Goodeid Status Update, January 2004

John Lyons

University of Wisconsin Zoological Museum and Wisconsin Department of Natural Resources, 1350 Femrite Dr., Monona, WI 57316-3736, lyonsj@dnr.state.wi.us; photographs by the author.

From January 7-17, 2004, I participated in scientific fish surveys in springs, streams, and rivers over a broad area of central México. This field work had multiple objectives and focused on a variety of species, including suckers (*Scartomyzon*), minnows (*Aztecula*, *Algansea*, *Hybopsis*, *Yuriria*), lampreys (*Lampetra geminis*), and goodeids. Here I summarize my observations on goodeids.

Lago Mayor, Chapultepec Park, México, D.F.

I arrived in Mexico City late on 7 January, and the next morning Norman Mercado-Silva, from the University of Wisconsin-Madison, and Andrés Martínez-Aquino, from the Universidad Nacional Autónoma de México (UNAM), México, D.F., and I sampled a small lake in Chapultepec Park in Mexico City for *Girardinichthys viviparus*. This goodeid is endemic to the Valle de México, the endorheic (no natural outlet) basin where Mexico City is located. *G. viviparus* is critically endangered, and is currently known from only three areas, the lakes of Chapultepec Park, Lago de Xochimilco (located on the southern edge of Mexico City), and a small spring tributary to the Río Tula in the adjacent state of Hidalgo, north of the Valle de México.

The Lago de Xochimilco and Río Tula spring populations of *G. viviparus* are apparently small, whereas the size of the Chapultepec population is unknown. Lago de Xochimilco is one of the last remnants of the extensive shallow natural lakes that once covered much of the Valle de México. The lake is heavily modified and polluted, with limited fish life. However, over the last 15 years there have been increasing efforts to restore the environmental quality of this lake. The Río Tula spring population of *G. viviparus* is outside the native range of the species and appears to be from a relatively recent colonization. In the late 1800s, a canal was constructed between the Valle de México and the Río Tula (which is part of the Río Pánuco basin flowing into the Gulf of Mexico) to drain the lakes in the Valle de México. *G. viviparus* presumably used this canal to reach the spring sometime within the last 100 years. The Río Tula now carries large volumes of poorly treated sewage and industrial wastes and does not support fish life, so the spring population is effectively isolated from the Valle de México.

Chapultepec Park is a large and beautiful park in the heart of México City, somewhat reminiscent of Central Park in New York City. It has a number of small "lakes" (=ponds), each a few hectares in size. They all appear to be artificial, with steep, concrete-lined sides, and canals and pumps to control their water levels. However, they may be located at the sites of former natural ponds or wetlands. The water quality in each is poor. Their steep, slippery sides make fish sampling difficult.

We were able to sample fish from the largest lake, Lago Mayor, located across the street from the famous National Anthropological Museum (19 25' 21.1" N; 99 11' 2.7" W). This lake has a boat rental area, and here the water is shallow enough to pull a seine. We made two short seine hauls, covering about 50 m^2 total, and captured well over 150 *G. viviparus*, plus about 100 *Goodea atripinnis*. We also collected several individuals of *G. viviparus* in a trap made from a one-liter soda bottle with a hole cut in the side and baited with bread. This type of trap is commonly used by kids to capture goodeids from the Chapultepec Park lakes; many captured fish are kept as pets or eaten. Most of the *G. viviparus* we caught had distended abdomens full of parasitic worms.

The population in Lago Mayor appears to be relatively large, despite the artificial habitat conditions, poor water quality, and heavy parasite burden. This is encouraging given the rarity of the species. However, the Chapultepec population

occupies a small isolated habitat and is hardly secure. It could be quickly decimated or even eliminated if, for example, the lakes were drained for repair.

La Mintzita Springs, Michoacán

After we sampled Lago Mayor, we were joined by Guillermina Cabañas-Carranza from UNAM and Dr. Hank Bart and Mark Clements from Tulane University, New Orleans, and we began the expedition in earnest. We left Mexico City that evening and headed west to Morelia. We arrived there late on 9 January, after sampling two non-goodeid sites along the way. On the 10th we met with Professor Martina Medina-Nava from the Universidad Michoacana de San Nícolas de Hidalgo (UMSNH), Morelia, and three of her students. Together, we first sampled the Río San Marcos, Michoacán, in a small wooded canyon below the falls of Chiquimitio (19 47' 56.4" N; 101 14' 45.9" W) for the native catostomid *Scartomyzon austrinus* and the native lamprey *Lampetra geminis*. This stream was not really suitable goodeid habitat, being 5 m wide and 0.5-1.2 m deep, with a cobble/gravel and boulder bottom and a very steep channel with fast currents. However, in 120 m of electroshocking we did catch five specimens of the goodeid *Goodea atripinnis*, along with 18 *L. geminis*, 60 *S. austrinus*, and seven *Aztecula sallei* (Cyprindae, native). After a late lunch, we met briefly with Professor Omar Domínguez-Domínguez, who is in charge of the goodeid conservation and captive maintenance facility at UMSNH. Then, as the afternoon waned, we visited the La Mintzita springs about 20 km southwest of Morelia (19 38' 52.3" N; 101 16' 13.0" W), one of the most important remaining goodeid habitats in central México.

La Mintzita is a marshy spring-fed lake that drains into the Río Grande de Morelia and hence into Lago Cuitzeo. The Río Grande de Morelia/Cuitzeo basin is endorheic, although its fauna indicates that it was once connected to the adjacent Río Lerma basin. Most of the Río Grande de Morelia/Cuitzeo system has been greatly degraded, and La Mintzita is one of the last remaining high-quality sites in the basin. A few hundred meters below the lake the outlet canal receives wastes from a large paper mill and no longer has the capability to support fish life, so La Mintzita is isolated from other fish populations in the basin.

We sampled the outlet canal just below the lake with a backpack electroshocker and the lake itself just above the outlet with a seine. The canal was about 8-m wide and 0.5-1.0 m deep with a fast strong current and gravel bottom. In 80 m of sampling we collected the following goodeids: three *Alloophorus robustus*, 30 *Goodea atripinnis*, about 100 *Xenotoca variatia*, five *Skiffia lermae*, and about 15 *Zoogoneticus quitzeoensis* (Fig. 1). We also caught 10 *Poeciliopsis infans* (Poeciliidae, native) and about 25 *Xiphophorus helleri* (an exotic poeciliid), plus 10 *Yuriria alta* (Cyprinidae, native) and 10 *Scartomyzon austrinus*. We then pulled the seine for over 300 m^2 in the lake, which averaged about a meter deep and had a sand-and-clay bottom and clear water at 15-19°C. We captured three *A. robustus*, five *G. atripinnis*, 30 *X. variata*, about 100 *S. lermae*, three *Z. quitzeoensis*, plus at least 1000 *P. infans*, five *X. helleri*, and 30 *Y. alta*. The *S. lermae* males were beautifully colored, but unfortunately by the time we finished processing our samples it was too dark for photos.

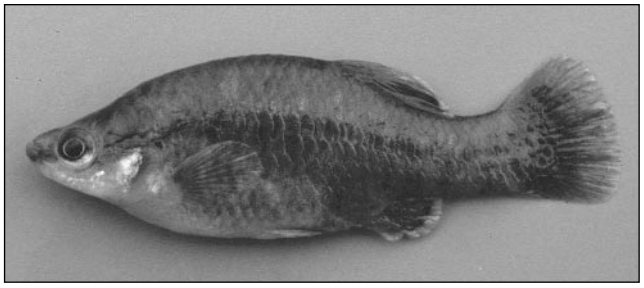


Fig. 1.
Picotee goodeid (*Zoogoneticus quitzeoensis*).

Skiffia lermae is endangered and *A. robustus* and *Z. quitzeoensis* are uncommon (La Mintzita is one of their last strongholds), whereas *Goodea atripinnis* and *X. variata* are widespread and common in central México. La Mintzita remains in good condition, but its future is uncertain. Settlement and use of the adjacent lands around the lake have increased in the last 10 years, as has runoff of domestic wastes into the lake. More ominously, the city of Morelia is considering pumping water from the lake for municipal use, which could reduce the lake level and perhaps even eliminate the springs that feed the lake, thus destroying this unique goodeid habitat. Martina and her students are working to help protect the lake.

Ameca Basin, Jalisco

We were on a tight schedule, so as darkness fell we said our goodbyes with Martina and her students and drove west to Guadalajara, arriving late that night. The next morning, the 11th, we headed west from Guadalajara into the Ameca basin, which drains to the Pacific, to look for *Allodontichthys polylepis* (critically endangered), *Allotoca goslinei* (endangered),

Fig. 2.
Río de la Pola,
near Estanzuela, Jalisco,
México.

and *Scartomyzon mascotae*. We first visited the Río de la Pola at the Highway 70 crossing near Estanzuela, about 40 km west of the city of Ameca (20 31' 27.7" N; 104 20' 12.0" W), one of the three sites from which *A. polylepis* has been taken. Here the river was about 8 m wide with long pools from 0.8-2.0 m deep connected by short shallow riffles (Fig. 2). The bottom was gravel/cobble, bedrock, and sand, and the surrounding landscape was open dry scrub. I first visited this site on 23 August 1997 and in 70 m of electroshocking took 10 *A. polylepis*, 48 *Ilyodon furcidens*, two *S. mascotae*, and four *Tilapia* (an exotic cichlid). My next visit, on 9 February 2000, was less productive, and in 300 m of electrofishing I took only 90 *I. furcidens* and 10 *S. mascotae*. This year's trip had the lowest yield of all, with only 10 *I. furcidens*, two *Tilapia*, and 15 *Cyprinus carpio* (common carp, an exotic cyprinid) in 90 m of shocking. I'm doubtful that *A. polylepis* still remains at this site. The reason for the disappearance of *A. polylepis* is unclear. The site had no obvious major pollution or habitat modifications. However, on my last two visits the flow was very low, providing little of the riffle habitat that *A. polylepis* needs. Perhaps flows during recent dry seasons were insufficient to support *A. polylepis*.

We next moved to the Arroyo Diabolos, about 10 km N of the Río de la Pola, to which it is a tributary. We sampled at the crossing on the road to Guachinango (20 33' 25.4" N; 104 21' 33.9" W). This site flowed through a narrow canyon. The creek itself was abut 3 m wide, with deep, slow bedrock pools up to 2 m deep connected by short shallow gravel riffles (Fig. 3). On my first visit here, on 9 February 2000, I electroshocked 75 m and took 10 *A. polylepis*, 152 *I. furcidens*, and eight *Tilapia*. The *A. polylepis* came out of the deep pools, an atypical habitat, probably because little of their preferred riffle habitat was deep enough to support fish. On this trip's visit we shocked 100 m, but caught no fish of any kind. The absence of fish was perplexing. No pollution was evident and the habitat conditions looked similar to those in 2000. However, as I have speculated for the Río de la Pola site, perhaps flows during recent dry seasons were so low that the fish populations were eliminated. Whatever the reason, *A. polylepis* no longer occurred at this site.

We then moved west to the Río Atenguillo at Highway 70 near the town of Atenguillo (20 25" 54.6" N; 104 28'

Fig. 3. Arroyo Diablos, near Guachinango, Jalisco, México.

56.4" W). The Río de la Pola is a tributary to this river. The Río Atenguillo was much larger than the other sites with a width of about 25 m and a strong flow. It had numerous riffles that looked ideal for *A. polylepis*. However, although we shocked 100 m and captured a variety of fishes, we collected no goodeids. In my one previous visit to this river (at a site farther upstream) I also did not take any goodeids, nor did other ichthyologists in earlier visits.

We moved east to the Arroyo Potrero Grande, on Highway 70 about 10 km west of Ameca (20 31' 17.2" N; 104 7' 29.2" W). This is the third and final site from which *A. polylepis* has been taken, and is also the only site from which *Allotoca goslinei* has been found in the last 20 years. The creek here was only 1-2 m wide, with a maximum depth of 0.4 m, small rocky pools and very shallow riffles, and limited flow. The banks were heavily wooded. *Allodontichthys polylepis* was taken here as recently as 1996 by Derek Lambert, but I did not see the species in my only previous visit on 10 February 2000 nor on this year's visit. On both of my visits flows were so low that there was no suitable riffle habitat for *A. polylepis*.

Allotoca goslinei has declined dramatically in abundance at this site over the last four years. During my 2000 visit, *A. goslinei* was common. In 200 m of shocking, 99 *A. goslinei*, six *I. furcidens*, and 28 *Scartomyzon mascotae* were collected. However, during this year's visit only seven *A. goslinei* (Fig. 4) were taken in 200 m of shocking, as well as 19 *I. furcidens*, 17 *Scartomyzon austrinus*, and about 120 *Xiphophorus helleri* (an exotic). The appearance of *X. helleri* may account for the decline in *A. goslinei*; both occupy the same pool habitat and are potential competitors.

The complete absence of *A. polylepis* from its three known localities and the major decline in *A. goslinei* abundance at its one remaining locality indicate that the future of these two species in the wild is precarious. It is too early to conclude that *A. polylepis* is extinct in nature or that *A. goslinei* is doomed, as large areas of potential habitat for both species have not yet been surveyed. During my next visit to this area I hope to survey the Río Ameca downstream from where the Arroyo Potrero Grande enters it. This area is badly polluted from the city of Ameca, but it once supported *A. goslinei* and possibly *A. polylepis* as well. Perhaps individuals of one or both species still persist in poorly accessible areas far downstream from Ameca where the pollution has somewhat dissipated.

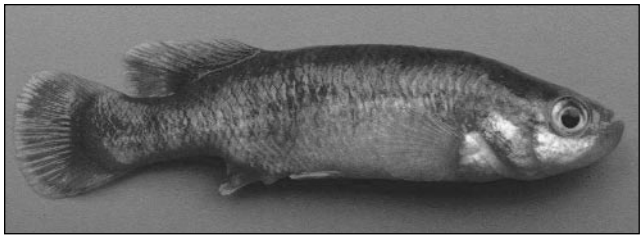


Fig. 4.
Banded allotoca (*Allotoca goslinei*).

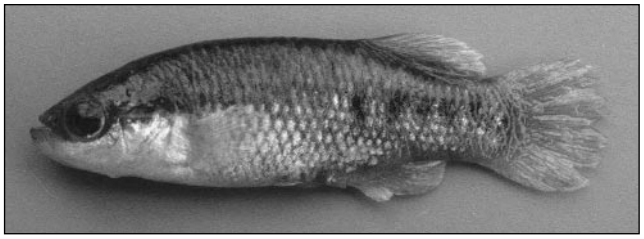


Fig. 5.
Rainbow characodon (*Characodon lateralis*).

However, even if *A. goslinei* and *A. polylepis* are found in the Río Ameca, their native habitat appears to be deteriorating, and it is critical that captive populations of both species be maintained and expanded.

Springs Around Durango

We spent the night of 11 January in Guadalajara and left on the 12th for the city of Durango, far to the north. We sampled two non-goodeid sites on the way and arrived in Durango late that night. The next morning we began sampling sites in the Río Mezquital system around Durango, looking for *Scartomyzon milleri* and goodeids in the genus *Characodon*.

Historically, *Characodon* was widespread and common in springs in the Río Mezquital system just north and west of the city of Durango. In a morphological analysis of the genus, Smith and Miller (1986) described *C. audax* from a spring near the town of El Toboso. They attributed all other populations in the region around Durango to *C. lateralis*, a species described by Günther in 1866 for which the type locality is unknown (erroneously listed as "Central America" in the original description). However, recent genetic analyses by Doadrio and Domínguez (2004) indicate that the taxonomic situation is more complex, and question the current definition and distribution of both *C. audax* and *C. lateralis*.

Regardless of how they are defined, both *C. audax* and *C. lateralis* are in trouble. The Río Mezquital system has been highly degraded by pollution, excessive water withdrawls, and exotic species. Only six or seven *Characodon* populations remain extant, each isolated in a small spring. Both species are considered critically endangered.

The weather, which had already been unusually cold and rainy, became notably bad when we arrived in Durango, with temperatures of only 5-12°C and steady (and at times heavy) rain. There was even talk of snow. Every site was dreary and muddy. We spent most of 13 January at non-goodeid sites, but ended the afternoon sampling the El Toboso and Abraham Gonzales springs for *Characodon*.

The El Toboso spring, known as "El Ojo de Agua de las Mujeres," is located in an open scrubby, stony, and normally arid (but quite wet this trip) landscape about 200 m north of the town of El Toboso (24 16' 30.7" N; 104 34' 52.8" W). The spring had been impounded by a stone wall to form a small pond and contained numerous aquatic plants. It is the type locality of *Characodon audax*, which we found to be common among the plants. We quickly took about 40 with a few swipes of our dip nets and short pulls of the seine. The specimens were beautiful with black fins and dark iridescent flanks, and some of the males had reddish ventral areas, although poor light and steady rain made it difficult to get a good photo.

As we walked back into El Toboso after sampling the spring, we encountered some friendly (and a bit drunk) locals, who asked what we were fishing for. In subsequent conversation they told of how catfish had recently been stocked into the El Toboso spring for aquaculture purposes on the advice of the state government agricultural agency. They also said that catfish, largemouth bass, tilapia, common carp, and perhaps other species had been stocked into the Abraham Gonzales springs 10 km to the south, our next destination. This was unwelcome news since several of these species, if established in the springs, could harm the *Characodon* populations. Catfish and bass are predators that could eat *Characodon*, and common carp might uproot and eliminate aquatic plant habitat.

We proceeded to the town of Abraham Gonzalez. The springs there originate in a series of marshy ponds on the east side of town, and their outflow passes through the middle of town via a narrow concrete-lined channel. We sampled this channel with dip nets just as it left the ponds (24 12' 50.7" N; 104 31' 47.8" W). At least some of the springs were thermal; the channel was 24-27°C despite an air temperature of only 9-10°C. The channel had little habitat but was nonetheless full of fish. In about 25 m we collected about 50 *Characodon*, over 100 *Gambusia senilis* (an exotic poecliid), seven of the native pupfish (Cyprinodontidae) *Cyprinodon meeki*, and

Priorities for Captive Maintenance of Mexican Goodeids
December 2003

Extinct (no captive populations available):

Characodon garmani

Extinct in the Wild (captive populations available):

Skiffia francesae

Critically Endangered:

Allodontichthys polylepis
Allotoca maculata
Allotoca meeki
Allotoca zacapuensis
Ameca splendens
Ataeniobius toweri
Chapalichthys pardalis
Chapalichthys peraticus
*Characodon audax**
*Characodon lateralis**
Girardinichthys viviparus
Hubbsina (formerly *Girardinichthys*) *ireneae*
Hubbsina turneri
Neoophoorus (formerly *Allotoca*) *regalis*
Neotoca (formerly *Skiffia*) *bilineata*
Xenoophorus captivus
Zoogoneticus tequila

Endangered:

Allodontichthys hubbsi
Allotoca dugesii
Allotoca goslinei
Skiffia lermae
Skiffia multipunctata
*Xenotoca eiseni**

Threatened:

Allotoca diazi
Girardinichthys multiradiatus

Vulnerable:

Allodontichthys tamazulae
Allodontichthys zonistius
Alloophorus robustus
Allotoca catarinae
Chapalichthys encaustus
Goodea gracilis (=*atripinnis*?)
Ilyodon cortesae
Ilyodon whitei
Xenotaenia resolanae
Xenotoca melanosoma
Zoogoneticus quitzeoensis

Relatively Secure:

Goodea atripinnis
*Ilyodon furcidens**
Xenotoca variata

Note: Status categories are not official Mexican government designations, but are based (with some updates) on:

De La Vega-Salazar, M. Y., E. Avila-Luna, and C. Macías-Garcia. 2003. Ecological evaluation of local extinction: the case of two genera of endemic Mexican fish, *Zoogoneticus* and *Skiffia*. *Biodiversity and Conservation* 12: 2043-2056.

Domingúez-Domingúez, O., N. Mercado-Silva, and J. Lyons. In press. Conservation status of Mexican goodeids: problems, perspectives, and solutions. *In*: *Proceedings of the International Livebearer Conference.*

Species with an asterisk have large amounts of morphological and/or genetic diversity and may prove to consist of more than one species.

about 50 *Tilapia*. The *Characodon* here looked similar to those from El Toboso, although they were not quite as dark. Failing light and rain made photography difficult.

We spent the night in Durango. The following morning we sampled non-goodeid sites before heading towards the city of León, far to the south and east. Along the way, about 70 km southeast of Durango, we sampled for *Characodon* at the springs in the town of Amado Nervo. Our site was in an open grove of cypress trees on the south edge of town just north of Highway 45 (23 50' 33.2" N; 104 11' 12.1" W; Fig. 6). Here a series of small springs entered a small (<1 m wide, 0.3 m deep) stream that drained the town. Using dip nets, we collected about 30 *Characodon* and one *Tilapia* in 25 m of sampling. These fish were much lighter in color than the El Toboso or Abraham Gonzales specimens, and had dark spots/blotches on the sides and a faint reddish cast to their abdomen. Their appearance matched the description of *C. lateralis* (Fig. 5).

Río Duero, Michoacán

We left Amado Nervo near dusk and arrived in León at 2:30 a.m. I had developed a stomach illness that afternoon, so it was a long ride, and I was never so happy to collapse into

Fig. 6.
Amado Nervo spring, Jalisco, México.

bed. The following morning, 15 January, I felt better and we headed south towards the Río Duero to look for *Scartomyzon austrinus* and *Lampetra geminis*. On the way we briefly sampled the Río Turbio, Guanajuato, a Río Lerma tributary, at the Highway 41 crossing (20 43' 15.3" N; 101 42' 15.7" W). In the late 1960s this site had supported at least three goodeids and a variety of other fishes, but now it was polluted and we caught no fish.

We arrived at the Río Duero, another Río Lerma tributary, in mid afternoon, and sampled at the crossing on the road to Etúcuaro (19 53' 3.6" N; 102 8' 53.9" W). I had visited this site previously, on 7 November 1991, and taken a number of *L. geminis*, *S. austrinus* and *Algansea tincella* (a native cyprinid), but for goodeids only a single *Goodea atripinnis*. Elsewhere in the Duero system I had done much better, catching a few *Alloophorus robustus* and many *G. atripinnis*, as well as *Skiffia multipunctata* (endangered), and *Zoogoneticus quitzeoensis*. However, on this year's trip the goodeid yield from the Etúcuaro site was much better.

We began by electrofishing some narrow (1-2 m), deep (1-1.5 m), clear spring channels that entered the river just above the bridge. I had been unaware of these channels on my previous visit. Fish density was low in the channels, but diversity was high. For goodeids, we took a single *Allotoca dugesii* (endangered; Fig. 7), to my knowledge the first record of this species from the Duero system, two *S. multipunctata*, and two *Z. quitzeoensis*. The male *S. multipunctata* were particularly attractive (Fig. 8.). We also took three *L. geminis* and three *A. tincella*. We then moved out into the river proper, which was 8 m wide and 1-1.5 m deep, with a clay and gravel bottom (Fig. 9). It was surrounded by agricultural lands and was swollen with muddy irrigation runoff. The strong currents made sampling difficult. In 120 m of shocking we collected seven *S. multipunctata*, 11 *L. geminis*, seven *S. austrinus*, and 13 *A. tincella*.

With completion of the sampling of the Río Duero, our fieldwork was over. We packed up and made the long drive to Mexico City, arriving, as had become our habit, long after midnight. The next day we organized gear, packaged specimens, bought souvenirs for our families, and visited with friends before returning to our homes on 17 January.

Summary

Our trip yielded both encouraging and discouraging results concerning goodeids. On the positive side, *Girardinichthys viviparus* persisted in Chapultepec Park, La Mintzita continued

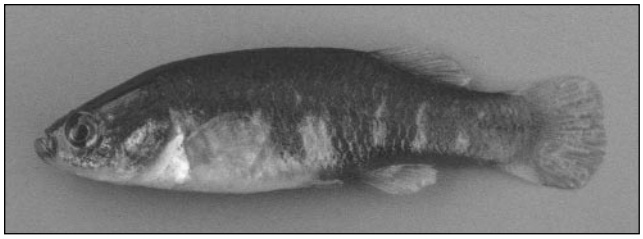


Fig. 7.
Bumblebee allotoca (*Allotoca dugesii*).

to provide a home to five goodeid species, *Characodon* hung on in a few springs near Durango, and the Río Duero remained a refuge for at least three goodeid species. On the negative side, we could not find any *Allodontichthys polylepis* within its known range, the single remaining population of *Allotoca goslinei* had declined precipitously, and the La Mintzita and Durango springs faced imminent environmental threats. The future does not look promising for most goodeids in central México. Protection of those sites that still support goodeids and other native species must be a top conservation priority. Concurrently, captive populations of all goodeids species must be maintained and expanded, since the survival of many wild populations is in doubt.

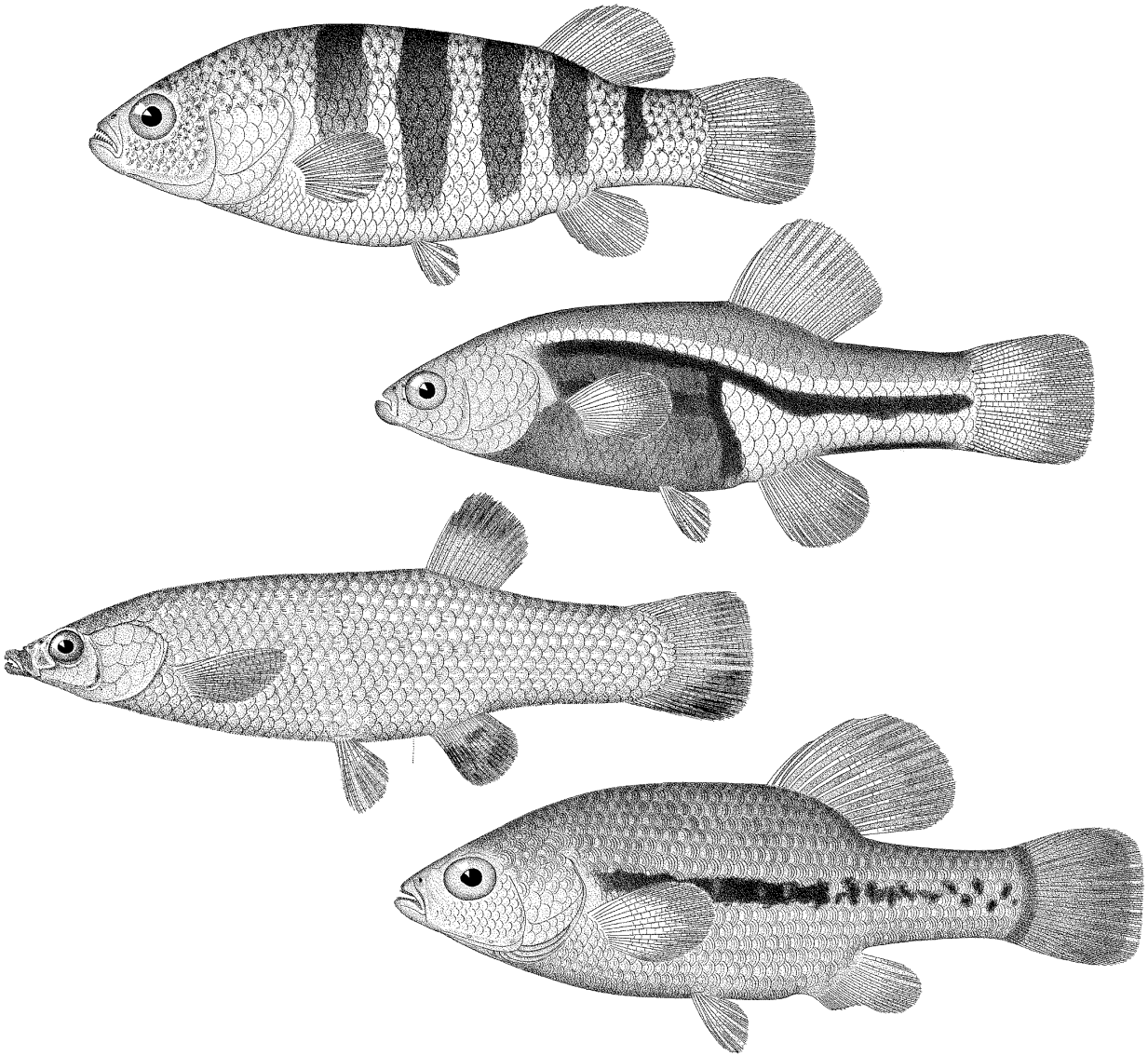
Fig. 8.
Splotched skiffia (*Skiffia multipunctata*).

Literature Cited

Doadrio, I., and O. Domínguez. 2004. Phylogenetic relationships within the fish family Goodeidae based on cytochrome *b* sequence data. *Molecular Phylogenetics and Evolution* 31 (2): 416-430.

Smith, M. L., and R. R. Miller. 1986. Mexican goodeid fishes of the genus *Characodon*, with description of a new species. *American Museum Novitates* 2851: 1-14.

Fig. 9.
Río Duero, near Etúcuaro, Jalisco, México.



Four historical goodeid illustrations from the files of the Smithsonian Institution, National Museum of Natural History, Division of Fishes. From top to bottom: Allotoca dugesii, bumblebee allotoca, illustration by H.L. Todd (1887), Neotoca bilineata, twoline skiffia, illustration by W. S. Haines (1887); Goodea atripinnis, blackfin skiffia, artist unknown (1879); Xenotoca variata, jeweled goodeid, illustration by H.L. Todd (1887). All four specimens were collected in Guanajuato, México, by Prof. Alfredo Dugès, for whom Allotoca dugesii is named.