB, <https://m.elewa.org/Journals/wp-content/uploads/2019/03/10.Ouanko.pdf>] {Jean Huber, 9-April-2019} <°))>< <°))>< <°))><
- Labbaci, A., L. Chaoui & M.H. Kara. [Labbaci et al. report on LHT of *Aphanius fasciatus* from Mellah lagoon, East Algeria, with again females larger and more numerous ; on a total of 1169 specimens ranging from 14.3 mm T.L. to 54.4 mm, caught monthly from January to December 2012, maximum life expectancy is 6 years, sex-ratio is 1:1.6 in favor of females, reproductive season extends from February to July and length at first sexual maturity is 3.84 cm for male and 4.14 cm for female {note : it is a pity the authors cannot collect also between Sétif and Bathna (today Batna), northeastern Algérie, the type locality of *Aphanius thersites*, unknown live since description by Eichwald, in 1851, and confirm or not its junior synonymy

with *Aphanius fasciatus* s.l.}. 2019. EBF, <https://link.springer.com/article/10.1007/s10641-019-00863-w>] {Jean Huber, 20-March-2019} <°))>< <°))>< <°))><

- Bragança, P.H.N. & W.J.E.M. Costa. [Bragança and Costa reshuffles lampeyes molecular data, confirming distinct family, yet without many (coming) changes in genera taxonomy ; this is part of Ph.D. study by first author (and student of second author) that is published in a series of independent papers ; it is not analyzed herein, pending the publication of the next paper {announced, but not yet published, even online in June 2019}, except to mention that with those molecular results including 36 species representing all Procatopodidae genera except the monotypic *Apticheilichthys*, (1) Procatopodidae is a distinct family of killifish, *Procatopus* being the most basal genus, linked to *Valencia* and *Aphanius*, not to Poeciliidae anymore, (2) most genera and subgenera will be impacted by those results- like in most (all) molecular studies the phylogeny is in line with biogeography and contradicts morphology and micro-morphology and global osteology, (3) then Clausen and Wildekamp neuromast patterns and other micromorphological characters are outdated (1966 onwards up to 2004), even if they are already questioned by Huber (1981), (4) then Huber (1999) with computerized morphological systematics and Ghedotti with osteological findings (2000) are outdated too {note : passionate aquarists are kindly asked to forget a little while emergency alerts of changes in buoyant social networks and simply wait for the announced coming publication where everything is clarified with Bragança's detailed results}. 2019. ODE, <https://rd.springer.com/article/10.1007%2Fs13127-019-00396-1>] {Jean Huber, 16-March-2019} <°))>< <°))>< <°))><
- Jung, E.H., K.V. Brix & C.J. Brauner. [Ellen et al. confirm separation of *Cyprinodon variegatus* and *hubbsi* on temperature tolerance in the wild, but not significantly in lab and they are considered as subspecies by the authors ; freshwater *Cyprinodon variegatus hubbsi* diverges from its euryhaline relative *Cyprinodon variegatus variegatus* ca. 150 KYA {thousands of years of age} and these subspecies are physiologically distinct in their osmoregulatory capabilities ; the latter inhabits intertidal estuaries and saltwater marshes along the Gulf of Mexico and Atlantic coast, where they experience a broad temperature range from -1.9°C to 43°C and frequent bouts of hypoxia, whereas the former lives in several lakes in central Florida, where temperature is more stable (12°C-31°C) and hypoxia is uncommon ; the present experiment discloses differences in temperature and hypoxia tolerances between the 2 taxa, but they are not significant {therefore *hubbsi* and *variegatus* s.l. (including *ovinus*) are distinct biological species but in lab represent a single evolutionary unit (ESU) {and various authors consider them either as 2 distinct species, ecologically and geographically separated, like in Killi-Data, or subspecies to one another, along many other subspecies already named for *variegatus* s.l.}. 2019. CBPA, <https://www.sciencedirect.com/science/article/pii/S1095643318301600>] {Jean Huber, 13-March-2019} <°))>< <°))>< <°))><
- Volcan, M.V. & F.S. Neto. [Volcan and Neto describe *Austrolebias ephemerus* from upper rio Paraguai basin, Chaco, as northernmost record of genus in S.W. Brasil ; the new species is only described on a combination of characters, i.e., Pectoral fin posterior margin reaching vertical between base of 4th and 7th anal fin rays in female, a high number of gill rakers in first branchial arch, a lower head width in both sexes, and a small number of neuromasts in preopercular series, among a group of species known as the *bellottii* superspecies (*accorsii*, *bellottii*, *ephemerus*, *melanoorus*, *queguay*, *univentripinnis*, *vandenbergi*) which are very variable within and between populations for each component ; the authors present a distributional map where *ephemerus* single locality is placed eastwards from *vandenbergi* and southeasterly from *accorsii* in Bolivia, but most of the region in Brasil, in neighboring Paraguay, east of rio Paraguay, is totally un-prospected {anecdotal notes : the name is trivial but excellent and it is surprising it is not used before ; besides, during the 19th century several of such trivial names with characteristics shared by other congeners -e.g. *viviparus*, are erroneously changed for new ones by authors including French Valenciennes, because they are too trivial... times change!}. 2019. Zootaxa,

<https://www.mapress.com/j/zt/article/view/zootaxa.4560.3.6>] {Jean Huber, 26-February-2019} <°))>< <°))>< <°))><

- Garcia, D., M. Loureiro, E. Machin & M. Reichard. [The Loureiro team presents LHT {life history traits} of 4 sympatric *Austrolebias* in 18 Uruguayan pools (*bellottii*, *nigripinnis*, *elongatus* and *alexandri*). Samples concern 18 pools in the lowlands of confluence of rio Negro and rio Uruguay in western Uruguay, with 16 sampling trips ; *Austrolebias bellottii* is a ubiquitous and generalist species, *nigripinnis* is more common in pools influenced by active floodplain, *elongatus*, a large predatory species, is rare overall, and *alexandri* is found only in 2 pools. 2019. EBF, <https://rd.springer.com/article/10.1007%2Fs10641-019-00854-x>] {Jean Huber, 22-February-2019} <°))>< <°))>< <°))><
- Costa, W.J.E.M. [Costa describes *Nothobranchius kwalensis* and *prognathus*, related to *melanospilus*, based on museum specimens from respectively Kenya and Tanzania, previously identified by several authors, notably expert Ruud Wildekamp, as *melanospilus* {with some populations maintained in aquariums that should be relabeled, e.g., for *prognathus*, Kidete (TZL 01-15), Kimamba, Mvumi, Saadani (TZ 99-13) (aff.) are previous populations of *melanospilus*, and for *kwalensis*, Kaioleni (aff.), Mrima (aff.), Ramisi are previous populations of *melanospilus*, but this is tentative and experts are puzzled by those new names like for *Nothobranchius insularis* also described by Costa, in 2017 {note : the article is fully available, even in its online version as a PDF, freely readable but totally crypted even the abstract text}. 2019. VZ, [http://www.senckenberg.de/files/content/forschung/publikationen/vertebratezoology/vz69-1/02 vertebrate zoology 69 1 2019 costa.pdf](http://www.senckenberg.de/files/content/forschung/publikationen/vertebratezoology/vz69-1/02%20vertebrate%20zoology%2069%201%202019%20costa.pdf)] {Jean Huber, 15-February-2019} <°))>< <°))>< <°))><
- Nagy, B. [Nagy describes cryptic *Nothobranchius taiti*, from Lake Kyoga basin (upper Nile) in Uganda, in *taeniopygus* group (previously misidentified as *taeniopygus*, or as sp. cf. *taeniopygus*, or later as sp. Apapi). The species is known since preserved collections by Tait (hence the name) and live collections probably at the end of 1970ies ; it is diagnosed from all congeners by combined colors of male on blue sides (7 to 10 irregular red-brown vertical bars) and unpaired fins (with differently arranged transversal bands) {note : among aquarists, *taiti* is previously identified as sp. Apapi-Madi or sp. Apapi}. 2019. IEF, <https://pfeil-verlag.de/publikationen/nothobranchius-taiti-a-new-species-of-annual-killifish-from-the-upper-nile-drainage-in-uganda-teleostei-nothobranchiidae/>] {Jean Huber, 11-February-2019} <°))>< <°))>< <°))><
- Valdesalici, S., A. Brahim & J. Freyhof. [Valdesalici et al. identify molecularly and morphologically *Aphanius almiriensis* from S.E. Italy, originally described from W. Greece ; *Aphanius almiriensis*, a cryptic species, is only known with certainty from 2 very close localities in western Greece {other reports from eastern Greece and Turkey, are uncertain identifications, based on Triantafyllidis et al. [ref. Triantafyllidis, A., I. Leonardos, I. Bista, I.D. Kyriazis, M.T. Stoumboudi, I. Kappas & T.J. Abatzopoulos. 2007. Phylogeography and genetic Structure of the Mediterranean killifish *Aphanius fasciatus* (Cyprinodontidae). Mar. Biol., Springer, 152 (5): 1159-1167]} ; it is reported from Italy, based on molecular and morphological characters ; according to the authors, *almiriensis* might be native to the Palude del Capitano, alternatively it might come from an import with goods from the eastern Aegean in the late Republican age and the late Imperial period {but they do not address the issue that *almiriensis* populations can be a mere molecular and pattern variation of *fasciatus* and its junior synonym as proposed by other previous authors, e.g., Kärst, H. & J. Warner. 2010. *Aphanius almiriensis*- Impressions in Nature and first Steps in keeping them. British Killifish Association (B.K.A.), Killi News, 536 (May-June): 49-53, 10 figs.}. 2019. JAI, <https://onlinelibrary.wiley.com/doi/10.1111/jai.13873>] {Jean Huber, 7-February-2019} <°))>< <°))>< <°))><

Nielsen, D.T.B. & R. Britzke. [Nielsen and Britzke describe cryptic *Melanorivulus aithogrammus* {K-D maintained in *Rivulus*}, *zygonectes* group, from rio Tapajos basin ; this is the 62nd species in subgenus *Melanorivulus*, this time from outskirts of the lower Amazon basin in Para state, northeastern Brasil ; it is

diagnosed from components of *zygonectes* group by a combination of male colors and a key to the species belonging to that group is presented {although it is apparently not given as diagnostic in description, *aithogrammus* is characterized by the low number of Anal fin rays}. 2019. Aqua, https://aqua-aquapress.com/product/aqua-251_melanorivulus-aithogrammus/] {Jean Huber, 6-February-2019}

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