

A MARATHON MARCH FOR MEXICAN GOODEIDS



Konrad Schmidt

St. Paul, Minnesota

The Mexican goodeids are in the subfamily Goodeinae, comprised of livebearing fishes endemic to Mexico. Instead of a gondopodium found in livebearers (i.e., Poeciliidae) used for reproduction, male goodeids have an andropodium, which is a flexible structure on the anterior rays of the anal fin separated by a notch (Wikipedia contributors 2017).

I first became aware of goodeids (aka splitfins) from a Trading Post ad in *American Currents* about 40 years ago. I was very tempted to order some, but the prices and shipping costs were a tad high for a student's zero disposable income. Many years later, I met NANFA member, Dr. John Lyons who has been conducting research on go-

odeids and other Mexican fishes since the 1980s and also has published articles in *American Currents* (Lyons 2001, 2004, 2006). These are available on the NANFA website (<http://www.nanfa.org/ac2.shtml>). John is also the Chair of the North American Goodeid Working Group (NAGWG), which I joined (for free) and I'm now part of a network maintaining goodeids as captive populations in the event they may be needed someday for reintroduction to historical habitats.

In 2016, John emailed an announcement he would be leading a study group to Mexico the following February and I was one of the first to sign up. My son, Bryan, also soon joined the group. He had been very active with keeping goodeids as a hobby and was racking up points with the Minnesota Aquarium Society's Breeders Award

Photos by the author unless otherwise indicated.



2017 goodeid study group sites. The distance between Rio Cuautla (site 1) and Manantial Teuchitlan (site 6) is 343 air miles. The inset shows the three Mexican states in yellow where the study group surveyed, micro-fished, and snorkeled. Overall, the study group visited seven localities and encountered 29 species in eight families. This includes nine goodeids, but also ten exotics (Table 1).

Table 1. 2017 Study group's final species list, localities, latitudes (N), longitudes (W), and Mexican states. Common names will be used in the article. Please refer to the table for scientific names.

	Rio Cuautla	Laguna Zempoala	Lago Zacapu	Manantial La Luz	Manantial Teuchitlan	Lago de Chapala	Manantial Mintzita
Locality:							
Latitude and longitude:	18.71636 98.96682	19.04991 99.31694	19.82748 101.78712	19.93697 102.29958	20.68785 103.84171	20.2894 103.1943	19.64489 101.27495
State:	Morelos	Morelos	Michoacan	Michoacan	Jalisco	Jalisco	Michoacan
CARPS AND MINNOWS - CYPRINIDAE							
Grass Carp (<i>Ctenopharyngodon idella</i>)*							
Common Carp (<i>Cyprinus carpio</i>)*							
Yellow Shiner (<i>Notropis calientis</i>)							
SUCKERS - CATOSTOMIDAE							
Mexican Redhorse (<i>Moxostoma austrinum</i>)							
TETRAS - CHARACIDAE							
Mexican Tetra (<i>Astyanax mexicanus</i>)							
TROUTS AND SALMONS - SALMONIDAE							
Rainbow Trout (<i>Oncorhynchus mykiss</i>)*							
NEW WORLD SILVERSIDES - ATHERINOPSIDAE							
Mesa Silverside (<i>Chirostoma jordani</i>)							
GOODEIDS - GOODEIDAE							
Bulldog Goodeid (<i>Allophorus robustus</i>)							
Zacapu Allotoca (<i>Allotoca zacapuensis</i>)							
Butterfly Splitfin (<i>Ameca splendens</i>)							
Barred Splitfin (<i>Chapalichthys encaustus</i>)							
Zacapu Splitfin (<i>Girardinichthys ireneae</i>)							
Darkedged Splitfin (<i>Girardinichthys multi-radiatus</i>)							
Blackfin Goodea (<i>Goodea atripinnis</i>)							
Balsas Splitfin (<i>Ilyodon whitei</i>)							
Olive Skiffia (<i>Skiffia lermae</i>)							
Spotted Skiffia (<i>Skiffia multipunctata</i>)							
Jeweled Splitfin (<i>Xenotoca variata</i>)							
"Lake Cuitzeo" Jeweled Splitfin (<i>Xenotoca cf variata</i>)							
Tarascan Splitfin (<i>Zoogoneticus purhepechus</i>)							
Picote Splitfin (<i>Zoogoneticus quitzeoensis</i>)							
LIVEBEARERS - POECILIIDAE							
Yucatan Gambusia (<i>Gambusia yucatanana</i>)*							
Spottail Killifish (<i>Heterandria bimaculata</i>)*							
Mexican Molly (<i>Poecilia sphenops</i>)*	NATIVE					EXOTIC	
Porthole Livebearer (<i>Poeciliopsis gracilis</i>)*							
Lerma Livebearer (<i>Poeciliopsis infans</i>)							
Green Swordtail (<i>Xiphophorus hellerii</i>)*							
CICHLIDS AND TILAPIAS - CICHLIDAE							
Convict Cichlid (<i>Amatitlania nigrofasciata</i>)*							
Blue Tilapia (<i>Oreochromis aureus</i>)*							
Species Tally (29) - Exotic* (10)	8	2	9	9	5	6	6



Figure 1. Bulldog Goodeid at Manantial La Luz. (Photo by Ben Cantrell)

Program (BAP) (Stefansky 2016). At the top of his wish list was seeing the Bulldog Goodeid, which is one of the largest goodeid species and also is a predator (Figure 1). Unfortunately, Bryan would not be adding any BAP points from this trip due to the cost and time required to secure permits from the US and Mexico to bring fish back.

THE JOURNEY BEGINS

February 18, 2017: Bryan and I flew into Mexico City where John Lyons met us at the airport. Study group participants had been trickling in all day, including NANFA members Ben Cantrell and Ryan Crutchfield, and American Livebearer Association members Jim Herman, Pat Hartman, and Kurt Johnston.

February 19, 2017: The next morning we met our co-leader, Dr. Norman Mercado-Silva (Universidad Autónoma del Estado de Morelos) and headed for our first site. However, escaping from Mexico City, with a population of almost nine million, was no easy task. I was amazed at the degree and intensity of urban development. Not an inch was spared. Many businesses reminded me of storage lockers with storefronts consisting of garage doors which could be locked at night. Norman showed off his excellent driving skills, negotiating the van through narrow streets in a traffic free-for-all. We also met the Mexican solution to too-fast traffic: speed bumps. We must have encountered at least a thousand during the week! I wondered many times about their random placement and hoped each one had not been placed at the site of a fatality.

Mexico City was once an enormous lake (Lake Texcoco), and the Aztecs made the first attempt to drain it. The Spanish made much greater headway, but the city was not protected from flooding until 1967 with the construction of the Deep Drainage System. Several indigenous species to the lake are now extinct or endangered from these centuries-long efforts (Wikipedia contributors 2018).

The city finally faded into endless sugar cane fields which are burned prior to harvest. During the week, we drove through many miles of smoky roads and encountered countless trucks hauling black-charred cane stalks to sugar refineries. After getting briefly lost in a sugar cane field, we arrived at our first site on the Rio Cuautla near Tenextepango in the state of Morelos. Ben and Ryan scrambled from the bus like soldiers on a mission jumping from a helicopter. Armed with their poles, tackle, and bait, they took up their positions on the river bank (Figure 2). Fishes they caught today and the rest of the trip may be the very first ever taken by hook-and-line! John and Norman surveyed with a backpack shocker and a grad student



Figure 2. Rio Cuautla. Top: Ryan fishing from ford crossing. Middle: Ben trying an off-channel spring. Bottom: Nestor cast netting.

(Nestor Rosales Quintero - Universidad Autónoma del Estado de Morelos, Cuernavaca), who joined us at the site, proved to be very handy with a cast net catching our first goodeid, Balsas Splitfin. Coincidentally, this was one of the species I maintain for the NAG-WG. Other natives found here included Mexican Tetra and Mexican Molly (Figure 3), but we also found here our first of many exotics (Figure 4). Being this far south in latitude, I was expecting a much greater diversity, but John explained that the area is geologically active, and many small watersheds are isolated by fault-related waterfalls and other barriers that make colonization difficult. Quakes and volcanoes have obliterated many areas such that they're relatively



Figure 3. Our first natives (from top): Balsas Splitfin (female), Mexican Tetra, and Mexican Mollies (male and female).

young in geologic time. So, there haven't been long periods for major species radiations to occur in many areas. There are a few areas that are quite ancient, and they have higher diversity, whereas others are fairly new in geological time and thus have fewer species.

En route to our next site the van broke down. Stormin' Norman jumped into action and within a very short time had a mechanic roadside looking it over. The diagnosis was not good: burned-out clutch. Norman arranged a tow to Cuernavaca, where he found lodging at a spa nestled on a beautiful estate (Figure 5).

Figure 4. Our first exotics (from top): Blue Tilapia, Convict Cichlid, Spottail Killifish (female, photo by Ryan Crutchfield), and Green Swordtail (female, photo by Ben Cantrell).



Figure 5. Top: van breaks down. Bottom: Luxurious lodging for the night.



Figure 6. Top: Laguna Zempoala. (Photo by Ben Cantrell) Middle: Arroyo Trancas. Bottom: Ryan micro-fishing.

February 20, 2017: John and Norman considered several options during the night but settled on using a university's crew-cab and Norman's personal vehicle: both served us faithfully. We headed for Zempoala National Park which at 9,500 feet above sea level, is the highest elevation occurrence of any goodeid (Darkedged Splitfin). First, and this became our daily routine, we stopped at an OXXO convenience store for beverages and snacks. This one left a lasting impression. It was not unusual to see police vehicles and officers from local, state, and federal agencies patrolling on foot, but inside the store they also had two private security officers in paramilitary garb. One stood guard with a pump shotgun and the other with an assault rifle. Both wore ammo bandoliers holding scores of rounds. Anyone considering armed robbery would be a fool!

The road became much steeper, and here the use of switchbacks is minimal. The air refreshingly cooled and the vegetation turned to coniferous trees. A very scenic drive indeed! Home-made signs offered "Trucha" (i.e., Rainbow Trout) for sale. John and Norman mentioned this coldwater aquaculture occurred at high elevations while the "lowland" aquaculture was dominated by mostly Blue Tilapia. The road wound around Laguna Zempoala offering a beautiful aerial view of the crystal clear mountain lake fed by the Arroyo Trancas (Figure 6). Only exotic Rainbow Trout were found in the stream and lucky for the tiny Darkedged Splitfins, which hid in the vegetated shallows along the lakeshore (Figure 7).

On the road again and long past lunch, we pulled into a roadside diner at the nearest town (Figure 8). I have to say the indigenous Mexican cuisine beats Taco Bell hands down! The cooks

thought it was hilarious all of us jockeying for position to photograph them making our delicious meals.

This proved to be one of our longest days with a last stop at Universidad Michoacana de San Nicolás Hidalgo (UMSNH) where Dr. Martina Medina provided a tour of her Aqua Lab. This captive breeding facility maintains 35 species and plays a vital role in goodeid conservation. I had found heaven on earth and could have spent several days photographing all of them. Alas, we only had a very short time so I had to select my species very carefully! In the same complex, the university also maintains a small, but impressive preserved fish collection (Figure 9).

February 21, 2017: Martina and her grad student, Arely Ramirez, joined us on our westward quest. The crazy fish huggers must have rubbed off on Arely who joined NANFA shortly after our trip. Our first destination was Lago Zacapu at La Angostura, Michoacan. This

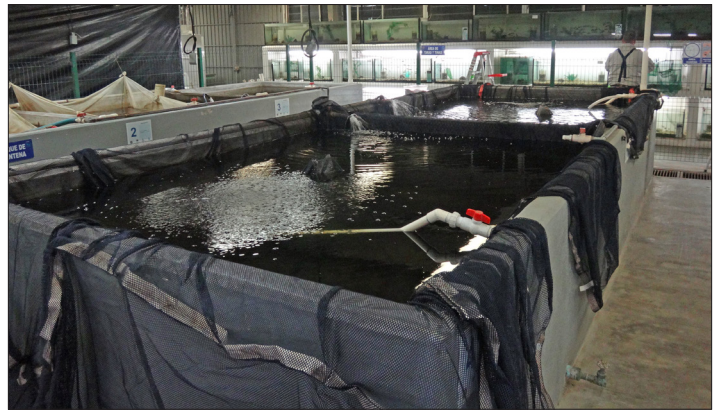


Figure 7. Top: Darkedged Splitfin. (Photo by Ben Cantrell)
Bottom: Rainbow Trout.



Figure 8. Roadside diner.

Figure 9. From top: Aqua Lab, Redtail Splitfin (*Xenotoca eiseni*) (Photo by Ben Cantrell), Aqua Lab, and John showing Bryan and Jim the fish collection.



Figure 10. Top: Lago Zacapu. Middle: Martina and John electrofishing. Bottom: another “trophy” for Ryan.

site, like two other goodeid habitats we later visited, exists because the owners operate the springs and lake as a private picnic/swimming area (Figure 10). Whatever they do or don't do to the habitat here appears to benefit the fishes which includes seven species of goodeids which is more than any other site we visited (Table 1 and Figure 11). The group spent their time surveying and microfishing, but the water temperatures were a little cool for snorkeling.

The next stop for the day was another recreational area at Manantial La Luz (aka Presa de Verduzco) near Jacona, Michoacan. This was a much larger waterbody than our previous stop, and was also popular with swimmers on the warm afternoon (Figure 12). La Luz was the only site where the Mexican Redhorse was observed, but the crafty devils hunkered down close to swimmers

where the backpack shocker would have zapped more than fish. Bryan tried his hand at microfishing and caught a Barred Splitfin which was one of five goodeids found here (Figure 13). Here I was “stricken” with a mild case of Montezuma's Revenge and headed for the “baños” (i.e., restrooms). I had a new life experience paying to use the facilities and an attendant dispensing too little toilet paper for my most immediate needs. When in Rome....

February 22, 2017: Onward to the state of Jalisco and my most anticipated destination of the trip—Manantial Teuchitlan! This area's springs may hold the last wild population of Butterfly Splitfin (Figure 14), but fortunately many captive populations are maintained by aquarists, museums, and zoos. Teuchitlan is managed as a private recreational area, and many in the study group donned their snorkeling gear for a refreshing dip or added new species to their micro-fishing life lists (Figure 15).

Tequila Splitfin (*Zoogoneticus tequila*), Ameca Shiner (*Notropis amecae*), and Golden Skiffia (*Skiffia francesae*) vanished from Teuchitlan around 1990. Ongoing UMSNH research is studying the feasibility of reintroducing the Tequila Splitfin (Figure 16), which is now believed extinct in the wild but, like many goodeid species, survive in captive populations. The project also includes an environmental education outreach program in the community and schools to increase public awareness and foster stewardship of the area's unique fishes and their habitats (Nava 2016).

Once we had our fill of fish, John insisted we visit the nearby pre-Columbian archeological mound site of Guachimontones (Figure 17). The guides revealed how the indigenous people lived, their customs, and how obsidian was valued like currency and was used to trade with other peoples. The site lies in the shadow of the Tequila Volcano, which spewed obsidian over the area, and it still can be easily found today mostly as flakes. It wasn't fully clear, but what was inferred from the guides while John translated is the civilization ended with a mass migration. However, the people hoped to return some day and buried all the mounds to protect them.

An army cannot march on an empty stomach so the group dined at a fabulous open-air Teuchitlan restaurant on the shore of Presa La Vega. What enticed many in the group was an enclosed spring inside the restaurant which loaned cane poles to patrons if they were so inclined to try fishing. Arely, Ben, Bryan, and Ryan fished for Butterfly Splitfins and Blue Tilapia before and after the meal (Figure 18).

February 23, 2017: John and Norman never failed to keep our schedule filled, but the first stop on our agenda this day was a change of pace. Dr. Eduardo Santana Castellon (Universidad de Guadalajara) gave the study group a presentation on a new natural history museum slated for completion in 2019. The museum will offer a diverse array of cultural and historical features, but will also house live exhibits of several Mexican goodeids (Figure 19).

No rest for the weary. On to Chapala, Jalisco. Lago de Chapala, Mexico's largest natural lake, was historically habitat for several now lost or endangered fishes. One silverside reached 300 mm (i.e., 12 inches!), was piscivorous, and sustained a commercial fishery (Lyons et al. 1998). Two smaller species still do: Smallmouth Silverside (*Chirostoma chapalae*) and Mesa Silverside are deep fried and locally sold as “charales.” John's review: “With a little hot sauce they're actually pretty good.” No one in the study group dared to give them a



Figure 11. Left column, from top: Blackfin Goodea (Photo by Ben Cantrell), Jeweled Splitfin, Picote Splitfin (Photo by Ryan Crutchfield), and a very dark Blackfin Goodea. Right column, from top: Bulldog Goodeid, Jeweled Splitfin, Picote Splitfin, and Zacapu Splitfin.



Figure 12. Manantial La Luz. Left: John and Arely electrofishing. Right: Bryan's first Barred Splitfin.



Figure 13. Left column, from top: Barred Splitfin, Splotched Skiffia (female, Photo by Ben Cantrell), and Blackfin Goodea (Photo by Ryan Crutchfield). Right column, from top: Lerma Livebearer (male), Splotched Skiffia (male), and Tarascan Splitfin.



Figure 14. Left: Butterfly Splitfin. (male, Photo by Ben Cantrell) Right: female. (Photo by Ryan Crutchfield)



Figure 15. Manantial Teuchitlan. Left: Bryan and Ryan teaming up to find fish. (Photo by Ben Cantrell) Right: Arely showing off her first Butterfly Splitfin caught micro-fishing.



Figure 16. Tequila Splitfin. Left: sparring males. Above: male (front) and female (back).

try. We arrived in time to see lakeside aerial performers (Figure 20).

Ben hit the beach far ahead of everyone else and headed for some interesting habitat, but in an instant was two feet shorter, sinking to his knees in muck. Undaunted, he returned to the task at hand: micro-fishing. John and Norman hauled the seine on the beach where one young and inquisitive girl patiently waited holding out a plastic cup for Norman to drop fish in for “further study.” Who knows, she may become one of Norman’s future students (Figure 21). The Barred Splitfins found here looked quite different from the ones at Manantial La Luz (Figure 22)

February 24, 2017: Our trip had wound down to one final stop at Manantial Mintzita near La Mintzita, Michoacan. This was a beau-

tiful public swimming area above a confluence with a paper mill’s effluent discharge. The area was partially ringed by elevated, old aqueducts flowing with foul looking water. I’m no engineer, but this looked like an environmental catastrophe ready to happen. We had to cross one aqueduct and Kurt took a nasty fall on the other side. He limped it off and was soon enjoying the scenery and fish, but he was going to have some lasting aches and pains (Figure 23).

REFLECTIONS

I very much enjoyed this trip and felt privileged to see goodeids in their natural habitats. However, I was also concerned for the future of the goodeids and their native associates. The loss of historical localities has been shockingly swift. Given half a chance,



Figure 17. Left, top: a round mound of Guachimontones. Left, bottom: obsidian flakes. Above: post-tour libations at a nearby cantina.



Figure 18. Monte Carlo Restaurant in Teuchitlan. Left: study group. Right: Bryan's live entertainment, catching Blue Tilapia while he waits for his meal.



Figure 19. Left: Dr. Santana describing features of Universidad de Guadalajara Natural History Museum. Right: museum site under construction.



Figure 20. Left: Lago de Chapala’s aerial performers. (Photo by Ben Cantrell) Right: 2017 Study Group. (Photo by Pat Hartman)



Figure 21. Top: the aftermath of Ben’s little mishap. Bottom: Norman’s impromptu environmental education.

Figure 22. Barred Splitfin (Photo by John Lyons), Mesa Silver-side (Photo by Ben Cantrell), and Yucatan Gambusia (female).



Figure 24: “Lake Cuitzeo” Jewelweed Splitfin (Photo by Ryan Crutchfield), Olive Skiffia (male above, and female), and Yellow Shiner.

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Figure 23. Manantial Mintzita. Top: crossing aqueduct. Middle: Ryan showing his catch to swimmers. Bottom: Norman and John seining.

goodeids do manage to thrive in their tiny remaining high quality habitats. The UMSNH Aqua Lab has also found that goodeids establish rapidly in newly created artificial ponds. However, the wild populations face threats from agriculture, pollution, water diversion, and exotic species. On the long drive back to Mexico City, I asked Norman about water quality laws. I was surprised to learn that Mexico has laws that mirror our Clean Water Act in words but those laws are rarely enforced. We were reminded of this at almost every lake and river encountered along the roads, where we were compelled to roll up the car windows due to the foul odor of raw sewage.

For those that share my concern, I encourage you to follow the phrase, “Think globally, act locally.” Consider joining the Goodeid Working Group (<http://www.goodeidworkinggroup.com>) and also committing to the noble act of maintaining a captive population of goodeids. Most species thrive in captivity and there are no strings attached as far as managing a burgeoning colony. These conservationist fishkeepers are free to sell surplus fish at aquarium society auctions or share them with fellow aquarists.