Livebearer News

Official Members Magazine of the
BRITISH LIVEBEARER ASSOCIATION

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B. L. A.
Est 2002

Issue 78

June

2024

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Data Protection Act

In order to comply with the requirements of the Data Protection Act, we need to inform members that their name, address, email address and telephone number are being maintained on a database, the purpose of which is for the distribution of the Association's magazine and to inform members of forthcoming events. This information will not be provided to any other organisation for any purpose whatsoever without prior consultation. The association agrees to remove any details at a member's request.

Committee

Editorial

I must start by thanking Dan Fromm, again, for contributing articles and for putting my efforts into a much more professional look when he sub-edits this newsletter. I must also give a big vote of thanks to all those who made the Bristol show and auction the success that it was. It was an excellent venue with plenty of parking and enjoyable food on the day. I am already looking forward to next year's event there.

When did you last see a Merry widow, *Phallichthys amates*? I haven't seen one in years, either in an aquarium shop or at one of the BLA auctions. Are there any left in the UK? Does anyone know? Are they threatened in the wild?

Which brings me to the main point of this editorial – How can the BLA and its members do more for fish conservation? We have given sums of money to organisations involved in the conservation of fish in the past and we will do again in the future. But even zoos and public aquaria can only keep, breed and conserve a finite number of species. No one person or organisation can conserve all of the fish species which are endangered in the wild but we could each conserve one species, couldn't we? And with our friends in livebearer organisations in Europe, the USA and other countries we could conserve a huge number of fish species if we could only get organised.

So what is the way forward? In bird conservation circles they have "Species Champions" – could that work in fish-keeping circles? Would you be willing to keep and breed a species of fish in the long term? I would love to hear the views of BLA members on this one. What I do know is that we need to do ***something*** soon, as so many fish species, not just livebearers, are threatened with extinction in the wild.

I look forward to hearing your views.

A word from Clive Walker, our Deputy Chairman :-

I would like to thank all those who attended our event on June 2nd at Kempshott Village Hall and helped make it a successful and enjoyable day.

In particular I want to thank Andy Pearce, Chris Ralf and Tim Chamberlain of the Association of Aquarists and Chris Cheswright FBAS judge who between them helped to organise the show, canteen and sales table. Their help was invaluable.

The next A of A auction at Kempshott Village Hall, Pack Lane, Basingstoke is on November 3rd

At the May 5th auction last month there were 522 lots of everything fish connected, from all types of fish to plants to tanks to equipment to etc.

Our events take a lot of organising before and during and we always need help on the day. Volunteers on the day are greatly appreciated.

Our next event is at Carlisle on July 7th. At 350 miles this is a bit far for me. I will see you at Shenstone, though, on the weekend of 21/22 September.

Snippets / Musings from the fish room

1. I enjoyed the first BLA event of the year, the show and auction in Bristol – but then I always enjoy BLA events. Meeting up with old friends, talking to new people and seeing lots of nice fish – what's not to enjoy? The only problem is that I am always tempted to buy new fish in the auction and I really don't have room for any more species. The event was successful, with fifty-one people attending, up more than fifty per cent on last year. The one negative was that technology let us down again, which meant that Nigel couldn't give his talk but he will do so at the Basingstoke show instead.

One part of the event which I particularly enjoyed was the question-and-answer session with our three experts, Dave MacAllister, Nigel Hunter and Shaun Stevens. Points that stick in my mind are their answers to the question: "Which do you find the most difficult livebearers to breed?" to which the unanimous answers were *Brachyrhaphis*, from the poeciliids, and *Characodon*, from the goodeids. I would have said exactly the same. Our experts also talked about the value of feeding live food straight after dried food; the idea is that the presence of the dried food slows down the passage of the live food through the fishes' gut and gives more time for essential vitamins and other nutrients to be absorbed.

The auction went well. Interesting species sold included *Xiphophorus xiphidum, X. evelynae, X. pygmaeus, X. nezahualcoyotl, X. meyeri, X. milleri, X. alvarezi, X. andersi, X. malinche, X. continens, X. signum, X. clemenciae* and three different populations of *X. variatus* including "La Laguna". Other poeciliids included *Limia islai, L. melanogaster, L. tridens, L. grossidens, L. perugiae, L. nigrofasciata and L. vittata, Girardinus metallicus,G. uninotatus, Neoheterandria elegans, Poecilia wingei* and *Phalloceros caudomaculatus*. Goodeids sold included *"Xenotoca" doadrioi, Chapalichthys pardalis, Allophorus robustus, Skiffia multipunctata*, *S.* sp "Sayula*", Ameca splendens, Characodon lateralis "*Los Beros*", Ilyodon whitei, Ataeniobius toweri* and *Goodea atripinnis*. There were also plenty of cultivated livebearers, cichlids, *Ancistrus, Corydorus* and shrimp changing hands. The top prices paid were £49 for a group of juvenile *Xiphophorus malinche* and £41 for a group of juvenile *X. montezumae.* As far as I could see, both buyers and sellers went home happy with the results of the auction. See you at the next one?

2. My fish-room and most of my tanks are unheated but the room does have a large south-facing window. During the winter temperatures in unheated tanks dropped to 15°C (and to 13°C In previous winters) but warmed up steadily in the spring. One result is that lots of female livebearers became gravid at the same time. I like to separate out the gravid females but just don't possess enough tanks to separate them all. With no more tank space I now have livebearer fry in plastic boxes on the floor of my fish-room. I would love to hear what you do in the circumstances.

3. I like to cover the bottom of tanks for heavily gravid females with rounded stones. The spaces between the stones give places for small fry to hide – especially important for genera like *Brachyrhaphis* and *Characodon* as mentioned above. Living near the coast it has been easy for me to collect plenty of stones from beaches that are suitably rounded. And then in the *Times* this week I read that what I have been doing is illegal and I could be prosecuted for it. Oh dear!

4. I have been keeping *Xiphophorus milleri* for a while now without separating out gravid females but a few young survived anyway. And then a couple of weeks ago a female, only about

three cm long, dropped thirty-four fry! [At least, I only ever saw one female being gravid.] Is this a record?

5. Brine shrimp: I still haven't got the hang of always having some freshly hatched brine shrimp ready for any fry. With my fish room getting down to 15°C and up to higher than 28°C in the hottest weather, hatching times vary wildly – from over 48 hours in the coldest weather to less than 24 hours in the warmest – and I still haven't got the hang of having a continuous supply of newly hatched brine shrimp.

6. *Neoheterandria elegans*, the tiger teddy, a properly tropical fish, yes? So when I was re-arranging my fish room many months ago my group went into a small tank on the top of a rack but without a heater. The temperature went down to 17°C at times and at this moment is back up to 22 - 23°C. And yesterday I saw a newly dropped fry! Some species of fish are tougher than we give them credit for. [Not that I would recommend anyone treating them this way.]

Pseudopoecilia aff. *chocoensis*

Vincent Dielen

First published in Le Vivipare 151 – March 2024:18-22. Translated by Dan Fromm.

I write to present the least colourful wild livebearer I'm acquainted with, even less colourful than the other wild species already in AFV's species maintenance list. I already know some of them; is even worse possible? I propose: *Pseudopoecilia chocoensis*. But you know that for a person passionate about livebearers all species are pretty, even those that seem less attractive.

How I acquired them:

After our last excursion in November 2023 to western Germany with the Belgian group nicknamed "the agitated fishbowl" that I was able to find this species that I was completely unaware of until then. As you'd expect, I found it with Thomas Tillman of Hobby-Zoo-Tillman (Duisburg). (http://www.hobbyzoo-tillmann.de/) Hobby Zoo is a store specializing in American cichlids, of which Tillman himself has collected many species. Obviously, the cichlids aren't the only fish in their habitats and Thomas regularly brings back other syntopic species from his expeditions, including livebearers that he then tries to breed.

A female of *Pseudopoecilia chocoensis* whose appearance confused at first sight.

Five pale fish with a puzzling appearance were in a remote tank in the store: half livebearer, half killie. All of the livebearer fanciers present (Alain Detrie, Robert Mambourg, Thierry de Metsenaere, Jean-Luc Ledeganck, Joao Monteiro et myself) were perplexed.

The largest individual, swimming at the front of the tank, strongly resembled a killie, with a thick body and a flat back, both typical of this group of fish. A female *Aphyosemion* or, better, a *Rivulus*? While looking more closely at them, I was able to discern other, smaller, specimens at the back of the tank, among them two individuals with a gonopodium! They were, then, livebearers and poeciliids. Which species?

Neither one nor two, I reviewed my spoken English for a few seconds and asked Thomas "What's that?" He replied immediately "I don't know. It is bycatch of *Nematobrycon lacortei* in Colombia." A fish collected in Colombia with Rainbow Tetras, then. A single individual had been caught, the largest in the aquarium. By chance, it was a gravid female who had given him the other four individuals in the aquarium.

"Do you sell them?" I asked in a tone of voice not at all interested. He told me "Hmm. 30 € for the whole aquarium" after hesitating. That comes, all the same, to 6 € per fish for an unattractive species of which one individual is visibly ill with a stomach problem. I told myself that one is a player or one isn't. After reflecting for a long time – 1.23 seconds – I accepted the offer.

Origin:

On returning home, I had to set the mystery fish up. Coming from a Colombian tetra biotope, I thought that the fish had to live in soft acid water: so I put them in a tank of rain water with … some tetras! I also keep some selectively bred *wingei*, some *Phalloceros caudimaculatus* and, more surprising, my *Xiphophorus milleri*, who seem to appreciate these tank conditions rather different from their native lake.

Next step: try to identify the species:

I know that they came from Colombia and had been collected with *Nematobrycon lacortei*. A quick search on the 'net taught me that the Rainbow Tetra comes from the Río San Juan on the Pacific side of Colombia. All that remained was to leaf through the bible of fanciers of wild poeciliids. Meyer 2015. This book is well done since collecting sites for all the species are shown on maps.
Nothing more to do than see which species live in western Colombia! Quickly done since there are few livebearers in that area. One or another *Neoheterandria* and *Poecilia* (some mollies), eventually some *Poeciliopsis* and *Pseudopoecilia*. I rapidly ruled out the *Neoheterandria* and

Poeciliopsis because their appearance and markings are totally different from my fishes'. That leaves, then, south American mollies and *Pseudopoecilia*. Both have a thick body like my fish but that area's mollies are more elongate and very coastal. Photos finally convinced me that I'd acquired some *Pseudopoecilia*. Given the descriptions of the different species and their geographic origins, I must be in the presence of *Pseudopoecilia chocoensis*, figured on p. 327 but rather different in colouration from my fish. Perhaps I have a colour form of this species or another closely-related one not mentioned in Meyer. … To be prudent, we'll call it *Pseudopoecilia* aff. *chocoensis*. Meyer explains that this species occurs in small tributaries of Río Calima near its confluence with the Río San Juan (this matches where *Nematobrycon lacortei* originates) in Chocó department (whence its scientific name) in Colombia, in soft acid waters.

***Pseudopoecilia* aff. *Chocoensis* stays close to the surface.**

Characterization:

Pseudopoecilia aff. *chocoensis* is a typical surface fish. Its dorsal fin inserts towards the rear, which allows it to position the greater part of its back just under the surface. From what I've observed in my aquarium, the smaller the fish, the more it stays near the surface. The mother of them all, my largest individual, who must be 4 cm long, doesn't hesitate to go to the bottom of the aquarium, where I've even seen her pick up food that's fallen to the floor. The elongate body isn't really clearly marked, but the scales have black edges, which at times give the impression that the body is lightly barred vertically. When the fish is the light, the body appears very pale but in shadow it darkens strongly to look more like the fish figured on Meyer p. 327. But the character most similar to Meyer's photos is the light blue edging on the female's anal fin and on the pelvic fins of both sexes. Moreover, this marking is more or less visible depending on the light's incidence. In shadow, the fish appear darker and the blue reflections on the female's anal fin and the pelvics of both sexes become very visible. The male seems to remain slightly smaller than the female and shows three well-delimited yellowish zones: the first at the base of the gonopodium; the second, very understated, at the base of the dorsal; and the third, the most evident, at the base of the tail.

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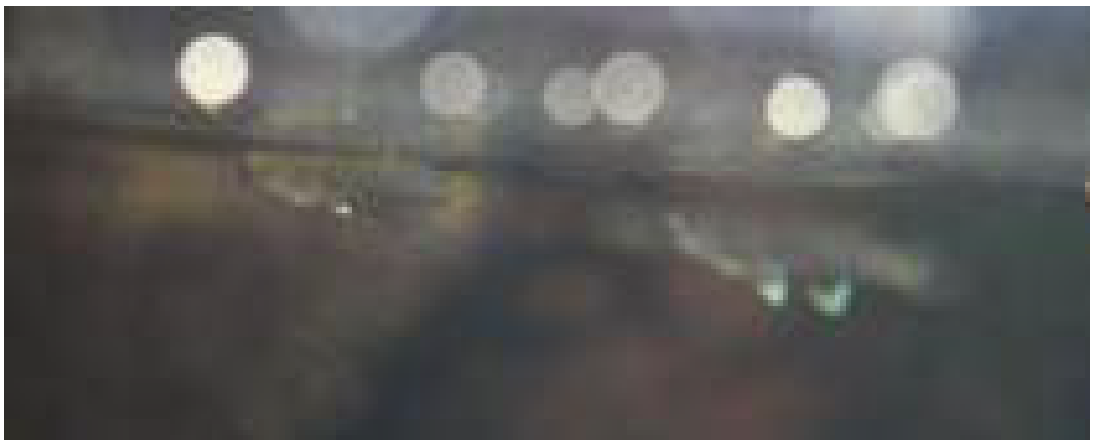
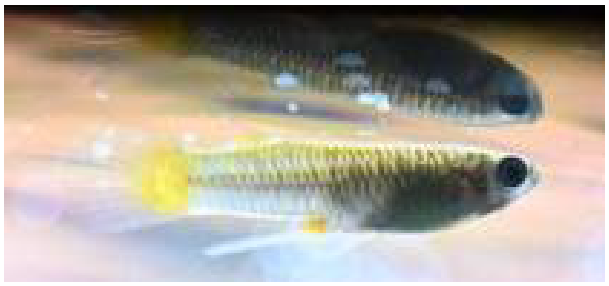


The youngest female I have has the same markings, but harder to discern.



Male *Pseudopoecilia* aff. *chocoensis* with its three characteristic yellowish zones.

Behaviour and feeding:

The fish seems slightly territorial. Each individual stays near the surface at a specific place and seems ready to charge any conspecific that approaches its personal space. Young female *wingei* are often confused with conspecifics and they regularly see a *Pseudopoecilia* rush at them, stopping at the last moment while seeming to apologize for the mistake. From time to time the youngest female swims around the most appealing male. He sometimes follows her and tries to mate from behind with no preliminaries. So far I've seen no agonistic behaviour with other species in the tank. One can reasonably think that *Pseudopoecilia* is peaceful with other species.

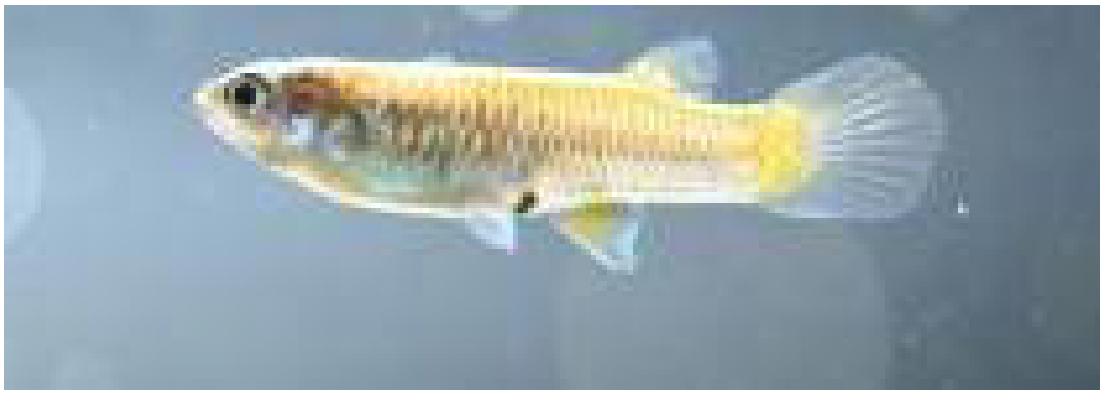
The fish seems to be an omnivore. In my tank, *Pseudopoecilia* try every food offered with more or less enthusiasm. To eat, they tend to separate themselves from the surface to rush at their prey and engulf it suddenly before returning to their initial position. They seem relatively gluttonous and repeat this behaviour several times until their bellies are clearly rounded. In view of this behaviour, in the wild this fish must certainly eat insects fallen on the water. A well-covered tank is certainly recommended if one doesn't want to find them on the floor. As mentioned above, the old female behaves differently, feeding in the water column and going to the bottom if there's no longer anything to eat above it. I've also noticed that the male occasionally nibbles on plants that reach the surface without damaging them but no longer seems to pull off whatever could be growing there.

Reproduction:

This is awaited! I have four individuals (the swollen male didn't survive very long): an old female perhaps too old to be able to reproduce; a young female who bears all hope for this species' future with me; a male in the prime of life; and a small individual whose yellow markings seem to indicate that it will be a second male (but no gonopodium yet). According to Meyer, broods are small, fewer than a dozen fry, 8 mm long. I hope to be able to confirm this in the near future!

Note:

Because of some doubt about their identification we call these fish *Pseudopoecilia* aff. *chocoensis*, i.e., they are probably *chocoensis*. We also note that the genus *Pseudopoecilia* isn't recognized by all scientists and that some classify this species as *Priapichthys chocoensis*.



The young female who carries all the hopes for the future of the species in my home.

Literature cited:

Meyer, M. K. 2015. Lebengebärende Zierfische Band 1 Poeciliidae. Privately published, Bad Nauheim. 436 pp. ISBN 978-3-00-048777-4

Rolled up from the back: The *Goodeids* from Z to A

Michael Köck

This article first appeared in Viviparos 2023-2. Viviparos is the magazine of the German Livebearer Association, a section of the VDA, and appears here with the kind permission of both Michael Köck, the author, and Reinhold Nickel, the editor of the magazine.

***Characodon audax* – Elke Weiand Photo**

The genus *Characodon*

My last article in this series, about the genus *Girardinichthys,* in issue 1.2017 was more than five years ago. Some people may have been happy that my admittedly often very long articles had come to a temporary end, others may have missed the explanations about the discovery of species and genera, their family history, so to speak.

After the long absence, it has now become important to me to finish what I have started. With some restrictions, however, because anyone who knows the Goodeid genera by name will now rightly miss *Empetrichthys* and *Crenichthys*. Two genera that inhabit spring areas in dry eastern Nevada with a handful of species. The reason for this is simply in the title of this magazine: "Viviparos" is the Spanish term for live-bearing animals, and the two genera listed above do not contain any of these. They are oviparous, i.e. they lay eggs, and therefore, strictly speaking, have no place in this magazine. I have therefore decided to leave these two genera out and move on to the next one, which is now again live-bearing. The genus that probably contains the most sensational species of the whole family, but which also raises a lot of questions and leads us to a wealth of speculation: *Characodon.*

While two Austrians, Johann Jakob Heckel as the describer and Carl Bartholomäus Heller as the discoverer, played a key role in the creation of the genus *Xiphophorus*, the birth of the genus *Characodon* is entirely German. Here it all begins in 1845 with the journey of a young, twenty-year-old botanist from Hanover, who had begun his studies at the Royal Botanic Gardens Kew,

south-west of London, in 1844, and for whom the then director of the gardens, Sir William Jackson Hooker, had found a job as a naturalist on board the H.M.S. Herald: Berthold Carl Seemann. **(Painting below from the "Flora Vitiensis")**

During this six-year voyage, which was aimed at the Pacific and the American west coast, the Herald reached Mazatlán on the coast of Sinaloa towards the end of 1849. From there, Seemann set out on November 23rd with two locals and just as many loaded mules on foot towards the city of Victoria de Durango and reached the capital of the state of Durango, located 250 km to the northeast, around three weeks later.

He wrote a letter from the city on December 15th, 1849, so he seemed to have arrived there immediately before, probably on December 14th. The young botanist stayed there for around two weeks, enjoyed the social life of the city, and then wanted to continue his journey north to Chihuahua. But the cold weather and the more than uncertain situation in northern Mexico forced him to change his plans. The new route would now take him around 500 km south to Tepic in the state of Nayarit.

With this goal in mind, the small group set out on January 2 1850 and after three days reached the town of Mesquital (now San Francisco del Mezquital). This three-week period after his arrival in Durango until shortly after his departure for Tepic is the decisive one for us, who want to retell the story of the genus *Characodon*. At some point between December 15 1849 and January 3 1850, he was the first European to see these fish, which were new to him, and caught nine of them. During his stay in Victoria de Durango, he apparently left the town for a short time on one or two occasions and collected plants in the dry surroundings, but due to the uncertain situation he seemed to have only moved imperceptibly far away from it.

Seemann did return to Victoria de Durango from the Tepic area at the beginning of February, but by a route further west, and he left the city on the 13th of that month with the well-known Austrian-French composer and pianist Henri (Heinrich) Herz and hurried to Mazatlán through unsafe territory ("Some of the places we passed had either been burned down by wild Indians or had been left desolate."). These last two weeks in Durango are probably no longer an option for collecting our little nameless jewels. The reason why I have repeatedly referred to the unsafe situation surrounding Victoria de Durango during Seemann's journey is important and will be of crucial concern to us later in the story.

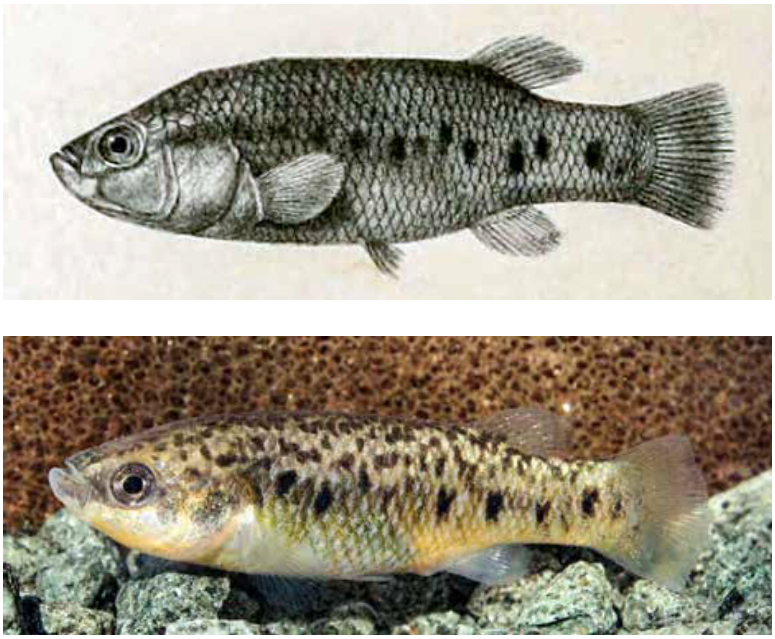
The nine specimens of the new fish species he collected lead directly to the second German in the history of the genus, Albert Carl Ludwig Gotthilf Günther. Günther came from Esslingen am Neckar, virtually from the backyard of Stuttgart, and started his unique career in 1857 at the British Museum, where from 1875 he took up the position of "Keeper of Zoology", the director of the Zoological Department, which he held until his retirement in 1895.

He is rightly considered one of the most industrious taxonomists of all time. For example, around 340 reptile species that he described can be traced back to him.

Günther stated that four of these nine fish came directly from Seemann's collection, and five more from the collection of the Haslar Hospital. This hospital was founded in 1762 for members of the Royal Navy and, in addition to its medical facilities, also had a collection of botanical,

zoological and ethnographic exhibits. When the hospital's collection was dissolved in 1855, most of it went to the British Museum, including the five specimens that came from Seemann's original collection.

Günther finally described the species based on these nine specimens, two males and seven females, in his eight-volume life's work Catalogue of Fishes in the British Museum (1859-1870) in volume 6 (1866) as *Characodon lateralis*. He described the fish species as similar to *Cyprinodon*, with a high body, arched neck and thick, broad head. He described the teeth, which obviously reminded him of a member of the tetras (genus *Charax*) and inspired him to name the genus (*Characodon* – tooth like a *Charax*), as a series of small forked teeth, behind which there is a narrow band of small, villi-like teeth.



Upper: drawing by G. H. Ford of a female C. lateralis, from Günther (1866)
Lower: Bruno Kaubisch photo of a female from Pino Suarez, possibly the type locality

Günther simply stated that the collection locality was in Central America. The fact that he could not give a more precise location is surprising, given Seemann's generally very precise records. Günther himself provided the explanation for this as early as 1868, when he corrected himself by saying that the fish collected by Seemann in the British Museum now all came from the collection of Haslar Hospital, whose exhibits "had lost most of their value for science because unfortunately no records were kept of their origin, where they came from". In this work he also presented the first drawing of a female representative of the species. What is surprising is that after these introductory lines he consistently marked the location of *Characodon lateralis* in a list of species with a question mark, but when describing the species he stated: "They are from Dr. Seemann's collection, who was able to capture them in southern Central America." Perhaps he was told this orally by the head of the collection at the time, but it was and is false, as we now know, and this story will keep us and science itself busy for a while in the years to come. In any case, the Natural History Museum in London confirms the origin of the fish from the Haslar collection, but funnily enough, it only has eight individuals in its collection, and has done so since at least the early 1970s. But where is number nine?

David Starr Jordan and Charles Henry Gilbert described *Characodon furcidens* in 1882, incorrectly from the Californian peninsula, and in 1887 Tarleton Hoffman Bean added three more species descriptions with the description of *Characodon ferrugineus*, *bilineatus* and *variatus*, and also transferred *Goodea atripinnis* to this genus due to similar dentition. All species

that we have already encountered in previous editions of Viviparos under *Ilyodon furcidens*, *Neotoca bilineata, Goodea atripinnis* and *Xenotoca variata* (with the synonym *Characodon ferrugineus*) as representatives of other genera.

The German-American ichthyologist Carl Henry Eigenmann also listed these six species in the genus *Characodon* in his Catalogue of the Freshwater Fishes of Central America and Southern Mexico in 1893. Things then get exciting again in 1895: Samuel Walton Garman, who worked at the Museum of Comparative Zoology at Harvard University in Cambridge, Massachusetts, included the species *Characodon luitpoldi* (now a synonym of *Goodea atripinnis*) described in 1894 in his work Cyprinodonts, but doubted that *Characodon atripinnis* belonged to the genus. Rightly so, as we know today, but this alone clearly shows that the criteria used at that time to classify the genera were extremely unsatisfactory. He then combined the remaining species of the genus, despite all the differences, with the exception of *Characodon furcidens*, with *Characodon lateralis* and made them its synonyms. But the most important thing about his work is the following line, which he added at the end for *Characodon lateralis*: “originally discovered in Central America; described here from Parras, Coahuila, Mexico.” A succinct line that suddenly assigned a species with an actually unknown origin (at the time, no one saw sailor’s travel reports as being related to these fishes) a location that was, however, geographically far away from Günther’s information. Eureka, we finally have a location! Or not? Well, not quite, but we’re getting closer to the matter.

David Starr Jordan and Barton Warren Evermann removed *Characodon bilineatus* and *variatus* from the synonymy of *Characodon lateralis* in 1898, added *Characodon eiseni* to the now already extensive genus, and, because of the different location (*Characodon lateralis* was thought to be in southern Central America), they described a new species from this individual from Parras: *Characodon garmani*, a species that is still considered one of the greatest mysteries within the Goodeids.

The female holotype of *Characodon garmani*

This Parras, or actually Parras de la Fuente, is located around 300 km as the crow flies northeast of Victoria de Durango in the state of Coahuila. While the waters around Durango drain into the Pacific via the Río San Pedro, the streams and rivers from these extremely dry areas of Coahuila collect further north in the Laguna de Mayrán, where they seep away and evaporate during the dry months. This area is therefore an endorheic region, meaning it has no outlet into the sea and, with the exception of springs and their outflows, there is hardly any permanently standing or flowing water. But the area is botanically and ethnologically extremely interesting and was still completely unknown at the end of the 19th century.

This prompted the 50-year-old British botanist, ethnologist and archaeologist Edward Palmer to visit this area in 1880, and it is precisely Edward Palmer who is credited with the discovery of

Characodon garmani that year. He reached Monterrey in the state of Nuevo León in January, where he stayed until March. From March onwards he set up camp in Saltillo, around 70 km west of Monterrey, from where he set off west towards Parras on April 19. He returned to the USA in September, so he was only in the area of interest to us for four to five months. During this time Palmer collected a lot of everything that was unknown to him, including some new fish, and supposedly also the only known individual of *Characodon garmani*. The fish's namesake, Samuel Garman, published an article just a few months later in February, 1881, in which he described a number of fish that were new to the Harvard University Museum. The majority of them "come from streams and springs that drain into Lake Muerte and Lake Parras in the southwestern part of Coahuila. It is said that these lakes or lagoons are completely isolated. At least that is how they are noted on current maps of the area. The list is made up of a collection that Dr. Edward Palmer made for the museum." In fact, no fewer than eight species from the area around Parras de la Fuente that were previously unknown to science are on this list, but he makes no mention of the little fish of our liking.

We still don't know why he didn't do that. After all, at that time only nine specimens of *Characodon lateralis* were known (we remember that fifteen years later he would assign this individual to this species), and they were of more or less unknown origin. Any scientist would note this in such a case. But Garman did not. But he mentioned other, already known species from the area around Parras. So why should he not have included this one not entirely insignificant fish in his work? Could he have overlooked it or even forgotten it? Possible, but unlikely. It is therefore reasonable to assume that the fish was not even in Palmer's collection from 1880. Palmer, in turn, had no further opportunity to collect it until Garman mentioned it in 1895.

He had been to Mexico again by then, but on the west coast of Sonora and on the Californian peninsula, and thus far from Coahuila. It is therefore possible that *Characodon garmani* was not collected by Edward Palmer at all. Interestingly, no other research trips to Coahuila are recorded between 1880 and 1895, so no other collector is likely to be involved. So where does this fish come from?

Well, just because Palmer may not have collected this fish does not mean that it could not have come from Palmer's collection. Shall we speculate a little? Edward Palmer traveled to England in 1855, where he married a shepherd's daughter on March 29, 1856, and only then returned to the USA. So he was in England at the very time when the Haslar collection was dissolved and the nine syntypes of *Characodon lateralis* came to the British Museum of Natural History. Nine syntypes, of which only eight are still in London today. And with that I end my speculative thought experiment - for now. The fact remains that the type material of both species differs in a few morphometric details, even if these differences are marginal and, according to current knowledge, lie within the range of variation of all described *Characodon* species.

Jordan, in turn, this time with his student John Otterbein Snyder as co-author, described *Characodon encaustus* (now *Chapalichthys encaustus*) in 1899, a species that we will only look at in my next article. Thus, just before the turn of the century, the genus *Characodon* already had an almost inflated number of species, but that was the peak.

An old acquaintance of ours, Seth Eugene Meek, recognized only four *Characodon* species in 1904. In addition to *Characodon furcidens* and *variatus*, which we will not be concerned with here, there were *Characodon lateralis*, still from Central America and Jalisco (he had adopted the Mexican state of Jalisco after a misidentification by the French zoologist Jacques Pellegrin without checking the relevant material), and *Characodon garmani* from Parras, Coahuila and Labor, Durango. Meek himself had collected *Characodon* at the Estación La Labor train station

northeast of Victoria de Durango, now on the outskirts of the city. He speculated that “it is quite probable that the fish Garman described did not come from Parras but from Durango.”

Left: 8 *C. lateralis* syntypes Right: specimens Meek collected at Estación La Labor in 1904 Rupert Collins photo

Well, if Meek is allowed to speculate, shall we do so again ourselves? Just under 10 km as the crow flies south of this train station is a small town which, like the one in Coahuila, is called Parras de la Fuente. Could it be this place near the outskirts of Victoria de Durango where Seemann collected the type material of *Characodon lateralis* in December 1849? And could it be that Edward Palmer, who knew his botanist colleague Berthold Seemann, who was only six years older than him, personally, as they were both in London and especially in Kew Gardens at the same time, had learned more from him about the origin of these fish than Albert Günther, who had taken the fish from the Haslar collection without any information about their origin? Perhaps, but both are pure speculation and rather unlikely, as this Parras is located about 15 km outside of Victoria de Durango and was therefore not reachable within a day, including the return journey. There is also no reason why Günther should not have asked the almost equally old botanist Seemann (who was the collector of the fishes, after all), and no reason why fishes could have interested the botanist Palmer in the first place. Unless he might have had the intention of taking one of the nine individuals (perhaps as part of a larger group of individuals on commission or as part of scientific collaboration) to Massachusetts, which brings us back to our first speculation and we are currently on very, very thin ice, because there is no evidence for any of these speculative ideas that I have just written down here. On the contrary: Günther only described *Characodon lateralis* in 1866, when Palmer had already been back in the USA for ten years, and Günther still had nine fish to describe. Well, his Catalogue of Fishes of the British Museum was an eight-volume monster work that took twelve years to be published in full. Theoretically, he could therefore have described the species as early as 1855 or 1856 as part of the creation of his work, but this only became clear in 1866 when the corresponding volume was published. And there are, above all, morphometric differences to *Characodon lateralis*, which, as previously noted, lie within the range of variation of this species. What remains for the time being is the uncertainty as to what *Characodon garmani* is.

Only genetic studies are likely to help here, but this could actually be possible because the specimen is fixed in ethanol and is probably being done (note by Kyle Piller, 2019). My contribution to solving the question was that I requested photos of the syntypes of Characodon

lateralis in order to be able to compare their appearance with the photo of the holotype of *Characodon garmani* and asked about the whereabouts of individual nine. The appearance of the *Characodon garmani* holotype shows visible differences (a regular row of dots), so it probably does not come from Günther's collection. However, storage in different institutions could have had an impact. The *Characodon lateralis* group in the British Museum has grown by originally ten, now only six types from Meek's collection. Günther's number nine is missing, as are four of Meek's fish, and no one knows what happened to them. Ichthyology is sometimes real detective work.

The British zoologist Charles Tate Regan, Albert Günther's successor as director of the Zoological Department of the British Museum, grouped both species together under *Characodon lateralis* in his 1907 work "Pisces" because, in his opinion, *garmani* is indistinguishable from lateralis (or from *Characodon variatus*). Individuals that he received from Meek as *garmani* were said to be identical to Günther's types (he does not mention the number), but this is not surprising. Both were probably collected very close to each other. This made the question of whether *Characodon* consists of one or two species almost a question of faith. One group of scientists considered it proven that there was only one species, *Characodon lateralis*, because the differences were too small, while another group considered the differences to be large enough to allow *Characodon garmani* to exist as a separate species. The fact that the latter species was never found again and that a large proportion of the species from the area around Parras de la Fuente in Coahuila had become extinct (or almost extinct) meant that scientists at that time had no way of resolving the issue in a way that was satisfactory to everyone.

Again, it was Carl Leavitt Hubbs and Clarence Lester Turner who brought some clarity to the genus *Characodon* in 1939 with their groundbreaking work “Studies of the Fishes of the Order Cyprinodontiformes. XVI. A Revision of the Goodeidae”. Based on the ovary structure and the structure of the trophotaenia, they classified all species except *Characodon lateralis* into other genera. They also agreed on the validity of the species *Characodon garmani*: "Our investigations of this species are based on Meek's material from the headwaters of the Río Mezquital. We find no reason to doubt the correctness of Meek's assignment to *C. garmani* or Regan's synonymization of *C. garmani* with *lateralis*." In other words: In their opinion, *Characodon garmani* undoubtedly belongs to *lateralis*.

In 1972, John Michael Fitzsimons revised the genus *Characodon* in addition to the genus *Xenotoca*, using live specimens from the Ojo de Agua de San Juan spring near Los Berros for his cross-breeding experiments. Until the 1940s, the species was only known from the immediate vicinity of Victoria de Durango, while Los Berros is located approximately 40 km east-southeast of this city as the crow flies. The first collections of fish from this spring date from 1946 (Robert Rush Miller: 445 specimens).

Ojo de Agua de San Juan, a former habitat of *Characodon*. In 2015, only *Tilapia, Gambusia,* swordtails and tetras (*Astyanax*) were found here. Photo: Günther Schleussner

The American malacologist (snail researcher) Artie Lou Metcalf collected living specimens there on September 1 1968, and Fitzsimons used these fish for his studies, and not only that: fish from this line have survived to this day. A large proportion of the *Characodon lateralis*, known under the locality name “Los Berros”, can still be traced back to Metcalf’s collection. This makes this line, along with that of “*Xenotoca*” *eiseni* from El Sacristán (1955), one of the oldest Goodeid lines that we keep in aquariums. In 1970, Fitzsimons was at the spring with Miller and observed the fish underwater, while Miller used the opportunity to – for whatever reason – kill another 327 specimens in the name of science. Back to John Fitzsimons: As part of his revision, he compared Günther's syntypes (eight of them!) from the original description and material from near Durango (and also Los Berros) and came to the conclusion that all 127 specimens belonged to the same species. He was also allowed to use Miller's data from the review of the holotype of *Characodon garmani* from 1963, and these, "when compared with those of the syntypes and the Durango individuals of *Characodon lateralis*, support the identity of the Parras and Río Mezquital populations." So he was also sure that both species belonged together.

Two male *C. lateralis*, which date back to the 1968 Metcalf introduction. The common name Rainbow Goodeid fits them well. Anton Lamboj photo.

Fitzsimons was also the first to take a closer look at the habitats of *Characodon lateralis*. The species was "very common in clear, presumably spring-fed ponds or low-current river pools with lots of underwater vegetation and banks with grass overhangs at water temperatures between 18 and 27 °C." In the Ojo de Agua de San Juan spring, he found masses of filamentous algae, stonewort and hornwort. The former, along with diatoms, blue-green algae and other green algae, were the main food, but he also found two larger worms in the digestive tract of a fish, which he assumed had only been swallowed by accident. However, the digestive tract of *Characodon* species is quite short, which speaks against a purely herbivorous diet. Michael Tobler (2011), for example, found many small water snails in the digestive tract of representatives of a population. A certain plasticity of this probably omnivorous species in small-scale habitats, where a fish hardly has a choice as to what it wants to eat, is plausible and could also lead to an adjustment of the length of the intestine due to the prevailing food supply. The author was also the first to describe the courtship behavior of this species in detail and gave individual phases names that are still used today.

The first sparse reports of experience with the keeping of this species from the years 1975 to 1985 came from the USA and raved about colorful fish (“rainbow Goodeid”) in red, yellow, green, black and brown. The keepers were completely enchanted, the former curator of the Belle Isle Aquarium in Detroit, James Langhammer (1976) even dreamed of a flood of color forms like those of platys and swordtails, which could be obtained from these fish through selective breeding (which fortunately never happened). The first very short reports also told of small litter sizes of four or five young, cannibalistic behavior (Edward Taylor, 1982) and sometimes very aggressive behavior of the males towards the females (Robert and Rosemary Clarke, 1984). The first photos of this species from European aquariums also date from this year. Virginia Eckstein published the first comprehensive report on keeping them in the magazine Livebearers in 1984. She had gotten her fish from Paul Loiselle but was initially very unsure because of the many failed attempts among her friends. Ultimately, however, she was very successful in keeping and breeding this species. The secrets of her success were based on extensive (50%) water changes

every other day and feeding them several times a day with live food and plant-based food. Her litter sizes were significantly larger and she joined the offspring to the parents after just four weeks, and subsequently she refrained from separating the females altogether. In principle, these are measures that are still effective today and are practiced in a similar way by many contemporary breeders.

For almost fifty years, science within the genus was solely concerned with the question of whether *Characodon garmani* and *lateralis* belonged to the same species or not. And just when the majority of scientists had come to terms with only one species within the genus, 1986 brought another species, and with it everything would ultimately become even more complicated. But back to the beginning: Robert Rush Miller, his wife and some fellow travelers collected a *Characodon* for the first time on March 16, 1982 in a spring pond near the village of El Toboso in Durango (Radda would mistakenly mention this fish two years later as an undescribed species from Coahuila) that was clearly distinguishable from other representatives of the genus due to its coloring. The males were mostly black, while typical *Characodon lateralis* males had (mostly) red unpaired fins in life. The concave head profile in contrast to the more convex one in *Characodon lateralis* also prompted Michael Leonard Smith together with Miller to describe the population from the El Ojo de Agua de las Mujeres spring near El Toboso as a new species: *Characodon audax*.

Part of the lagoon near El Toboso, the site from which Smith & Miller (1986) described *Characodon audax* Photo: Günther Schleussner

Two males and one female from the lagoon near El Toboso, photographed in 2015. Note the males' strong red color. Photo: Günther Schleussner

The two authors were unable to identify the species based on other distinguishing features such as a different number of fin rays or similar; there were simply overlapping parameters with *Characodon lateralis*. The only other indication for them of the species' validity was the fact that the folded back pelvic fins of *Characodon audax* did not cover the anus, but in most populations of *Characodon lateralis* they did. But that was not enough, they declared *Characodon garmani* to be valid again. They did this based on morphometric differences that they had found compared to the other two species. However, these were limited to a longer pectoral fin of one known female compared to the females of the other two species examined. So the old question about the species status of *Characodon garmani* went into the next round and the genus had another player in *Characodon audax*.

Although it did not differ anatomically from the other species, its coloring was all the more obvious. But is that enough to distinguish it? Shane Anthony Webb raised the first doubts in his doctoral thesis in 1998. Part of his study dealt with the phylogeny of the goodeids and the relationship between the genera and species, with his results being based on a large number of morphological characteristics and (for the first time) the sequencing of a 627 base pair long portion of the cytochrome C oxidase subunit I gene and the 16S ribosomal RNA gene. This study also included representatives of *Characodon audax* and *Characodon lateralis* (from the Metcalf collection from 1968). However, he insisted on sequencing a new, predominantly red-finned *Characodon* population and came to a completely surprising result.

In a short paragraph about the distribution of the genus and the considerable genetic differences between *Characodon audax* and *lateralis*, he wrote the following: "The spatial proximity and limited distribution of these taxa obscure their genetic distance of 2.1% (corresponding to a separation about 2.5 million years ago). M. Smith and Miller considered *C. audax* to be an inhabitant of an independent hydrographic unit that had no connection to the Río Mezquital in historical times. However, sequencing of a new color morph from Abraham Gonzales (near the northern extent of the Río Tunal) revealed it to be a form of *C. audax* (the difference is only a single nucleotide [0.2%]). The shared distribution (author's note: of *audax* and *lateralis*) suggests

that spatial separation in the upper reaches of the Río Mezquital cannot explain the split of the genus." What did Webb mean by this?

Specimens from Abraham Gonzales (above, a male) and Laguna Seca (below, two males and a few females), are closer to *Characodon audax* from El Toboso than to *Characodon lateralis* Photos: Günther Schleussner

Well, the division into *Characodon audax* (black fins and only found in the El Toboso spring) and *Characodon lateralis* (red fins and living along the Río Mezquital) was not reflected genetically and was therefore probably not tenable, and at the same time there was no geographical explanation for the origin of the two species. A similar result, albeit for another new population (Laguna Seca near Guadalupe Aguilera), was reached in 2004 by researchers from the University of Morelia in Michoacán. He also investigated the phylogeny and evolution of the goodeids and he also sequenced a mitochondrial gene (more precisely, two overlapping fragments of the cytochrome B gene with a total length of 1,440 base pairs). Like Webb a few years earlier, he also referred to the new population, which was clearly closer to the population of El Toboso than to that of Los Berros, as *Characodon audax*. *[sub-editor: this section is muddled. The author does not explain who the researcher(s) was or refer clearly to a publication. He may have meant Doadrio and Domínguez-Domínguez (2004)]* But is that so? Let us briefly return to Berthold Seemann and the turn of the year 1849/50. We now know from his travel report when he was in the Durango area and when he had the opportunity to collect the syntypes of *Characodon lateralis*. The political situation at the time of his stay was complicated. Roaming groups of Comanches repeatedly attacked farms and travelers, leaving a trail of devastation even through villages and invading towns. This made it unlikely that the young botanist would dare to venture far from Victoria de Durango. The south in particular was still

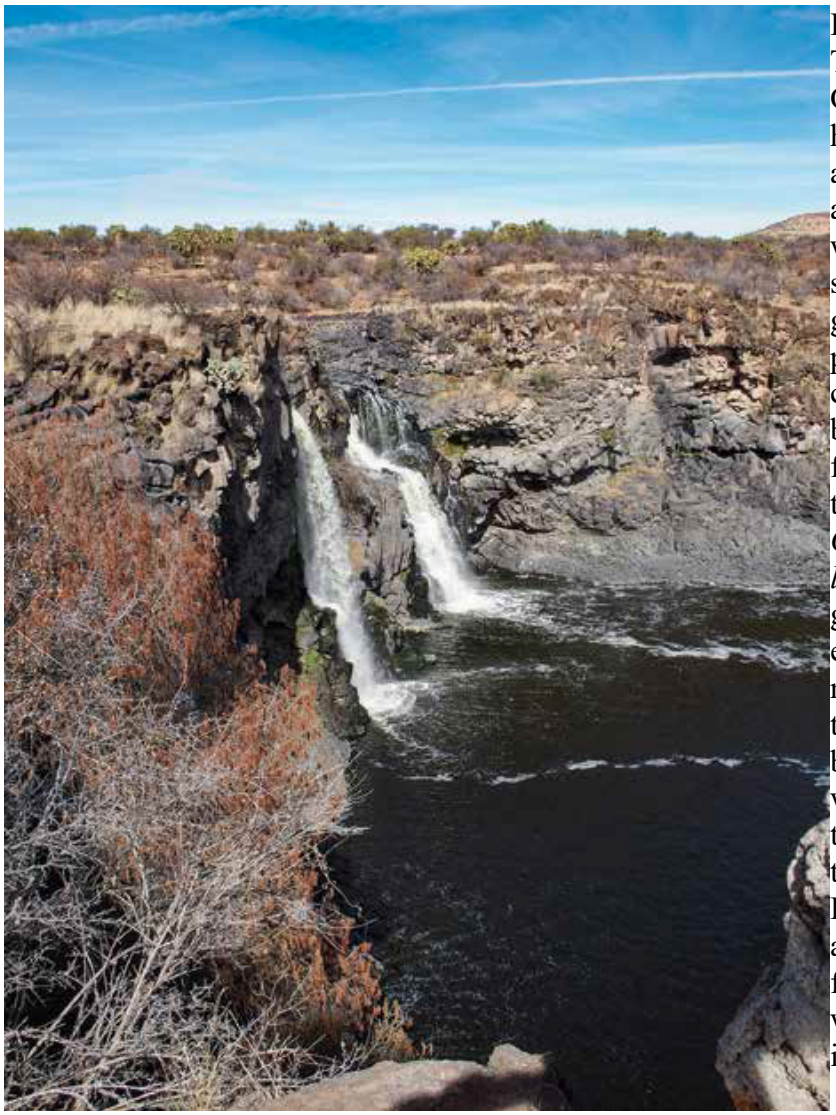
quite safe and that is where he headed on January 2nd on his way to Tepic. Now, according to genetic results, there are habitats around Durango for fish that are now classified as *Characodon audax*. Fish that are now classified as *Characodon lateralis* live around 40 km away near Los Berros and lived even further southeast near Amado Nervo.

Could Seemann have collected the syntypes of the species there at all? Only if he had ventured on roads about 60 km to the east, which would probably have taken four or five days. The whole journey there and back would have taken much more than a week. Given the considerable dangers, this is rather unlikely, and he did not even mention such a long journey during his three-week stay in Victoria de Durango. And another important point speaks against it: Seemann's keen powers of observation and his extremely precise descriptions. If he had actually seen Los Berros and the fish, he would have had to cross the Río Mezquital in the immediate vicinity of Los Berros. The only way across the river led directly past the Cascadas El Saltito, an impressive group of waterfalls around 30 m high, which must have carried a considerable amount of water by the end of the year. He would have most certainly reported on the foaming and roaring masses of water and the breathtaking scenery. But he didn't. From this it can be concluded that he didn't see the waterfalls, and therefore also Los Berros, which is only 4 km away. But that would also mean that the type material of *Characodon lateralis* actually comes from fish that are now classified as *Characodon audax*, and that would have to be changed. A step that would throw the entire taxonomy of the genus into disarray.

But why hadn't scientists recognized this at the turn of the millennium? Quite simply because Seemann's travel reports were not known to ichthyologists. The official type location of *Characodon lateralis* at the time was "Central America", and therefore could not be located geographically. But many were satisfied with that nonetheless.

The first person to bring Seemann's travel route into play in relation to the type locality of *Characodon lateralis* was the Mexican naturalist Juan Miguel Artigas-Azas, who had read the reports in 2013 and presented his assumptions to the public for the first time at the 2014 meeting of the Goodeid Working Group in Morelia. Back to modern times: The genetic results of the beginning of the millennium did not convince everyone. Ruth Hamill and Michael Ritchie and their teams from the University of St. Andrews in Scotland stuck to the original classification of black is *audax* and red is l*ateralis* in their work on the sexual dimorphism of goodeids in 2007, and even the well-known Swiss ichthyologist Michael Tobler from Oklahoma State University used it as a basis in 2014 when he looked at the morphometry, i.e. more or less the shape of the various *Characodon* populations.

This assumption was supported by his work because the El Toboso population (as well as that of Los Berros) differed noticeably from the other *Characodon* populations in some measurements, although these populations themselves also showed clear differences from one another. However, since many external factors influence the shape of the fish, this result, although ecologically very interesting, says less about the relationship within the genus. What science still lacked was something like a geographical barrier between the two species.
For Miller, the isolation of the body of water at El Toboso from the habitats along the Río Mezquital was the main reason that led to the independent development of *Characodon audax*. If this reason were to disappear, and all the results indicated this, where could a new one be found that could explain that populations along the river could also belong to *audax*?



In 2010, four years before Tobler's morphometric work, Omar Domínguez- Domínguez had provided a plausible theory, and once again the aforementioned El Saltito Falls were the focus. The Mexican scientist had determined through genetic studies that the populations above the falls were closer to each other than those below them and vice versa. The falls therefore seemed to mark the boundary between *Characodon audax* and *lateralis*. If one looks at the geological development of the entire area, then, according to new findings, the formation of the El Saltito Falls can be dated back about 1.4 million years, which roughly corresponds to the estimate of the separation of the two *Characodon* species. Lava flows in the late Pliocene and early Pleistocene led to the formation of a 30 m high barrier, which is now visible through the impressive waterfalls.

The El Saltito waterfalls in January at the beginning of the dry season Photo: Günther Schleussner

These lava flows consistently separated the upper part of the river from the lower part and created the basis for the separate development of the two population groups. Their differences have finally become so great over the millions of years that one now actually has to speak of two species, regardless of what is *Characodon lateralis* and what is not.

The last chapter on *Characodon audax* and *lateralis* was written in 2021 by the young Mexican Rosa Gabriela Beltrán López. Together with her group, she examined individuals that were collected in 2015 as part of a research trip in which members of this working group were significantly involved. This trip was already described in a previous issue of Viviparos. Knowing about the uncertainty of the type locality of *Characodon lateralis* and therefore the impossibility of correctly assigning populations to species, she initially referred to all of them, with the exception of those from El Toboso (*Characodon audax*), purely by the name of the location, without assigning them to species.

Without going into the exact methods here, her work also confirmed the separation into two different clades at species level: one above the falls and one below. She also found differences between the fish from El Toboso and the other populations above the falls, which are clearly present, but at 0.3% are well below the limit for a separate species status (which is usually in the range of 1.7 to 2% for the cytochrome B gene examined). As far as the southern clade is

concerned, differences were also found, namely between the population from Amado Nervo and the others. These were slightly higher for the cytochrome B gene at 0.4% than the result for the El Toboso population from the northern clade.

A young male from Amado Nervo. This population differs from the other southern populations to a greater extent than that of El Toboso differs from the other northern populations. Photo: Anton Lamboj

Here we will repeat what she derived taxonomically from her work: “The results presented here indicate that there are two well-distinguished species, one north and one south of the El Salto waterfall. In the case of *Characodon audax*, the genetic results presented here and the contradictory results of the morphological findings do not allow any conclusions to be drawn about the taxonomic status. We therefore consider *Characodon audax* to be a valid species until a more comprehensive and integrative taxonomic study is carried out. If *Characodon audax* is confirmed as endemic to El Toboso, our results suggest that the remaining northern populations should be considered *Characodon lateralis*, while the southern clade appears to be an undescribed taxon. All this underlines the need for a comprehensive integrative taxonomic study to clarify the taxonomic status of the genetically and morphologically differentiated groups.” She therefore did not dare to make a final statement despite clear genetic results and referred to future studies.

And so we are back to a question of faith, only this time it concerns *Characodon lateralis* and *audax*. One group of scientists believes that the morphometric results, the isolated occurrence, the black coloration (which in wild-caught specimens also has a lot of red in it and is therefore not quite as typical as one would think) and minor genetic differences are enough to recognize *Characodon audax* as a separate species. Others believe that the genetic differences are simply too small and that morphometrics should be viewed more as an adaptation to a habitat than as a means of defining a species. As previously noted, this only concerns the northern populations. The group south of the falls is certainly awaiting redescription and does not belong to *Characodon lateralis*.

It is time for a brief summary: With *Characodon garmani* we have a species that was described based on a single female specimen and where it is quite unlikely that it ever existed. With *Characodon lateralis* we are using a name that will have to be used differently in the future. *Characodon audax,* on the other hand, with a varied history, but which is probably flourishing and will be included as *Characodon lateralis*. And we have a still undescribed species that we have referred to as *Characodon lateralis* for many years, but which is not.
So what has 170 years of *Characodon* history brought us to date? Confusion, chaos and the prospect of a lot of future changes. For the time being, for the sake of clarity, it makes sense to

keep the previous classification into *Characodon audax* above the falls and *lateralis* below the falls. Simply to avoid causing even more confusion and also to give science time to find a final decision using newer methods.

But we are probably not far off the mark with the prediction that everything above the El Saltito Falls will be called *Characodon lateralis* in the future and everything below will be given a new name. Provided that the fish are still around by then.

The species is generally in a bad state. In the south, only the population in Los Berros seems to still be alive in large numbers.

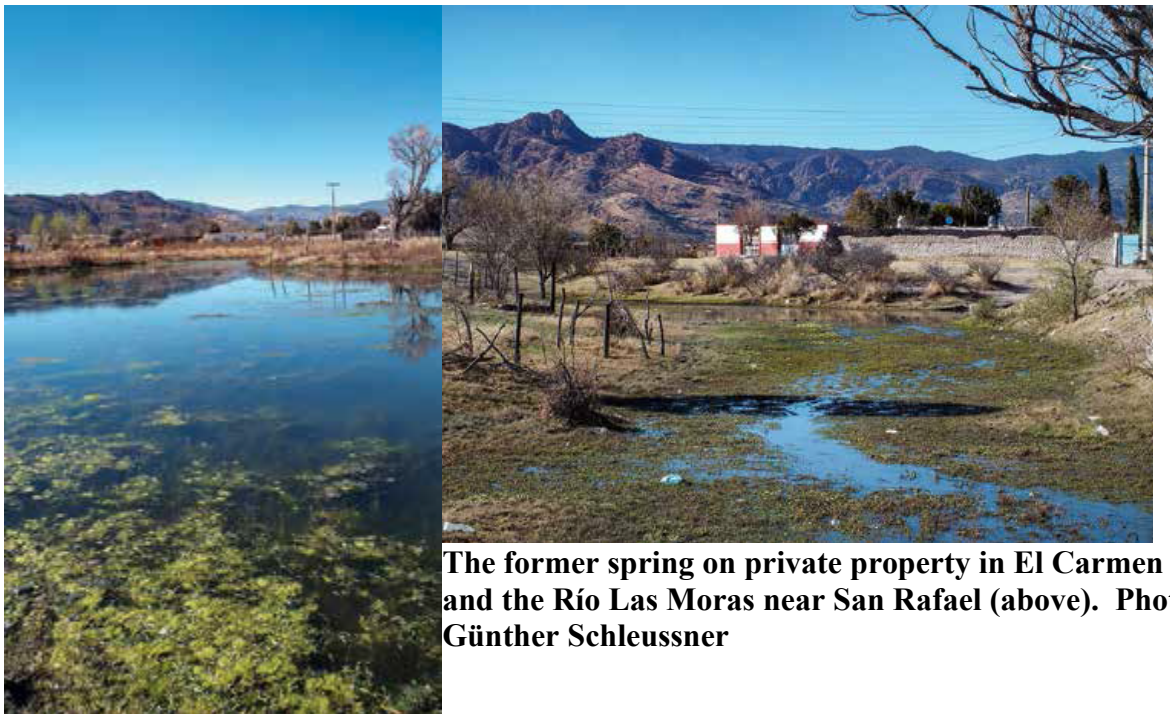
Two tiny habitats of Characodon lateralis with representatives: the spring on private property in La Constancia (top, left) with one male (bottom, left) and a spring near Los Berros (top, right, diameter just over 1m) with one male and two females (bottom, right) Photo: Günther Schleussner

In La Constancia, the occurrence is limited to a very small spring pond, which is located on private property and is used as a swimming pool. The population of Ojo de Agua de San Juan seems to have fallen victim to an abundance of exotic fish that now inhabit the spring pond, which is now free of aquatic plants. The population of Amado Nervo has also died out; its habitat simply dried up. In the aquarium trade, all except the La Constancia population are represented; the Ojo de Agua de San Juan population is confusingly known as Los Berros, while the population from Los Berros is called Ojo de Agua Los Berros. They are all currently still listed under *Characodon lateralis*, and the species is considered to be critically endangered due to the few known locations and the rapidly dwindling stocks.

The northern populations are doing somewhat better. However, the numbers of the populations we found in 2015 were generally not large. The best situation was around Laguna Seca. We were

able to identify five different springs with *Characodon* that more or less drained into Laguna Seca, all of which were largely populated with *Tilapia*. At Abraham Gonzales we only found the fish in a flooded meadow, and the spring itself was free of *Characodon* due to predation by largemouth bass. At Ojo Garabato, there could be a larger number of *Characodon*, but the area is quite large and confusing. At El Toboso, the species is under massive pressure from *Gambusia senilis*. The river at Pino Suarez, on the other hand, is in danger of falling victim to a major drought one day. To our surprise, in 2015 we found previously unknown populations of *Characodon* on the east bank of the Río Tunal (upper reaches of the Río Mezquital) with the promise of many more. One of them was on private land near El Carmen. It was at the mercy of the owner and has since become extinct (Artigas-Azas, verbal, May 2023), the other in a river in San Rafael, whose bluish water was practically free of hardness in 2015 due to detergent (still in existence in May 2023).

A section of the Ojo Garabato spring system (top, left – note the different water levels) with two males and one female (bottom, left) and the Arroyo La Estancia at the bridge near Pino Suarez (top, right) with the aquarium photo of a male from this location (bottom, right) Photos: Günther Schleussner except (bottom, left): Bruno Kaubisch



The former spring on private property in El Carmen (left) and the Río Las Moras near San Rafael (above). Photo: Günther Schleussner

Males from El Carmen (left) and Río Las Moras (right). Photo: Günther Schleussner

A colorful *Characodon* male from El Carmen Photo: Gunter Teichmann

All of these populations are currently referred to as *Characodon audax* and are present in the hobby, although not very frequently. Due to the comparatively larger number of habitats, it is listed as threatened in the IUCN Red List. In terms of habitats, both species have in common that they prefer clean, clear and oxygen-rich habitats. Larger and smaller spring ponds, often only structured by coarse stones and with fine sandy bottoms from which oxygen-rich water bubbled towards the surface, were typical in the Laguna Seca area

The fish could be observed grazing almost non-stop in groups on rocks. In riverine habitats such as Pino Suarez or San Rafael, the fish were mainly found in dense underwater vegetation or in the shade of riparian vegetation, while in shallow lagoons they sought out denser underwater vegetation in areas close to the bottom or hid near the shore in root systems or under overhanging grass. The most divergent habitat was a shallow flooded grassland at Abraham Gonzales with a large amount of dead grass. But here too, fresh water from the spring flowed through.

While the total hardness and the carbonate hardness ranged fairly consistently between 6 and 13 degrees of hardness (the private spring at El Carmen with 3 °KH and 4 °dGH was the only exception, along with the river at San Rafael, which was completely softened by detergent), the water temperature showed considerable fluctuations. We measured the highest value at 24 °C in Los Berros, and the lowest at an incredible 8.6 °C at Pino Suarez.

At La Constancia, juvenile fish were found in January, indicating that the breeding season in this habitat began in November, but in all other habitats, no fresh offspring could be found. We found the highest density in a spring pond near Los Berros, where in the pool, which was just over a meter in diameter, there were around 20 non-native swordtails (*Xiphophorus helleri*) and between 60 and 80 *Characodon lateralis*.

Let's move from nature to the aquarium. The design should be based on the natural conditions found in tanks no shorter than 80 cm. Larger stones, but also denser clumps of aquatic plants in between, have proven to be good. Because the natural habitats usually have a high oxygen content of 8 mg O_2/l and more, this should also be taken care of in the aquarium with good filtration and ventilation. The copious water changes (60% weekly), as already stated by Virginia Eckstein in 1984, are still valid today, as is the copious feeding she mentioned. Since the diet in nature is probably adaptive to the available food sources, the two species can also be fed in an aquarium with ease but with variety. They will easily take any form of dry, frozen or live food. At a friend’s, they greedily pounce on cooked peas and even garden fruits (*Hosta* and mulberries), at my place they prefer frozen gammarus, mussel meat and live food of any kind. Smaller shrimps of the genus *Neocardina* are particularly popular alongside *Daphnia*.

In large aquariums with plenty of hiding places, young fish will find enough hiding places so that a larger number of them will always get through. As soon as the fish reach different stages of development, newly born *Characodon* offspring remain completely undisturbed. Like most highland killifish, they love fluctuating temperatures throughout the year, but also during the day-night cycle, and can sometimes cope with temperatures around 10°C. Since this tolerance is probably habitat-dependent, caution should be exercised here, because some populations that inhabit springs with constantly higher water temperatures in nature may not have this tolerance to the same extent. Long-term (over a few weeks) temperatures of just over 15°C are never a problem, however.

It is very important that the individual populations are kept separate from one another and that there is no accidental mixing by jumping fish. This is less of a problem in aquariums than in outdoor conditions, for which both species are unconditionally suitable from mid-May to October or November. The clear separation is important because the populations of red-finned *Characodon audax*, which are sometimes called Red Princes as a counterpart to the black-finned Black Prince, as the population from El Toboso is also called, cannot be told apart.

Some people will now groan and deny this, but the *Characodon* in the aquarium are descendants of a small founder population that developed in one direction or another depending on the initial group in the aquarium. We may have aquarium strains that seem typical to us, but this is not the case in nature. Males can have dark or light red unpaired fins, and the majority of their body can

also be this color. But males with broad, black edges on their fins are also common, even orange and yellow finned ones, and even males that, like females, have completely colorless fins, and I wouldn't be surprised if there were also males that were very similar in color to those from El Toboso. When we visited in 2015, this one had a lot of red in the unpaired fins, while the *Characodon lateralis* from Los Berros almost completely lacked red. Instead, the body was characterized by a row of black spots on a yellow background. Pretty, but different from what we saw from the same spring in a collection from 2005. If the coloration of the fish from the same place is not the same every year, then it is easier to understand that there is no such thing as the "typical" fish from Abraham Gonzales or from Laguna Seca. On the contrary, the genre is characterized by the fact that there is nothing typical in it.

The yellow tail fin of a male from Laguna Seca Photo: Gunter Teichmann

What many readers will remember after endless pages - I sincerely apologize to each and every one of you - of *Characodon* is that these are small fish full of mysteries. A genus that has kept its exact origins secret from us for a long time, that has not even told us how many species it contains and what they are called, and that makes it practically impossible for us to assign a typical coloration to its representatives. One might get the impression that this northernmost representative of the highland killifish wants to take on an outsider role not only because of its distribution area, far from the other species, but also because of its history. But one or two readers will also remember that these are endangered, colorful jewels from a barren landscape of lava and cacti, where water is rare and whose aquatic inhabitants are becoming fewer and fewer from year to year. Wonderful creatures that tell stories of adventurous journeys and of secrets from a time when in Mexico, at every step, even behind every mountain top, you came across something unknown that was worth exploring. Today they are ambassadors of a disappearing world in which the small miracles along the way have long since been ignored and in which, in denial of the signs of the times, everything that does not promise immediate profit is destroyed. But they are still there, these small rubies from Durango, and they are resisting their disappearance with all our help.

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Limia zonata (Nichols (1915))

Daniel W. Fromm

Male *Limia zonata* from the Río Quisibaní. Mark Sabaj photo courtesy of the Academy of Natural Sciences of Drexel University. Mark put the fish in cold water to slow it down for photography. This intensified its colors.

Taxonomic history:

Limia zonata's taxonomic history is somewhat confusing, largely because Myers' 1931 redescription of *zonata* as *L. nicholsi* was long accepted.

Nichols (1915) described *Heterandria zonata* from specimens collected by F. E. Watson from a creek near the railroad station in the town of Sánchez, Samaná province, Dominican Republic. Mr. Watson also collected fish that Nichols (1915) identified as *H. versicolor* from the San Juan River (freshwater) in Sánchez. Locality data taken from catalogue entries (*H. zonata* AMNH 5232, 5238: *L. nicholsi* AMNH 5239, 20925), not from Nichols (1915), because the catalog entries are clearer and more specific than the descriptions. If Watson reported these localities correctly, they are very close to each other.

Nichols and Myers (1923) reassigned *H. zonata* to *Limia*, citing fine details of the gonopodium.

Myers (1925) reassigned Nichols' *H. zonata* to the genus *Limia* and synonymized it, incorrectly, with *L. heterandria* Regan, giving no reasons for either decision.

Myers (1931) described the Watson specimens that Nichols (1915) identified as *H. versicolor* as *L. nicholsi*. The description is sketchy and admits that key characters could not be discerned in the male holotype:

> The largest male (Nichols, 1915, Fig. 1) has barely reached adult size and its long gonopodium, although it appears to have attained its full length, is not differentiated sufficiently at the tip for the generic characters to be visible. However, there seems little likelihood of it being anything but a *Limia*. It agrees with none of the known poeciliids of the island and seems without doubt to represent an undescribed species. I propose that it be called *Limia nicholsi*, the name to rest for the present on Nichols' description and

> figures. A more extended description will be presented in a review of the fresh-water fishes of Hispaniola.

As far as I can tell the promised more extended description was never published. I found no mention of it in Myers (1970).

Myers (1935) reiterated that *Heterandria zonata* is a synonym of *Limia heterandria* Regan and treated *L. nicholsi* as valid without giving reasons.

L. zonata and *L. nicholsi* were regarded as good species until Lechner and Radda (1980, 1986) asserted that Myers (1931)'s *nicholsi* were young *zonata* and treated *nicholsi* as a junior synonym of *zonata.* I don't believe that they examined the *nicholsi* types.

Rivas (1980) asserted that *L. nicholsi* is a synonym of *L. zonata* without giving reasons. However, in that paper he reported that he'd examined the types of all described *Limia* species. This is consistent with his 1979 unpublished key to *Limia*, which doesn't mention *nicholsi*.

Chambers (1987) wrote:

> Rivas (1980) synonymizes *L. nicholsi* with *L. zonata*. I have, therefore, figured one of the two specimens of *L. nicholsi* available to me [Roloff specimens mentioned in Trewavas (1948)] as an example of *L. zonata*, after comparing it with the holotype and paratypes.

The current consensus is that *nicholsi* is a junior synonym of *zonata*. However, some lists of fish names posted on the internet, often by aquarists, show *nicholsi* as valid.

Distribution:

Most museum specimens of *L. zonata* were collected on the eastern north slope of the "north island" of Hispaniola. Its western limit is the Río Yaque del Norte drainage. UF has specimens collected from the Río Cana and the Río Yaguajal, both tributaries of the Yaque del Norte, and from the Yaque del Norte. *Zonata*'s eastern limit is the eastern end of the north island's north slope.

So far it is known from four south slope drainages. UF holds specimens, which I haven't seen, collected from tributaries of the Río Ozama, a major river of the eastern south slope. The city of Santo Domingo is at the Ozama's mouth. Lechner and Radda 1980 report collecting it from "Rio Jainao des Rio Haina-Systems bei Villa Altagracia, Provinz S. Cristobal." In 2023 Mark Sabaj and I collected it from the Río Quisibaní, an afferent of the Río Yuma northeast of Higüey and from the Río Sanate. These two last extend the fish's range westwards on the south slope.

There doesn't seem to be a Rio Jainao. Although they vouchered no specimens, making checking the identity of their Rio Jainao *Limia* impossible, in late May 2022 Mark Sabaj and I collected what I thought at the time were unmistakable *L. zonata* ANSP 208508 from a tributary of the Haina near Villa Altagracia. Close examination of the males in that lot, including internal features (see below) found that these specimens are in fact *L. versicolor*, so I doubt Lechner and Radda's record.

Lyons & Rodriguez-Silva (2021)'s map shows *zonata* present in the Valle de Neiba, the Dominican section of the gap between the two proto-islands that came together to form Hispaniola. I've found nothing that supports this. In addition, they report that *zonata*

occurs in the northernmost part of the Yaque del Sur (Cohen et al. 2015, Torres-Pineda et al. 2019, Rodríguez-Silva et al. 2020, Rodriguez-Silva and Weaver 2020).

None of the papers cited reports *zonata* in the Yaque del Sur.

Where museum specimens of *L. zonata* were collected

Habitat preferences:

Lechner and Radda (1980) say little about the situations in which they found *zonata*:

> It is not demanding with respect to water quality and can be found even in heavily polluted and rather oxygen-poor waters.

Meyer, Wischnath and Förster (1985) expanded on this:

> In different biotopes water temperatures of 21-30 °C (in summer 1978) were measured. The waters have an electrical conductivity of 150-600 µS/cm and a pH of 4.2-8.0.

Meyer (2015) repeated this information and added:

> *L. zonata* is found both in small streams with shallow water levels, mainly in areas of the Samaná Peninsula, and in deep water zones of wide, slow-flowing rivers, mainly in the Rio Yuna system. *Limia zonata* prefers the open water zones of muddy bottoms.

Torres-Pineda et al. (2019) studied the population structure of *L. zonata* in the Río Maimón, a tributary of the Yuna. Their four sampling stations:

> presented sand, gravel, pebbles and mud substrate. Los Plátanos locality (headwaters) presented the highest water transparency, with clarity decreasing downstream. Aquatic vegetation was found just in Piedra Blanca and Maimón (the middle course sites). Water current velocity ranged from 0.03 to 0.57 m/s. Water temperature ranged from 21.2 °C to 30.5 °C, and pH was 6.7 to 8.3. Conductivity ranged from 92.0 to 205.5 mS/cm, dissolved oxygen concentration ranged from 5.9 to 9.1 mg/L. Total dissolved solids

> ranged from 58.5 to 121.5 mg/L. All sites presented some level of impact from agriculture and cattle grazing, as well as solid wastes in water and at the river banks

In April 2019 I took two stations in the Maimón above Piedra Blanca, didn't find *zonata*. At both of my stations the river was shallow and the substrate was very rocky. Terrestrial grasses extended over the margins. It appears that the Maimón floods severely during the rainy season. A highway bridge across the river near one of my stations had collapsed because its central pier had been undermined and partly washed away.

In December 2019 I collected *L. zonata* in the Río Acapulco, a tributary of the Río Yuna, in the town of El Pino, La Vega province; at my site it is a broad shallow stream with considerable current. The substrate is cobble and gravel. As in my Maimón sites, terrestrial grasses grew out over the margins. I found *L. zonata* in the current in mid-river, not under the grasses as I'd expected. I also collected *Poecilia dominicensis* and *Nandopsis haitiensis* at that site.

I conclude from these observations that *L. zonata* doesn't have strong habitat preferences.

Behavior, including courtship:

Jacobs (1971) knew *zonata* as *L. nicholsi*. I believe he received it directly from Roloff. The two were friends. Jacobs wrote about aspects of its male coloration:

> The coloration of the males can change more radically than that of any other livebearer. When there are several males in a tank, only one will show really intense coloration. If the other males are then removed, this fish will lose its previously brilliant colour and will only regain it if at least one male is introduced. This male coloration is very striking. Some parts of the body, particularly the throat, become bright yellow. The body is crossed by a few dark, almost black bars which often more or less fuse with each other. Sometimes the copulatory organ also become completely black. The dorsal fin becomes red-brown with a black border. In the front part of the dorsal fin this border enlarges to form a black spot.

Farr (1984) acquired *L. zonata* from Manfred Meyer and studied their behaviour:

> Males change colour as their social status in aquaria changes. Dominant, more aggressive males develop a black and orange dorsal fin and black pigmentation on the gonopodium and caudal peduncle. Less aggressive (subordinate) males are identical in colour to females - nearly uniform yellow in body color with no pigmentation of the fins. The colour change associated with dominance in males is reversible and can occur within minutes in either direction. Jacobs (1969) noted in his description of *L. nicholsi* (= *L. zonata*) that only one male in an aquarium exhibits the darker coloration. In 200-1 aquaria with 20 or more individuals, I observed that several, but not all, males exhibited the dominant coloration simultaneously.
>
> Male sexual behaviour consists only of gonopodial thrusting and nibbling. No courtship display was observed.

As captured, i.e., flopping in the net, both sexes of the *zonata* I collected in December 2019 had the same coloration: bright clear gold, darker above than below. I keep my fish in stock tanks. As many as half of the males in a tank colour up at the same time as described by Jacobs and Farr. When I catch a well-coloured male to put in a photo tank he instantly turns off his dark pigmentation. In my tanks the lower half of large females' urosomes are sometimes dark. My preserved 2019 specimens of both sexes show 4 dark vertical bars.

Male *L. zonata*. Males fade instantly when put in the photo tank. Dan Fromm photo.

Female *L. zonata*. Dan Fromm photo.

Like Farr, I've never seen behaviour recognizable as courtship. My males nuzzle females' vents and then attempt to copulate. At times one to four males will cluster below a female and try to mate. When this happens, the female usually tries to flee but sometimes hangs motionless in the water, head down, tail up. I suspect that when only one male is involved there's been some sort of negotiation.

***Limia zonata* in the aquarium hobby:**

The first introduction of *L. zonata* to the hobby probably occurred in 1938 when the great German aquarist E. Roloff carried some live fish from the Dominican Republic to Germany. He sent preserved material to the British Museum to be examined by Ethelwynn Trewavas, who identified his two *Limia* species as *L. nicholsi* and *L. perugiae*. As an aside, Roloff's *perugiae* came from the Nizao drainage. The Nizao is the first river west of *perugiae*'s type drainage. See Trewavas (1948), which has photographs of "*nicholsi*." The only trace of both introductions is in Jacobs (1969) and (1971).

The next introduction to Europe, by Lechner and Radda, was in 1978 as *L. zonata*. Meyer, Wischnath and Förster (1985) mention it. Farr (1984) reported male coloration and courtship. Kempkes and Schäfer (1998) have photographs taken by five photographers. I have not, however, been able to find accounts of the fish by European aquarists except in the two books mentioned above. Although it may have been brought in more recently, it seems to have been lost from the European hobby.

Limia zonata came to the U.S. later than it did to Europe. Crane (2012) said that the fish had been collected in the Rio Caracor near the village of Linea Nueva in eastern Dominican Republic in February 2010. The Caracor is thought to be a tributary of the San Juan River and offered specimens to participants in ALA's species maintenance program. The brood records table in Livebearers 212 contains an *L. zonata* record submitted by Joanne Norton (51 fry). Monje (2012) wrote about keeping the fish and stated that the collector was Rit Forcier.

Mr. Forcier told me (e-mail of March 20, 2023):

> "I was on vacation in Punta Cana, DR, when a vendor there put me on to this place, about 10 miles to the north. … Both Alex Cruz and Pablo Weaver have verified that my fish from Dominican Republic is the eastern strain of *Limia zonata*. "

Monje (2012) mentioned without explanation that there are "a northern and a southern morph." This has not been reported elsewhere and is probably a miscommunication. I also haven't been able to find references to eastern and western strains.

L. zonata seems to have been lost in the U.S. However, I've distributed it and hope that it will stick.

Care and breeding, etc.:

I keep my *zonata* in Cherry Hill tap water, TDS 130 – 150 ppm. I feed them Tertramin® staple flake. My tanks are well planted and run slightly alkaline. I change water once weekly, 50% - 70%.

Flock breeding works fairly well as long as the tank has considerable floating vegetation. I use Water Sprite (*Ceratopteris thalictroides*). Few fry survive without floating plants. However, fry survival in well-planted tanks doesn't seem to be density dependent.

I suggest subculturing every 6-9 months. The female should be trapped – my traps are 10" cubes of ⅛" mesh Ace netting – or isolated in a well-planted tank and removed after she's delivered.

If I haven't been clear, *Limia zonata* is undemanding and easy to keep. It is a very active fish, mine are always in motion. I like them and am glad I brought some home with me.

About the etc. *Zonata* is relatively slender. Large females become slightly chunky when gravid but smaller females do not. Not surprising, considering that the fish occurs in hill streams where there's strong selection for streamlining.

I've had one inadvertent *zonata* cross, male *zonata* x female *L. melanonotata*. I don't know how many males were involved. They ruined two known virgin *melanonotata*. Each female delivered one brood. All of the fry grew up looking like males. Each has a gonopodium and a large dorsal fin. They try very hard to mate with each other. Forced mating, there's no courtship. I haven't dissected any. The two broods have slightly different colour patterns. In

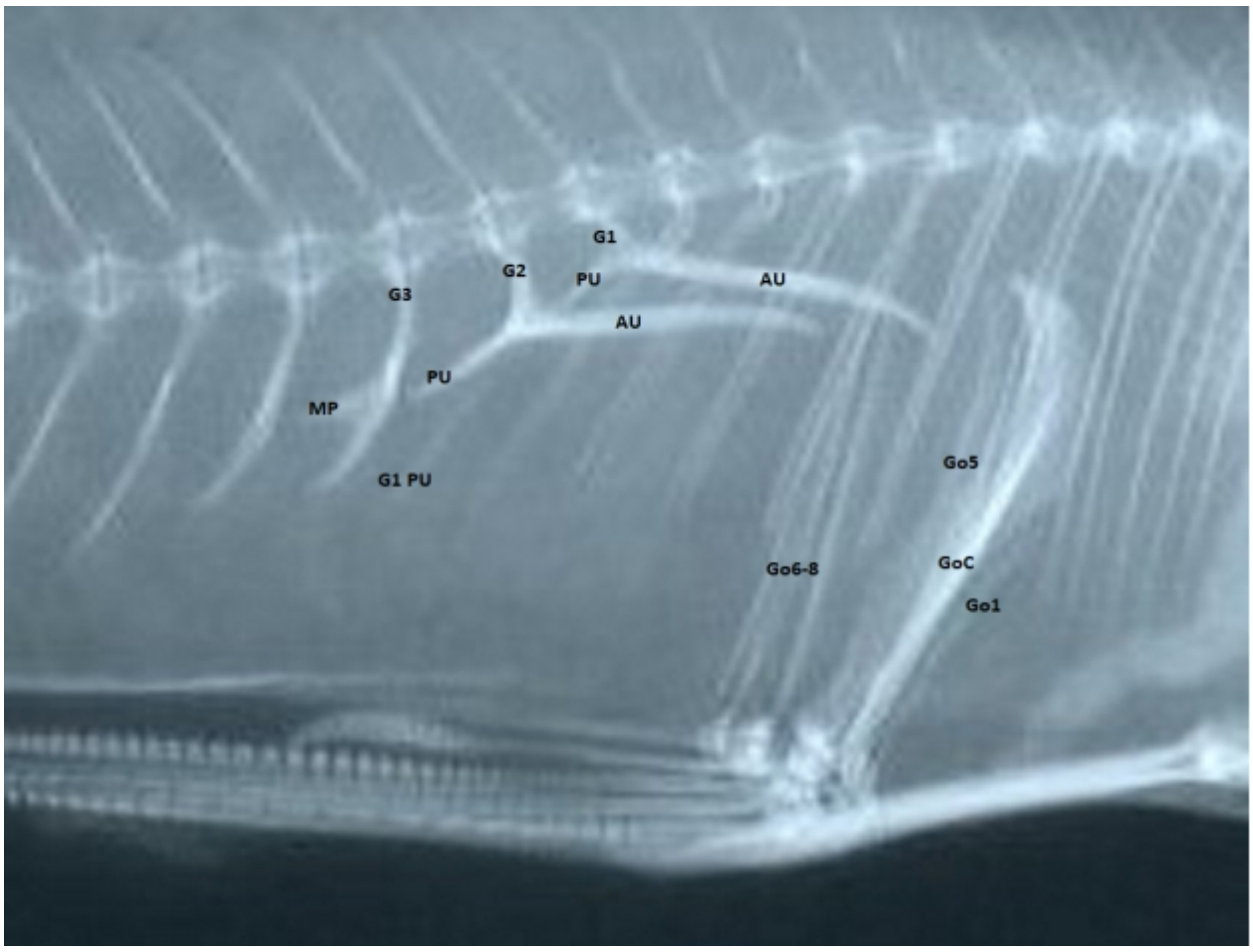
view of this accident, I don't recommend keeping *zonata* with other *Limia*. **Conservation status:**

The IUCN has classified *Limia zonata* as Near Threatened because of its small range and "area, extent and/or quality of habitat." Its range is estimated at ~16,000 km^2; this is probably an over-estimate and the upper limit of "small range" is 20,000 km^2. I see the classification as overly pessimistic but it follows from IUCN's criteria.

Looking inside the fish:

We aquarists can easily see our fishes' exteriors. Few of us are equipped to see skeletal features. We're not set up to clear and stain or X-ray preserved specimens. I'm fortunate to have a courtesy appointment as Research Associate, Ichthyology in The Academy of Natural Sciences of Drexel University and to be allowed to use the department's X-ray machine.

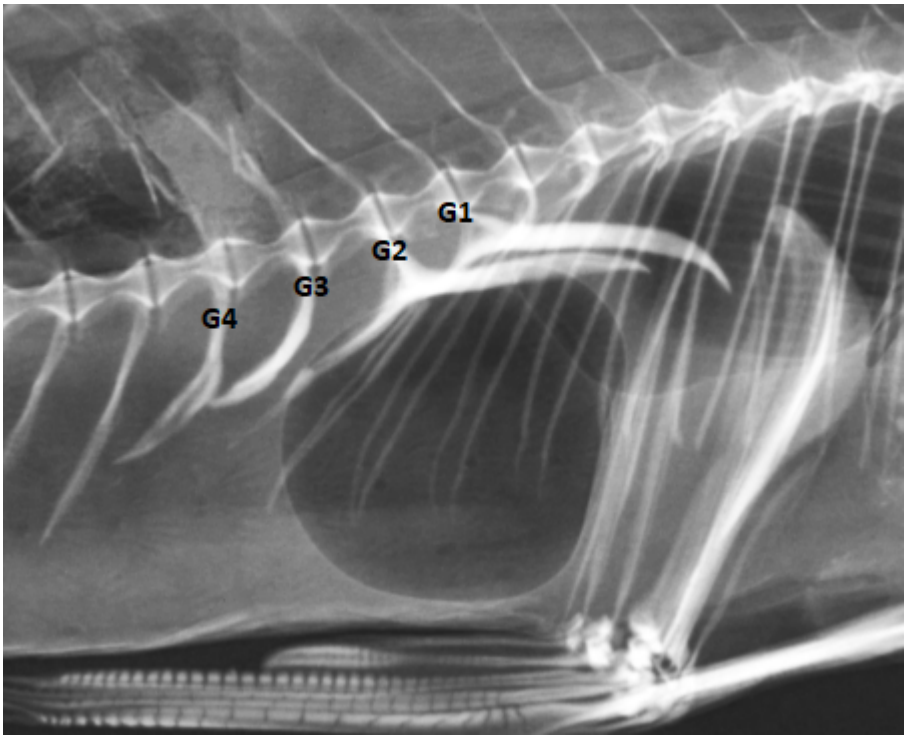
The most important idea in male poeciliids' little minds is probably survival. After that, mating. We can see the external structure used in mating, the gonopodium. It is the anal fin much modified from the female condition. We can't see the internal structures – bones and muscles – used to swing the gonopodium forward for mating. Soft tissues such as muscles are transparent to X-rays but bones aren't. Radiographs of male *L. zonata* reveal a few surprises. To begin, here's a radiograph of the male holotype AMNH I-5232 of *L. zonata* with the important (for mating) parts labelled:



Radiograph courtesy of The American Museum of Natural History.

"**Go**" means gonactinost, **GoC** is the gonactinostal complex, formed from gonactinosts 3,4 and 5. **Go1**, **GoC**, **Go5** and **Go6-8** are linked to the gonopodium cartiledges called radials. In the female, these bones are relatively shorter, straighter and not fused. **G1**, **G2** and **G3** are the first three hemal spines modified into what are called gonapophyses. They anchor the muscles that swing the gonopodium. 1 and 2 are shaped like clothes hangers. The branches are called uncini (hooks, in English); **AU** is the anterior uncinus, **PU** is the posterior uncinus. **G1**'s posterior uncinus is very long. **MP** on gonapophysis 3 is a medial projection. *L. zonata* has three gonactinosts; in other *Limia* there are usually two. Females first three hemal spines are nothing like males' gonactinosts. The bones descending from the spine in front of **G1** are ribs.

So far, so good and so irrelevant to aquarists' concerns. Here's another specimen, with what I see as 4 gonapophyses. The norm in *Limia* is 2, but in some species 3 is not rare.



ANSP 208583-T6753 radiograph by Dan Fromm

Limia zonata males aren't particularly variable externally, so the fish isn't a good candidate for improvement by selective breeding. They are, though, surprisingly variable internally.

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The genus *Alloophorus*

by Michael Köck

This article was first published on the Faceboook page of the Goodeid Working Group and appears here with the kind permission of Michael Köck

Going ahead with descriptions, and we move on to the second genus in the Goodeid alphabet: *Alloophorus*, and as far as we know the only declared predator among Goodeids, and for sure one of the biggest representatives. The English name Bulldog Splitfin says everything: This fish has got character. Widely distributed but rare in many places, simply due to the fact that it is a predator. While the oldest description of an *Allodontichthys* species dates back to 1932, *Alloophorus robustus*, the only valid species of this genus was described 40 years earlier in 1892, and the describer Tarleton Hofman Bean put it - due to superficial similarities - in the genus *Fundulus.* Only three years later Samuel Walton Garman observed a few specimens of this species, but erronously thought they would belong to the California Killifish, *Fundulus parvipinnis*, and named them this way. A mistake as we learned later, and an entry in the list of synonyms of this species. In 1902 Seth Eugene Meek finally made a Goodeid out of this species and put it into the genus *Zoogoneticus*. Another entry in the list, but at least the direction was good(eid). Two years later in 1904 the British ichthyologist Charles Tate Regan described *Zoogoneticus maculatus* from the Río Santiago near Guadalajara. He was aware of *A. robustus*, but found differences in the head profile and caudal peduncle. Later he recognized "his own" fish being a synonym of *robustus*, and in 1939 finally (the story of *Allodontichthys* was only seven years old), Hubbs and Turner erected the genus *Alloophorus* for this species. So we have only one species in this genus - or not? Besides the morphological differences between the eastern population (*A. robustus*) and the western (*Z. maculatus*) come genetic differences. The future will show if they are big enough to make *Zoogoneticus* (then *Alloophorus*) *maculatus* valid again; for the moment however, all specimens are regarded as *Alloophorus robustus*. Here the link to the Bean's description: https://goodeidworkinggroup.com/sites/default/files/Alloophorus%20robustus.pdf, the Garman's mistake: https://goodeidworkinggroup.com/sites/default/files/Fundulus%20parvipinnis.pdf, Meek's transfer into the genus Zoogoneticus: https://goodeidworkinggroup.com/sites/default/files/Zoogoneticus%20robustus.pdf and Regan's description of *Zoogoneticus maculatus* through Regan: https://goodeidworkinggroup.com/sites/default/files/Zoogoneticus%20maculatus.png

NOTES ON FISHES COLLECTED IN MEXICO BY PROF. ALFREDO DUGÈS, WITH DESCRIPTIONS OF NEW SPECIES.

BY

TARLETON H. BEAN, M. D.,

Ichthyologist of the United States Fish Commission.

(With Plate XLIV.)

The U. S. National Museum received from Prof. A. Dugès, August 24, 1891, a small but very interesting collection of fishes, including three species which appear to be new to science, and which are described in the following paper. Among these fishes are two examples of *Lampetra spadicea* of much larger size than any previously obtained, and which show some very interesting variations from the types. The species of *Acara* from the region Huazteca Potosina, in the province of San Luis Potosi, Mexico, is interesting because it appears to be the first one of its group from the locality. It is rather curious that the name Mojarra should be held in common by this fish and the species of *Gerres*.

Diary dates:

1. The second summer show
Cumbria, July 7th,
Harraby Catholic Club,
Edgehill Road,
Carlisle,
CA1 3PQ

2. Autumn Convention
Midlands, September 21st/22nd
Shenstone Village Hall,
Barnes Lane,
Shenstone (Near Lichfield),
WS14 0LT

I hope to see you at either, or better still, both, of these events.

3. Poecilia Scandinavia invite members of the BLA to their meeting on Saturday 31st August, in Dronninglund, Denmark.

Venue:
Dronninglund Hotel,
Slotsgade 78
DK-9330 Dronninglund

More details can be found on the website www.poecilia.org