

Livebearer News

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BRITISH LIVEBEARER ASSOCIATION



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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

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Editorial

In the last issue of "Livebearer News", in March, I put out an appeal for males of *Xiphophorus nezahualcoyotl*. I had about fifteen of the species growing on from last year but none of them had sexed out as male and you can't breed this species if you only have females! Fortunately – no-one responded. Why fortunately? Because in the three months since that appeal went out a number of the "females" have in fact grown a sword and developed a gonopodium. At over a year old! I have mentioned this to a number of people from the BLA who have all said :- "OH yes, this species does not sex out until it is a year old, or more". I didn't know that. Why didn't I know that? Because no-one told me. This is the sort of information that is invaluable if we want to keep a species long-term. So get writing! Get your experience into print so that other people can benefit in future. Don't worry about spelling or punctuation – that is my job. My email address is on the previous page.

Many thanks to Kees de Jong and Marketa Rejlkova. They supplied me with all of the articles in this issue of the newsletter and it would have been a very thin affair without their help. Another reason for you to get writing – PLEASE! At the moment, I have nothing in reserve for the next issue.

The BLA has come in for some criticism recently. A few recently-joined members have not been happy with what we offer. One possible response is :- "The subscription fee is only £6 and for that you get access to the BLA's website, warning of the events that we run, reduced entry fee to the three events that are being put on this year and four copies of the newsletter."

I prefer the other response. If you don't think that we are doing enough then please let us know what you think we should be doing. Better still; join in. The BLA is a collaborative affair with several people contributing their time and effort. The committee has a "Zoom" meeting once a fortnight and you are welcome to join us if you can help out with what you think we should be doing. You would be even more welcome if you could take on some of the jobs that could make the BLA better.

Snippets

1. Holidays. Don't you just love them. I recently had a week and a half away in Scotland. When I got home a female *Characodon audax* had given birth but there was no sign of the fry. Damn! Then I checked the tank containing *Phallichthys tico*. When I left there had been lots of fry and several females that were gravid. When I got back there were no fry visible and no females looked gravid. In the month since there have no more young born and no sign of any. It took me ages to get this species breeding in the first place and now it looks like I have blown it. The numbers of this very small species have been going down slowly and I will lose it entirely at this rate. It looks like this is one species that you just can't leave and need to get someone to feed if you go away for more than a few days. To counter that, I have heard many horror stories from people who have left friends or family to feed fish whilst they have been away and come back to find the whole tank wiped out through over-feeding. Hmmm!

Snippets - continued

2. A success story. Dr Laura Kelley of Exeter University contacted us to try to get hold of wild-type green sword-tails. After I put out an appeal to the membership of the BLA, newish member Vincent Nobel was able to supply Dr Kelley with almost 100 green sword-tails for her research into the effect of sword length on mating choice in *Xiphophorus helleri*. Dr Kelly was kind enough to send me a copy of her previously published research into the visual acuity of fish and how it affected their mating behaviour. I even understood some of it! Thank you to both Dr Kelly and Vincent. I hope to be able to talk to both of you at the next BLA event in Basingstoke.

35 pairs of fins reaching out for help

Text and Photos By Markéta Rejlková

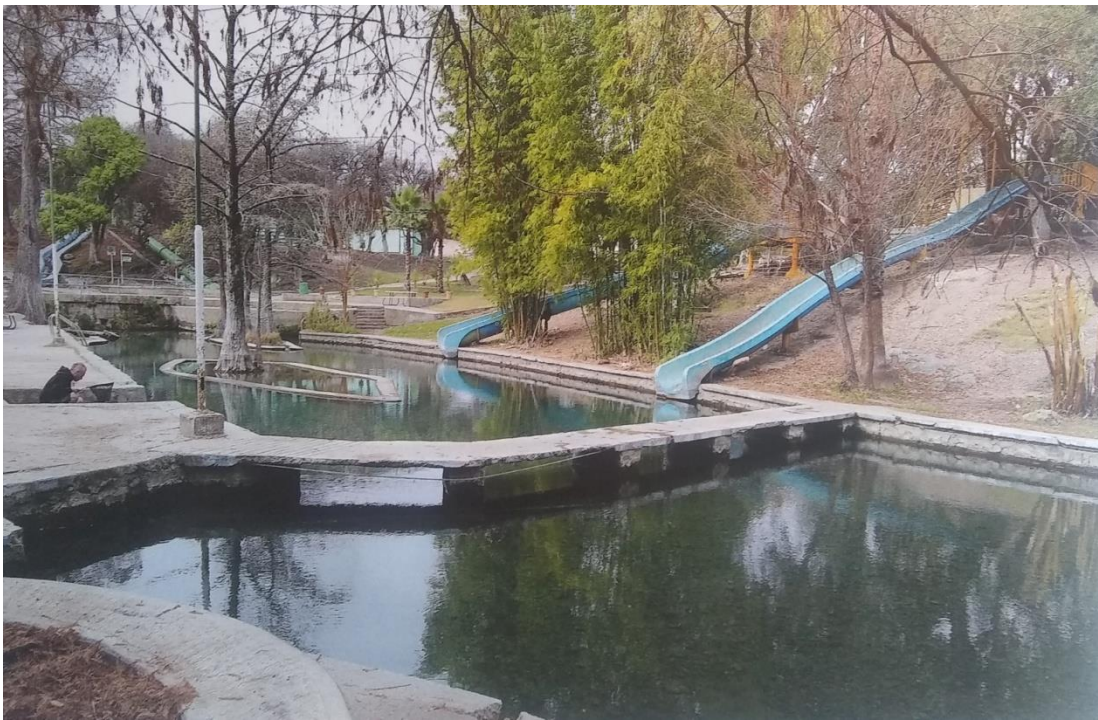


Photo : Múzquiz, Coahuila, Mexico. Former habitat of *Xiphophorus meyeri*.

Potential site for re-introduction?

Photo : Markéta Rejlková

Year 2021 has brought another major update of the IUCN Red List for Poeciliidae. The handful of threatened species which were mostly from the genus *Xiphophorus* and *Gambusia* has now grown to a list which has not only bigger variety, but is also considerably longer. And while it might be interesting to browse the complete list and note that for example the iconic species *Poecilia velifera* is considered to be Vulnerable (due to the threats to coastal mangroves) and the elusive *Priapella bonita* is officially not Extinct since 2018 (no, it was not rediscovered – but due to the uncertainty, this species is assessed as Data Deficient), I want to direct your attention to the „top of the pyramid“. Species which truly need our help.

Let's have a look on the species Extinct in the Wild (EW, 2), Critically Endangered (CR, 17) and Endangered (EN, 16). Hence the 35 pairs of fins, assuming that each fish (species) will only use their pectoral fins – most similar to our hands, what do you think?

If we replace the number by species' names, it starts to be quite personal. So here we go:

Extinct in the Wild: *Xiphophorus couchianus*, *Xiphophorus meyeri*.

Critically Endangered: *Gambusia beebei*, *Gambusia eurystoma*, *Gambusia hurtadoi*, *Limia fuscomaculata*, *Limia immaculata*, *Limia islai*, *Limia garnieri*, *Limia grossidens*, *Limia mandibularis*, *Limia miragoanensis*, *Limia nigrofasciata*, *Limia ornata*, *Limia rivasi*, *Limia sulphurophila*, *Quintana atrizona*, *Priapichthys puetzi*, *Pseudoxiphophorus attenuatus*.

Endangered: *Gambusia longispinis*, *Gambusia nobilis*, *Gambusia pseudopunctata*, *Gambusia xanthosoma*, *Limia yaguajali*, *Phallichthys quadripunctatus*, *Poecilia rositae*, *Poecilia sulphuraria*, *Poecilia teresae*, *Poeciliopsis catemaco*, *Poeciliopsis jackschultzi*, *Poeciliopsis monacha*, *Poeciliopsis paucimaculata*, *Priapella olmecae*, *Xiphophorus andersi*, *Xiphophorus gordonii*.

What is your first impression after seeing this list? Let me share with you mine: I know many of these species very well and keep them... but at the same time, I know almost nothing about quite a lot of them! But this is not about me, it is about us – do we know them and most importantly, **do we keep these species?**

Many of the threatened poeciliids are from the Caribbean region, including the endemics of the Haitian Lake Miragoâne: nine members of the *Limia* genus and *Gambusia beebei*. This place seems to be a hot spot. It is a small lake with area fluctuating seasonally between 9 and 25 km², the single locality of those ten livebearer species. Given the fact that the area around the lake is being deforested, which leads to changes in sedimentation and hydrology, and there are exotic fish species present, the future of the lake's endemic fauna is not bright. Can you imagine that *Limia nigrofasciata*, one of the "basic" species of our childhood, would go extinct in the wild?

And indeed, there is a very thin line between the categories Critically Endangered and the unfamous Extinct in the Wild (or Extinct, if we don't even manage to preserve the species in aquariums!).

Quintana atrizona has not been spotted in the nature for a decade.

Pseudoxiphophorus attenuatus has not been collected since 1979 when it was first described for the science... which means, let me count how many years this fish is in the missing notice ... all my life! So this is what it means to be Critically Endangered. You might still be out there, but with our world changing fast and your waving fins being so small... it might be late when someone realizes it is the time to go and do a thorough research of the area.

Now, the list might not be absolutely accurate. There are some points for discussion, and some species will definitely need our help more than others. And then, there is the base of the pyramid – the solid bottom of the species evaluated as "Least Concern" (73). But underlying, not to be overlooked, is one more category: Data Deficient. 64 species with the official tag "We don't know". One of them is the already mentioned *Priapella bonita*, not found since 1965. Other examples

include species with such different size of distribution areas like *Xiphophorus nigrensis* and *Xiphophorus maculatus*. Collecting data and evaluating the status and threats is obviously another challenge we need to face.

Why do I write this article? Well, it stands right at the beginning, in the title itself. I think we should help those fish, they are the crucial part of our hobby and passion, aren't they? Let's focus on those 35 most endangered species, let's try to learn as much as we can about them and make sure we



Many habitats of viviparous fish have become strongly influenced by human presence. Coastal lagoon in Veracruz, Mexico.

Photo : Markéta Rejlková

keep them in our aquariums for future. Ex-situ conservation breeding is something we can do, without having to worry about how remote or inaccessible the original biotope is.

As many of you know, the Xiphophorus Working Group was recently founded to facilitate our efforts to preserve the wild strains of the *Xiphophorus* genus (see the very top of the pyramid – this is a clear mandate, we can't let those fish disappear). But that's not the only news. The European Association of Zoos and Aquaria (EAZA) has approved a new ex-situ programme (EEP) for Poeciliidae. Grey little fish have gained the attention of this huge organization!

But there is the trick: zoos and aquaria alone can't save the species. We need private breeders, either as individuals or represented by their (national or other) associations, to be directly involved. Would you please help us and become a partner of EAZA institutions in this programme? Would you share your experience and knowledge, would you share your collection data and biotope information, would you dedicate one of your aquariums to a species you perhaps never wanted to keep?

I strongly believe that aquarium enthusiasts can make a difference and can significantly contribute to a species conservation. They have already proved it and they continue to do so. Especially the livebearer keepers. Talk to your friends, talk to your associations, get in contact with your local zoos, and get in contact with me. I will work hard to find out what I can about the “unknown” species and bring them in aquariums for conservation breeding, but I can’t succeed without your help.



Small black-water stream in an agricultural landscape near the Panama – Costa Rica border which is home to the endangered *Phallichthys quadripunctatus*. Photo : Markéta Rejlková

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EEP coordinator for Poeciliidae

IUCN SSC Freshwater Fish Specialist Group member

But above all, passionate aquarium hobbyists for ever :-)

Reference:

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The drawback of placentas for live-bearing fish *by Kathryn Knight*

Fishes have had a long time since the dawn of life to play around with how they reproduce. While many never meet their parents, hatching from externally laid eggs, others are protected within their mothers' bodies, consuming their egg yolk as they develop. An even more select group are nourished continually by their mothers through a placenta, which is great during times of plenty, but when food is scarce, what then? Youngsters that continually depend on their mothers for nutrition as they develop could be in trouble.

To find out how *Phalloptychus januarius* embryos – which are supplied with nutrition via a placenta – cope, Andres Hagmayer, Martin Lankheet, Johan van Leeuwen and Bart Pollux from Wageningen University, The Netherlands, cut the mothers' provisions by 75% and waited to see what impact it had on their developing young.

After collecting newborn fish – some of which had only experienced deprivation for a week of gestation, whereas others had completed their entire development (4 weeks) while their mothers were on reduced rations – Hagmayer and Judith Bijsterbosch (Wageningen University) recorded mass, fat carried and whether the

fry gained weight over the first week of life. Meanwhile, Lankheet and Bijsterbosch analysed the fish's swimming when startled and while feeding.

Sure enough, the offspring of mothers on a meagre diet didn't fare well: they were smaller and carried less fat than the youngsters of well-fed mothers. In addition, fish born after longer periods of scarcity were even smaller and leaner. And when the team followed up over their first week of life, these fish didn't thrive; even though they grew, they failed to gain fat. The youngsters' swimming also failed to improve as quickly as that of fish from well-fed mothers, with the newborns of mothers fed poorly for the longest time showing the least improvements in their swimming. 'This suggests that maternal food availability during pregnancy affects the development of swimming capabilities after birth', Hagmayer says.

So, *P. januarius* youngsters that develop within their mothers when food is scarce are at a disadvantage relative to species that provision their eggs with everything they need to develop before abandoning them to get on with it. 'Our study shows that placental provisioning can be disadvantageous when maternal food is scarce', concludes Hagmayer.

10.1242/jeb.243971

Hagmayer, A., Lankheet, M. J., Bijsterbosch, J., van Leeuwen, J. L. and Pollux, B. J. A. (2022).

Maternal food restriction during pregnancy affects offspring development and swimming performance in a placental live-bearing fish.

J. Exp. Biol. 225, jeb242850. doi:10.1242/jeb. 242850.

Kathryn Knight

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This article was kindly sent to me by Kees de Jong and originally appeared in "Journal of Experimental Biology".

Inside JEB highlights the key developments in Journal of Experimental Biology. Written by science journalists, each short report gives the inside view of the science in JEB.



Skiffia cf francesae – V188 “Sayula” Photo kindly sent to me by Kees de Jong

New research on the genus *Characodon*

By : Kees de Jong Translated by Google translate – with a little help from Greg Roebuck

The viviparous *Goodeidae* have been kept by a select group of breeders since the early 1980s. the fish live in central Mexico. This group of fish is also receiving more and more attention from non-specialists and from time to time some species are offered in the retail trade.



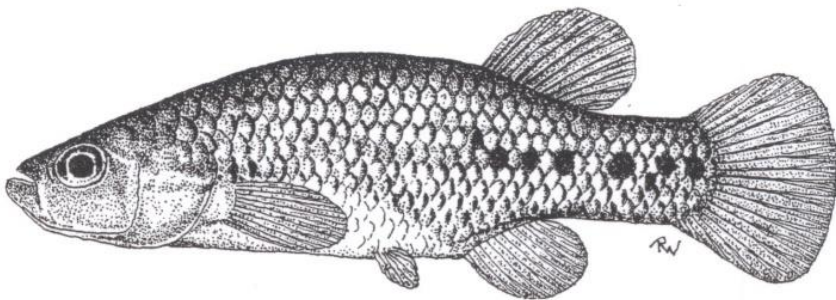
Photo 1 :- A *Characodon* as it was often kept in the 1990s. The site where it was caught is unknown. Photo : Juan Carlos Merino

I saw my first living fish from the genus *Characodon* in the late 1980s. They were offered at an auction held by the German association DGLZ under the name *Characodon lateralis*. Certainly, for *Goodeids* they were beautifully coloured fish that were sold for a considerable amount. In later years, the fish were more readily available. I then got the fish under the name *Characodon lateralis*: the site where they were caught was unknown. The males had a red body and a striking appearance. The care and breeding of these fish presented few problems. I kept a group of different ages in a planted aquarium measuring 80 x 40 x 40 cm. every week I changed a large part of the water. They were mainly fed food with an animal

basis. The fry born in the aquarium were hardly ever eaten by the larger fish. With the surplus that arose I could do a favour for other enthusiasts.

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Characodon garmani Photo : Ruud Wildecamp (Kindly sent to me by Kees de Jong)



The species of the genus *Characodon*

More information about this group of fish became available over time. The species of this genus, like the other *Goodeids*, are viviparous and have internal fertilization. The young get extra food in the female's ovary.

The genus *Characodon* split from the other *Goodeids* 15.5 million years ago. Since the description of *Characodon audax* by SMITH & MILLER in 1986, three species have been recognised in the genus *Characodon*. These are all from isolated springs and streams in the arid highlands of the northern Mexican states of Durango and Coahuila. *C. garmani* JORDAN & EVERMANN 1898 has not been found since 1880 and is considered extinct. The description of this species is based on one



female that is believed to come from a spring system. This spring system ends in the Laguna de Mayran in the Rio Nazas drainage basin near Parra.

Photo 2 : *Characodon audax*

Photo : *Juan Carlos Merino* (via Kees de Jong)

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Photo 3 : The El Salto waterfall separates the main populations of *Characodon*.
Photo : *Günther Schleussner*.

C. audax and *C. lateralis* come from the northwest and live in the upper stream of the Mezquital river. The naming of the species is debatable. It was believed that the boundary between the habitat of the two species was determined by the 30 meter high El Salto waterfall. The short description of *C. lateralis* from 1866 is based on

fish caught by B. SEEMANN during an expedition in 1849 – 1850. In GÜNTHER's description from 1866, he mentions "Central America" as the site where the fish were caught. That description is too broad to say anything about the habitat of the fish. Still, the impression had arisen that the fish were *C. lateralis* below the waterfall. However, ARTIGAS AZAS (2003) and BELTRÁN-LÓPEZ, ET AL (2021) conclude after reading the travelogue of SEEMANN (1853) that it has never been south of the waterfall. So the fish caught by him and used by GÜNTHER to describe *C. lateralis* come from above the waterfall! This led to discussions about the name, because everything above the waterfall was now called *C. audax*. 12



Photo 4 : *Characodon lateralis*; female giving birth.

Photo : Juan Carlos Merino

Status in nature

In nature, the number of *Characodons* has declined sharply in recent years. The main reasons for the disappearance of the habitats are :

- The introduction of exotic species,
- The pollution of the habitat,
- The drying out of wells and streams due to the pumping of groundwaters,
- Changing the catchment areas.

In the aquarium, the species are kept by specialist enthusiasts. The origins of the populations are now also accurately recorded. As a result, the differences between the populations are also noted. Depending on the population, the males have a red, metallic, Yellow or blue body colour. The unpaired fins can also have different colours and sometimes have a black band. Both sexes can vary in the amount of black spots on the body. In the females, these often form a dark band. The females are also more simply coloured than the males. The females do not differ with location. From the reports I have read about the area, I gather that different colour varieties can also occur within one population.

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Variation in body shape

TOBLER & BERTRAND examined the variation in body shape from ten locations. They also used X-Rays for this. They came to the conclusion that both the physiques of the sexes and of the populations differ. These morphological differences relate to the body height, the proportion of the caudal peduncle, shape of the head and the widths of the bases of the anal and dorsal fins. *Characodon audax* is described from El Toboso. This species differs most from the other populations. Furthermore, the populations below the El Salto waterfall and the Cerro Gordo form independent (morphological) groups recognisable by their appearance.



Photo 5 : for their research, TOBLER & BERTRAND used X-rays. The snails that the species eats in nature are also visible in the body of the fish.

Photo : *Michael Tobler*



Photo 6 : El Toboso is the location where the fish described as *C. Audax* were found.
Photo : *Günther Schleussner*

Finally, they conclude that the remaining populations above the waterfall consist of two groups. The first group includes the Presa Tunal Hot Springs and Rio Saucedá. These are close together and the populations show many similarities. The second group is formed by the other northern populations (Rio Mezquital, Aguila Laguna Seca and Los Pinos). The final conclusion of the TOBLER & BERTRAND article is that the situation is taxonomically complex. It is unclear where the demarcation between the different species should take place. Not being able to properly name

the various populations also has consequences for the protection of the species. This is based on species and not populations. Since the populations appear to be unique, protection should go beyond species. They also indicate that further research is necessary.

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Photo 7 : fish from El Toboso. Not all fish have the pronounced colours that we know from the *C. audax* strain.

Photo : *Günther Schleussner*

Genetic Research

That further research was carried out by BELTRÁN-LÓPEZ ET AL (2021). They have genetic research on fish from 11 locations. (See map) from the DNA analyses it becomes clear that there are clearly two distinguishable groups, one north of the El Salto waterfall (NG) and one south of it (ZG). These two groups separated from each other between 1.5 and 2.2 million years ago.



Photo 8 : Ojo Garabato, a system with many springs and connecting streams that end in a small lake near 27 de Noviembre. Photo : *Michael Köck*



Photo 9 : *Characodon* sp from Ojo Garabato
17

Photo : *Michael Köck*



Photo 10 : *Cyprinodon meeki* is an endangered killifish that also lives in this spring.
Photo : Günther Schleussner



Photo 11 ; Laguna seca is a beautiful location.
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Photo : Michael Köck



Photo 12 : Fish from a tiny spring between the Laguna Seca and the town of Anahuac.

Photo : *Günther Schleussner*

Northern group

C. audax comes from El Toboso and differs from the other species. El Toboso is an isolated spring that flows intermittently over volcanic rocks to the closed El Toboso Lake. The source and the lake have dried up several times. The genetic difference with the other northern populations is probably due to long-term isolation. The dark body colour is said to be an adaptation to the dark volcanic soil in the habitat. *C. audax* is considered to be an independent species.

The other populations in the northern group differ from each other , but the differences are not large.

Northern group conclusion :- *C. audax* and a group of fish that are currently unnamed.

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Photo 13 – La Constancia . A small pool fed from a spring is located on private property. This small biotope is visible here in its entirety.

Photo : *Günther Schleussner*

Southern group

The southern group, ie the populations below the El Salto waterfall, have retained the name *C. lateralis*. The three southern populations also differ from each other. The population of Amado Nuevo differs most genetically and in appearance from the others. The difference with the other populations is greater than that between *C. audax* and the other northern populations. Unfortunately, no more *Characodons* have been found in Amado Nuevo since 2005. Only one specimen of this population

was available for the study. The populations of Los Berros and La Constancia together form a separate group.



Photo 14 : *C. lateralis* from La Constancia .

Photo : *Günther Schleussner*

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Southern group conclusion : Differences between the southern populations have not been sufficiently demonstrated to recognize multiple species.



Photo 15 : A well-known southern location for *Characodon* sp is Los Berros. It is a very small resource. Photo : Michael Kock

Taxonomic implications

Since it can be concluded from closer examinations of SEEMANN's report that he was not south of the El Salto waterfall, the populations north of the waterfall should be called *C. lateralis*. An exception is the population from El Toboso, which, in view of the differences with the other northern populations, continues to be called *C. audax*.

The southern populations represent a new species that has yet to be given an official name.

Further research is necessary. The fact that only one specimen of the Amado Nuevo population was available also necessitates further research.

Protection and aquarium care

As HIERONIMUS (2021) also indicates in his article on this subject, given the taxonomic status of the genus *Characodon*, it is of great importance that we keep the populations in the aquarium separate and that we properly record the data about the trapping sites and pass them on in case of further distribution of these species of fish. KUNATH (1990) has already shown that the species are easy to cross and that the offspring are also fertile. So never keep multiple populations together to avoid hybrids.



Photo 16 : *Characodon* sp from Los Berros

Photo : *Marco Groeman*



Photo 17 : *Characodon* sp from Los Berros

Photo : *Marco Groeman*

In recent years, the number of locations where the species are found has decreased by 40%. Protecting the species and keeping healthy populations in the aquarium is therefore of great importance.

.Thanks to Michael Köck, Günther Schleussner, Marco Goeman, Michael Tobler and Juan Carlos Merino for providing the photo's. The drawing was made by the late Ruud Wildekamp. One of the many beautiful drawings he has made of killifish and viviparous fish.

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Not all men are created equal. By Kees de Jong Translated by Greg Roebuck



Limia zonata, male.

Photo : Rodet Rodriguez-Silva



L. perugiae, male.

Photo : Rodet Rodriguez-Silva



Limia zonata, female.

Photo : Rodet Rodriguez-Silva



Poecilia gillii, males.

Furness et al 2020.



Poecilia gillii, large male with damaged tail. Furness et al, 2020



Xiphophorus helleri, Rio Lancetilla, Honduras. Photo : Juan Carlos Merino

In recent years, much research has been done in viviparous toothcarps into the preferences of females and the influence this preference has on the appearance and behaviour of the males. Gradually, more is unravelled and we gain insight into one of the most interesting aspects of this group of fish.

In general, laboratory research looks at one part of the behaviour . Otherwise it is not possible to accurately determine the relationship between two parts. Because usually one species is included in the research, it is assumed that the same behaviour also occurs in related species. Much has already become clear.

The mate choice of the females is influenced by all kinds of other aspects in addition to the appearance of the males. For example, odorants secreted by males or the presence of predators can also influence the choice of a partner. The preference of the female does not 100% determine the parentage of the young. Less attractive males manage to co-fertilize the females by secret mating. In a litter, often young from several males are present.

We know that many viviparous toothcarps have different types of males. Large specimens with beautiful colours and striking features and small, less striking specimens. Some species also come in intermediate forms for it has been established that these intermediate forms have a different mating pattern. Males hardly grow any more when they reach sexual maturity. The time of sexual maturity is mainly determined by genetics, but other aspects also have an influence.

WALLING ET AL. 2007 investigated whether in green swordtails (*Xiphophorus helleri*) seeing a male with a long or short sword influences the moment at which the fish reach sexual maturity. To determine this, two groups were compared. One group had a view of a male with a long sword and the other of a male with a short sword. Since exchange of substances and physical contact between the male and the growing fish was not possible, this only concerned the influence of being able to see a male. By the way, it is already known that males delay becoming sexually mature in the presence of a large male. They then grow a little longer to better compete with the competition (the "leap fish" principle).

The study found that females who see a male with a long sword reach sexual maturity earlier than females who see a male with a short sword.

The opposite is true for the males. When they see a male with a long sword, they are sexually mature later than when they see a male with a short sword.

For females it seems an advantage to be sexually mature quickly if a perfect partner in the form of a male with a long sword is present and to wait if a potential partner is of lesser quality. Males continue to grow with a strong competitor so that they can offer a better match. The study does not address the aspect of the two forms of males in the green swordtail, one of which is sexually mature more quickly and thus is smaller than the other. The experiment only focuses on a female's view of a male; all other aspects are disregarded.

SPIKES & SCHLUPP (2021) investigated the preference of the males of *Limia perugiae* and *L. zonata*. The males of the first species have an extensive courtship and a large body, high dorsal fin and intensive colouring. They go to great lengths to seduce the females. The males of *L. zonata* don't do this. They do not have attractive body features (secondary sexual characteristics, such as the tail of the

peacock) and they do not show courtship. The authors therefore expect that the males of *L. perugiae* are more critical in their mate choice than those of *L. zonata*. They will choose the most fertile (largest) female.

In the laboratory, the preference of the males was investigated by having them make a visual choice. Other stimuli, such as interaction and odorants, were disabled. It turned out that the males of *L. zonata* chose the larger females and that *L. perugiae* males showed no preference. A remarkable result, because you would expect that the males of *L. perugiae* would go for the most fertile female after all that effort. Other criteria may play a part. Additional research is still being done on this. SPIKES informed me in an explanatory email that in this follow-up study she will include a possible preference for small virgin females (who have not yet stored sperm packages from other males).

In addition to all the laboratory research, research conducted in nature is, of course, also interesting. That's what FURNESS, HAGMAYER & POLLUX have done. In Costa Rica they investigated how the males of the molly *Poecilia gillii* behave when approaching the females.

The males of *P. gillii* have no courtship. There are big differences between the males. They cannot be distinguished into clearly delineated shapes; they also occur in intermediate formats. The large males have a higher body, larger dorsal and caudal fin and a shorter gonopodium than the small males. Also, they have more dark and orange colour in the dorsal fin. The smaller males use stealth mating and chase the females almost continually. The longer gonopodium helps them with this. The large males have a territory that they protect from other males. They try to fertilize females that come close. In this case, "sipping" at the genital opening of the females is common. This probably estimates the female's fertility. The males fight among themselves for the best territories. The little guys don't participate in this.

The question is what advantage a larger body and coloured fins offer. The authors suspect that the large body helps them fight other males and that the females prefer the coloured fins.

After reading the above, a logical question is whether not every litter contains young from several males.

This question also occurred to DEKKER ET AL. (2020) and they did research on it in Costa Rica. They examined 159 females of which 72 were gravid. The females had between 4 and 130 young. They determined the father of the young of 31 females and this showed that in 27 cases there was more than one father in a litter. The number of fathers can be up to 9. The number of fathers depends on the fertility of the female. Not all fathers have an equal number of offspring. The data found in *Poecilia gillii* differ from other species of viviparous toothcarp where the presence of multiple fathers in one litter has been established. Multiple fathers in one litter have been identified as giving the female benefits. There is genetic diversity in a litter and this ensures a greater chance of survival. Since large females are better able to scare away unwanted males, they may be fertilized by fewer males.

A lot of research has been done on the above topics and the mystery continues to be unravelled. We are gradually coming to better understand the complex reproduction of the viviparous toothcarps.

Literature

MYRTHE L. DEKKER, ANDRES HAGMAYER, KAREN M. LEON-KLOOSTERZIEL, ANDREW I. FURNESS & BART J. POLLUX 2020. High degree of multiple paternity and reproductive skew in the highly fecund live-bearing fish *Poecilia gillii* (Family Poeciliidae). *Frontiers in Ecology and Evolution* 8: 579105.

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ANDREW I. FURNESS, ANDRES HAGMAYER & BART J. POLLUX 2020. Size-dependent male mating tactics and their morphological correlates in *Poecilia gillii*. *Biological Journal of the Linnean Society* (131): 880-897.

MONTRAI SPIKES & INGO SCHLUPP 2021. Males can't afford to be choosy: Male productive investment does not influence preference for female size in *Limia* (Poeciliidae). *Behavioral Processes* (183): 1-8.

CRAIG A. WALLING, NICK J. ROYLE, NEIL B. METCALFE & JAN LINDSTRÖM 2007. Green swordtails alter their age at maturation in response to the population level of male ornamentation. *Biol. Lettr.* (3): 144-146.



Photo 1 : *Limia nigrofasciata*, two males.

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Photo 2 : *Limia melanogaster*, male.



Photo 3 : *Limia tridens*, male.

Photo : windows photo gallery.



Photo 4 : *Limia caymanensis*, pair, female above. Photo : Windows photo gallery.



Photo 5 : *Limia vittata*, pair, Male above. Photo : Windows photo gallery.

Some of the wild forms of the species which belong to the genus *Limia* are kept by members of “Poecilia Netherlands”, the Dutch equivalent of the BLA. At the time when the association was founded, the humback limia (*Limia nigrofasciata*) [Photo 1] and the black-bellied limia (*L. melanogaster*) [Photo 2] were the only wild forms available. In the eighties and nineties, in addition to many other viviparous toothcarps, we also acquired other species from the genus *Limia*. We obtained these mainly through our contacts with the German association DGLZ. Some species that I remember from that time are *Limia tridens* [Photo4] (which was kept under the name *Limia dominicensis*?). *L. caymanensis* [Photo3] and the very similar to *L. tridens*, *L. sulphurophila*. Later a nice strain of the Cuban *Limia vittata* and also *L. zonata* were added. We also received offspring of recently caught *L. nigrofasciata* [Photo 6] and only then could we see how tall and robust the males of this species can get. For a time, the sadly deceased Ciska Chiarone kept a large male called “Lord Pom” in her aquarium. The nickname still pops up now and then. A surprise for me was the first *L. grossidens* [Photo 7] that I saw alive at that time. The males of this species were even larger than those of wild-caught offspring *Limia nigrofasciata* and were otherwise barely distinguishable from these fish. An important difference is the size of the teeth, from which the species owes its name. The first *Limia perugiae* I saw alive came from the Las Marias population [Photo 8]. It was a pair that was taken by the American DOMINIC ISLA to a meeting of Poecilia Scandinavia and the beautiful fish made a big impression on me. The male was really beautiful and I have never seen them so beautiful since. I was able to take the pair home, but the offspring didn’t turn out as pretty as their parents.



Photo 6 : *Limia nigrofasciata*



Photo 7 : *Limia grossidens*



Photo 8 : *Limia perugiae* Las Marias male.



Photo 9 : *Limia perugiae* X *nigrofasciata* male.

In all the years that we have kept the *Limias* in the aquarium, it has become apparent that when the species are kept together, hybrids are quickly formed [Photo 9]. Also, keeping together with representatives of the genus *Poecilia* , such as mollies and guppies, can produce hybrids. These fertile hybrids add nothing to the often already beautiful wild forms and later cause confusion and misunderstanding among successive owners.

[Map 1 in text]

The genus *Limia* POEY 1854 currently contains 22 species. Of these, 19 are from Hispaniola (Haiti and the Dominican Republic). Cuba, Jamaica and the Cayman Islands are each home to one species. An intriguing location where 9 species of *Limias* are endemic is Lake Miragoâne in southwestern Haiti. *L. islai* and *L. mandibularis* originating from this lake were described in 2020.

The taxonomy of this group of fish is often subject to change. Whether the genus *Limia* is an independent genus with subgenera *Odontolimia* and *Limia* or a subgenus of *Poecilia* is a regular occurrence in the literature. In this article I maintain an independent status for *Limia*. The status of a number of species from the genus is also under discussion. MEYER (2015) indicates that a number of the species described by RIVAS from Lake Miragoâne do not deserve independent status. Furthermore, *L. caymanensis* could be seen as a local form of *L. vittat*. The relationship with the fish from the genus *Poecilia* is very close.

A species closely related to the *Limia* is the Venezuelan *Pseudolimia heterandria* [Photo 10]. This species also hybridizes easily with *Limias*.



Photo 10 : *Pseudolimia heterandria*

Distribution

As mentioned above, the *Limias* originate from the Caribbean and their closest relatives live in South America. A question that arises is how the freshwater fish from the genus *Limia* ended up on the scattered islands in the Caribbean Sea. After all, they couldn't have swum here through the salt water. How could this possibly have happened was already described in 2003 by the member of *Poecilia* Nederland FRED POESER in his dissertation.

WEAVER ET AL. (2016) further elaborate the migration to the islands and also make use of DNA research for this. Relatively few animal species live on the Caribbean Islands. A number of important groups that occur on the mainland do not live on the islands. This includes marsupials, groups of carnivores, salamanders and families from the group of salamanders frogs and turtles. The lack of species groups is characteristic of isolated islands, where new species often arise locally from the small group of animals that have managed to reach the location. DNA research can be used to determine how and when the split from one species into several species took place.

About 32 million years ago, the Caribbean Islands were connected to the mainland of South America and each other. This connection is said to have existed for about 3 million years. Animals such as the freshwater fish from South America were thus able to migrate via land to the later islands. This concerned species closely related to the genus *Pamphorichthys*. About 10 million years later (22 million years ago), the land connections between the mainland and the headland were increasingly broken and islands were created that were separated from each other by salt water. The current situation arose 15 million years ago. In the meantime connections between land areas were further broken and new isolated ones arose. [See Map 2]

The breaking-up of the land masses and the DNA analysis bring WEAVER ET AL. to the following timelines :-

32 million years ago – the Caribbean representatives of the genera *Limia* and *Poecilia* split off from the South American group;

22 million years ago – the Cuban *Limia vittata* splits off from the rest of the *Limias*;

3.7 million years ago – *Limia caymanensis* splits from its sister species *L. vittata*;

1.7 million years ago – the splitting of the *Limia* species on Hispaniola (including the great diversity within *L. perugiae*).

The timelines of these divisions are included in the attached figure [Map 2 in the text]. WEAVER ET AL. indicate that they find a clear relationship between the species from the genus *Limia* on the basis of DNA . The group of fish most closely related to the genus *Limia* are the species from the genus *Poecilia* that live on Hispaniola (*Poecilia elegans* [Photo 11], *P.dominicebsis* and *P. hispaniolana*) and not the South American representatives from the genus *Pamphorichthys*.

[Figure 1; in text]

Lake Miragoâne

As indicated above, Lake Miragoâne contains a large number of representatives of the genus *Limia*. The status of these species remained unclear for a long time. This was partly due to the description of RIVAS, but also the fact that this place was hardly explored further played a role. RODRIGUEZ-SILVA ET AL. (2021) investigated the lake and made an inventory of the species present in the lake. It is the first study of species diversity in this lake in 40 years. In particular, the swarm of species in the subgenus *Odontolimia* is scientifically interesting. They manage to capture five species from this subgenus : *L. garnieri*, *L. immaculate*, [Photo 22], *L.miragoensis*, *L. ornate* and the recently described *L. mandibularis*. They managed to catch two representatives of the subgenus *Limia*: *L. nigrofasciata* and the recently described *L. islai*. The *Gambusia beebei*, endemic to the lake, also ended up in their net. They also caught the cichlid *Nandopsis haitensis*, which is also found in other places in Hispaniola. Unfortunately, introduced species were also found in this lake : African tilapia and carp. These are a potential threat to the unique species in the lake.

Two species from the subgenus *Odontolimia* that RIVAS had also found in the lake, despite the fact that the same locations were searched, were not caught : *L. grossidens* and *L. fuscomaculata*. Capturing this species may require a more intensive search, but it is also possible that the species are rare or possibly extinct.

RODRIGUEZ-SILVA ET AL. (2021) give a short description of the viviparous toothcarps caught by them in Lake Miragoâne. From this I reproduce the most important characteristics below :-

Limia (Odontolimia) garnieri RIVAS 1980 [Photo 12]: dark black bands on the side of the body, which are less sharp in the females. Length around 3.5 cm.

Limia (Odontolimia) immaculata RIVAS, 1980 [Photo 13]: can be distinguished from the other species by the lack of any markings on the body. Length 3.5 cm.

Limia (Odontolimia) mandibularis RODRIGUEZ-SILVA ET AL. 2020 [Photo 14]: the most striking feature is the highly developed lower jaw. Also lacking in this species are any further marking on the body. Length 4 cm.

Limia (Odontolimia) miragoanensis RIVAS, 1980 [Photo 15]: dark spots on the flanks. Length 3 cm.

Limia (Odontolimia) ornata REGAN, 1913 [Photo 25]: the body is a number of more or less irregular black spots that are sometimes overlap into a black band. Length 4 cm.

Limia (Limia) islai RODRIGUEZ-SILVA & WEAVER, 2020 [Photo 16]: the species differs from the other species, except for *L. nigrofasciata*, due to the presence of vertical stripes on the body. This pattern is more striking than in *L. nigrofasciata*. Length 3 cm.

Limia (Limia) nigrofasciata REGAN, 1913 [Photo 17]: both sexes have 7 to 9 black transverse bands on the body which are darker in the males. Furthermore, the males have a higher dorsal fin and a remarkably high body.

Gambusia beebei MYERS, 1935 no outstanding features. Sometimes 2 or 3 horizontal rows with dark points according to RIVAS. The gonopodium and some other data formed the basis for identifying the species. The captured specimens lacked the characteristic large lower jaw mentioned by MYERS. It was previously stated by RAUCHENBERGER (1989) that *G. hispaniolae* also lives in the lake and that *G. beebei* is rare. It is possible that the captured specimens are hybrids between these two *Gambusias*. Further research is necessary.

From Rio Yaguajal

A number of *Limias* are well known and often kept, an unknown species is *L. yaguajali* RIVAS , 1980 [Photo 18]. It was believed that this species lives only in the river from which it owes its name: the Rio Yaguajal. RODRIGUEZ-SILVA ET AL. (2020) also caught this species in the Rio Cana and Rio Jamao el Norte in the Dominican Republic. They caught the fish in narrow, shaded stream spikes. The bottom consisted of sand and boulders with some mud here and there.

The temperature fluctuated between 25 and 29°C. Other viviparous toothcarps they caught here were the widely distributed *L. zonata*, *Poecilia hispaniolana* [Photo 19], *Poecilia dominicensis* [Photo 20] and *Gambusia hispaniolae*. Two more, introduced, livebearers, the guppy and the green swordtail, were also caught. Strangely, they were unable to catch *L. yaguajalín* in the type location (the Rio Yaguajal). The males of *L. yaguahali* like the males of *L. tridens*, have a yellow-orange belly, but have a straight caudal fin while that of *L. tridens* is round.

Reproduction

COHEN ET AL. (2015) investigated the the reproduction of 12 species from the genus *Limia*.

At the beginning of their article, they discuss the distribution and taxonomy of the species. They do it carelessly. They indicate that they share the view of ROSEN & BAILEY (1963) and see the genus *Limia* as a subgenus of *Poecilia*. That is a choice, but then name the species in the article *Poecilias* and not *Limias*. The genus *Pseudolimia* is described by COHEN ET AL., not seen as an independent genus. For this they refer to MEREDITH ET AL. (2010), but that article makes no mention of *Pseudolimia heterandria*. In REZNICK ET AL. (2017) the choice for not considering *Pseudolimia* as an independent genus is better substantiated. If *Pseudolimia* is not seen as an independent genus, not all representatives of the genus *Limia* come from the Caribbean any more, such as COHEN ET AL. then state again. They are quite inconsistent in this way. As far as I can see, RIVAS describes 5 *Limia* species from Lake Miragoâne and not six like COHEN ET AL. indicated. *Limia caymanensis* is not endemic to Jamaica but to the Cayman Islands.

Back to the actual topic. It appeared in all species studied that the embryos in the mother's body received little or no food, the dry weight of the newborn fry was lower than that of the eggs. The species are therefore lecithotrophic. None of the females studies had more than one generation of young in her body; this group of fish had no superfetation. The females are sexually mature at a length between 22 (*L. caymanensis*) and 35mm (*L. perugiae*) [Photo21]. The relatively large females of *L. nigrofasciata* had on average the fewest young (10) and *L. vittata* [Photo 5] the most young (88).

If the females of *Pseudolimia heterandria* with a length of 21 mm can already have young after 111 days, the females of *L. tridens* only have this when they are twice as long. The males of *P. heterandria* are also sexually mature significantly faster after an average duration of 72 days than the males of other *Limias* studied. *P. heterandria* occupies a special position with regard to a number of characteristics and the relationship between this species and the other *Limia* species appears to be weaker than that between the other species.

In a number of species, the impression is that there are several types of males; the size of which is determined by the moment at which they become sexually mature. In *Limia perugiae*, this aspect has already been investigated and three types of males have been identified, the difference in size of which is also genetically determined. COHEN ET AL., also indicate that several types of males are also present in *L. nigrofasciata* and *L. zonata*.

Conclusion

Not all species of the genus are present in the aquarium at the moment. However, some of the most attractive species are and prove to be perfect and popular aquarium fish. The fact that scientists continue to discuss genera, subgenera and whether or not independent species or not does not detract from the pleasure that the fish provide. The interesting background gives keeping and caring for something extra. Unfortunately, the same species are not always used for scientific analyses, which means that a conclusion of a scientific study is just missing a bit. For example, it is unfortunate that WEAVER ET AL. did not include *Pseudolimia heterandria* in their study. This is one of the reasons for continuing to follow research into this group of fish. We keep learning more.

Thanks to INGO SCHLUPP for making a number of articles available and RODRIGUEZ-SILVA & MONTRAI SPIKES for their permission to use some of the photos.

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www.poecilia.nl

Photo 1: Two males of *Limia nigrofasciata*. According to BAENSCH & RIEHL, many of the fish originally kept under this name would be hybrids of *L. nigrofasciata* and *L. tridens*. As a result, the males would be less bulky and have an orange chest. (Photo : J.C.Merino)

Photo 2: A male of the Jamaican *L. melanogaster*. (Photo J.C.Merino)

Photo 3: The males of *L. tridens* are beautifully coloured. (Photo: L.van der Meer)

Photo 4: A pair of *L. caymanensis*. In nature they often live in brackish water, but in the aquarium they are fone to keep in fresh water. (Photo: L. vn der Meer)

Photo 5: A pair of Cuban Limia (*Limia vittata*). (Photo J.C.Merino).

Photo 6: The wild-caught males of *L. nigrofasciata* were much more robust and higher-backed than the stock we kept in our aquaria. (Photo J.C.Merino).

Photo 7: The fish that we kept as *L. grossidens* were very similar to *L. nigrofasciata*. (Photo J.C.Merino).

Photo 8: The beautiful male of the Las Marias population of *L. perugiae*. (Photo J.C.Merino).

Photo 9: Hybrids quicly develop between two species from the genus *Limia*. Here one offspring of *L. nigrofasciata* x *L. perugiae*. (Photo R. Wildekamp).

Photo 10: A male of *Pseudolimia heterandria*. This species from Venezuela is closely related to the genus *Limia*. (Photo J.C.Merino).

Photo 11: *Poecilia elegans* is considered to be a a primitive species. (Photo R. Wildekamp).

Photo 12: *L. garnieri*. (Photo R. Rodriguez-Silva).

Foto 12: *L. garnieri* (foto R. Rodríguez-Silva)

Photo 13: *Limia immaculata*, a female. (Photo R.Rodriguez-Silva).

Photo 14.: The holotype of *Limia mandibularis* and a female of this species. (Photos R.Rodriguez-Silva).

Photo 15: *Limia miragoanensis*. (Photo R.Rodriguez-Silva).

Photo 16: *Limia islai* goes by the common name of “tiger limia”. (Photo R. Rodriguez-Silva).

Photo 17: *L. nigrofasciata*. (Photo R. Rodriguez-Silva).

Photo 18: *L. yaguajali* inhabits a larger area than originally thought. (Photo R. Rodriguez-Silva).

Photo 19: *Poecilia hispaniolana* is one of the three species from the genus *Poecilia* occurring on Hispaniola. (Photo R. Rodriguez-Silva).

Photo 20: *Poecilia dominicensis* (Photo R. Rodriguez-Silva).

Photo 21: A male of *L. perugiae*. (Photo R. Rodriguez-Silva).

Photo 22: A male of *L. immaculata*. (Photo R. Rodriguez-Silva).

Photo 23: *L. sulphurophila* lives in sulphurous water, but can also be kept in non-sulphurous water. (Photo R. Rodriguez-Silva).

Photo 24: *L. zonata* has several types of males. (Photo R. Rodriguez-Silva).



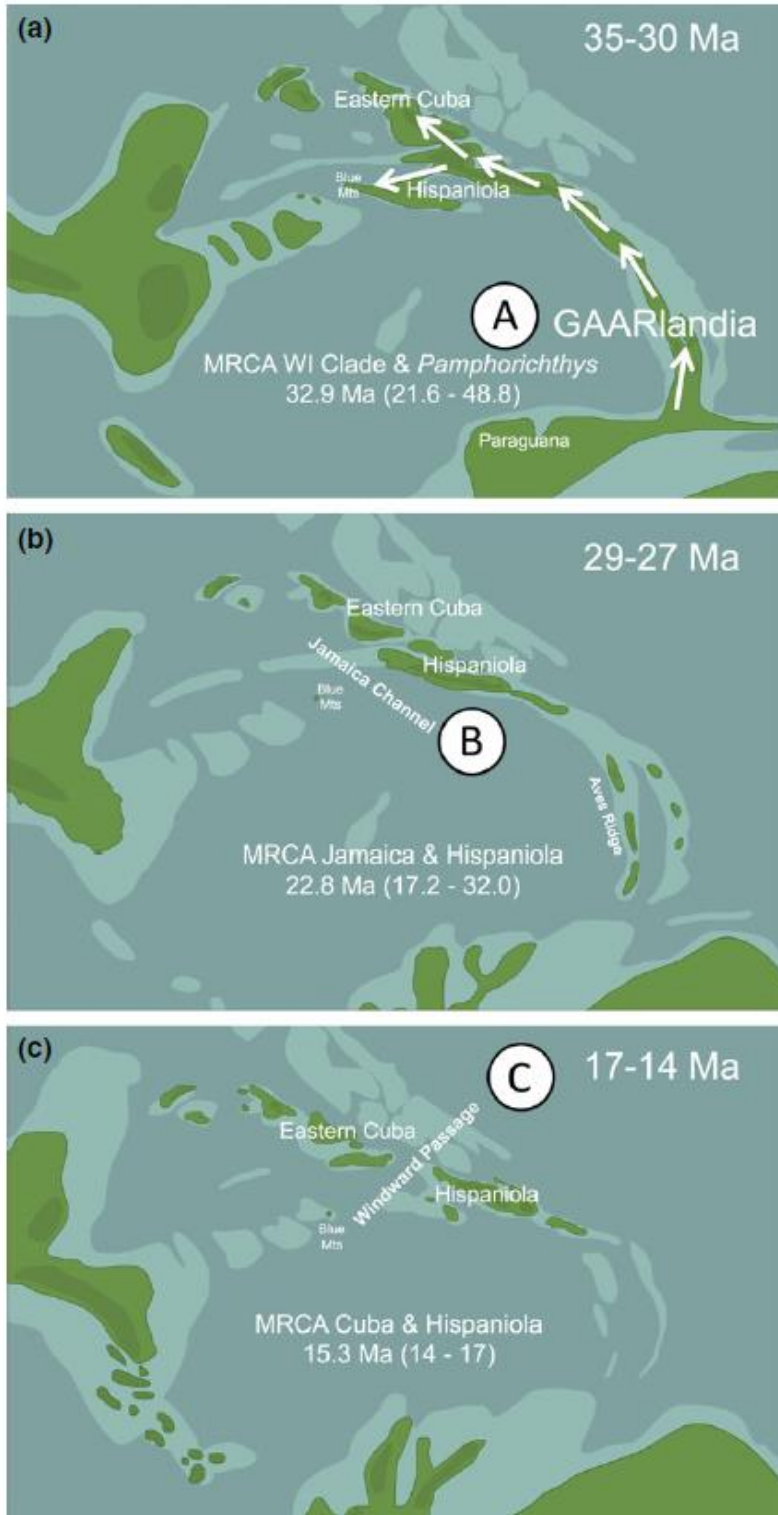
Photo 25: A preserved specimen of *L. ornata* (source: RODRÍGUEZ-SILVA ET AL. 2021)



Photo 26: *Gambusia beebei* the female is 4 cm long. (Source: RODRÍGUEZ-SILVA ET AL. 2021).



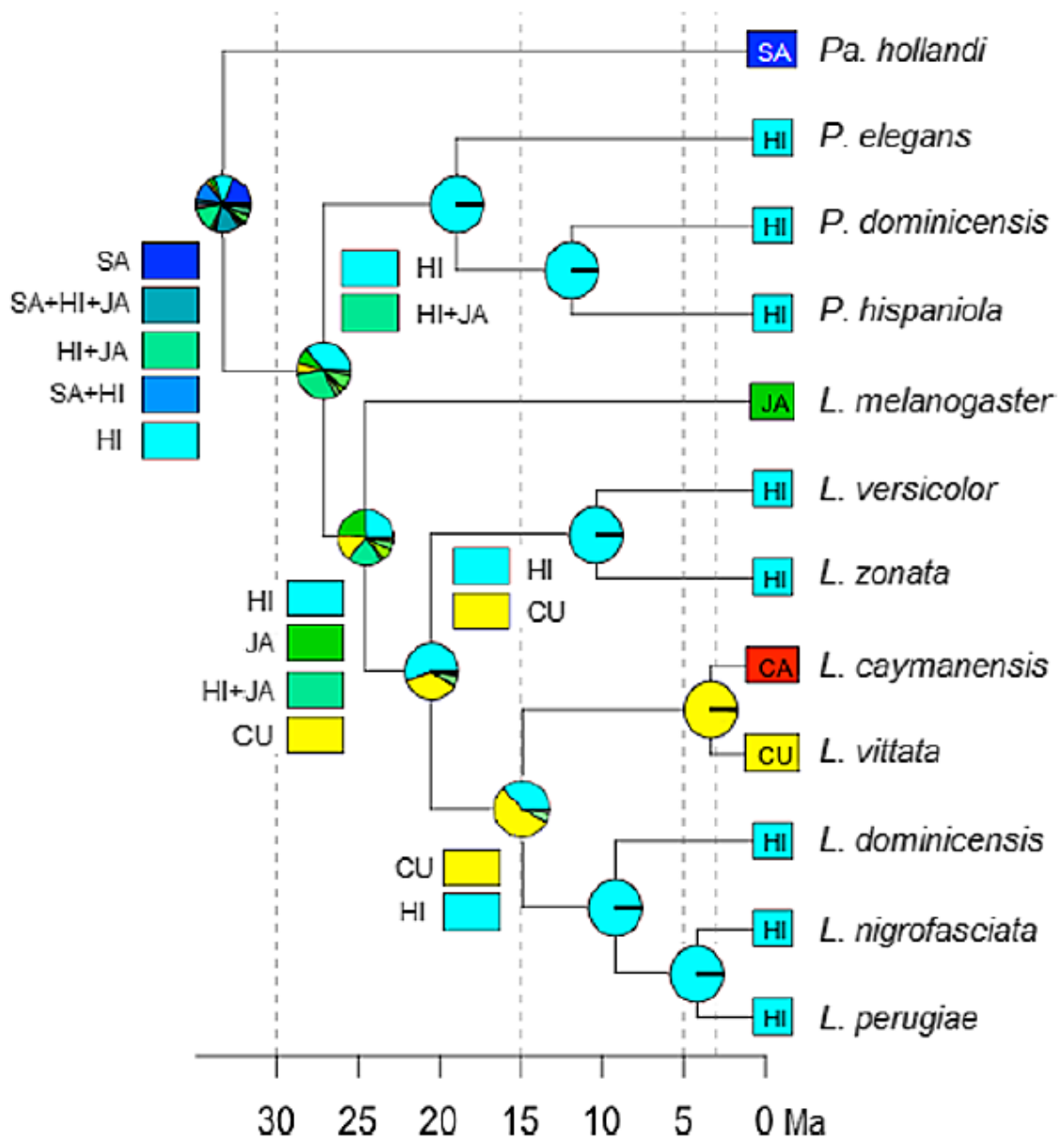
Map 1. The Caribbean. The habitat of the genus *Limia* (Source : internet).



Map 2. Map (a) shows the situation from 32 - 39 million years ago. Relatives of the genus *Pamphorichthys* can reach the islands via land and develop further there.

Map (b) 22,8 Million years ago, rising seawater caused the isolation of the Jamaican *L. melanogaster*.

Map (c) The species of eastern Cuba and Hispaniola were separated from each other 15,3 million years ago. (source: WEAVER ET AL 2016).



Figuur 1. De ontwikkeling van de soorten in de tijd. Als voorbeeld zie je dat *L. caymanensis* en *L. vittata* ongeveer 3 miljoen jaar geleden van een gemeenschappelijk voorouder zijn afgesplitst. De kleuren geven geografische gebieden aan. SA = Zuid Amerika, HI = Hispaniola, JA = Jamaica, CU = Cuba, CA = Kaaimaneilanden (bron: WEAVER ET AL. 2016).

The Leicester show and auction

The event at Leicester on the 24th April went very well – I thought – and most people seemed to be enjoying themselves. Once again, Dave Macallister did a brilliant job as auctioneer. The top price paid in the auction was £74 for a pair of *Xiphophorus cortezi*, but several other species also made very good prices. Both buyers and sellers seemed to go home happy. I am now looking forward eagerly to the next event, in Basingstoke – details in “Diary Dates”.

I have included a number of photos from the event below.











Diary dates

Our second event of the year is taking place at the Kempshott Village hall, Basingstoke, on 26th June.

We are changing things slightly for this show, we are not selling tickets online and all payments will be made on admission. Admission is priced at £3.00 for BLA and AofA members and £5.00 for non-members. Included with admission is day membership to the event for its duration (To comply with FHI/DEFRA guidelines) and £5.00 of free raffle tickets.

There will be a livebearer show featuring 7 classes, including awards for 'best in show' and a 'novice award'

Letters are now available for the livebearer auction, if you would like an auction letter please contact Steve Oliver (steven.oliver63@btinternet.com).

There will be a Raffle, Sales tables and there will be food and hot/cold drinks available.

We look forward to seeing you all there.

Details :-

When :- Sunday 26th June. Doors open around 10.00am. We are aiming to start the auction at about 12.30.

Where :- Kempshott Village Hall
Hall Pack Lane
Basingstoke
Hampshire
RG22 5HN

What :- Livebearer show; Auction, Raffle, Talks