

Will Mexican Goodeids survive this century?

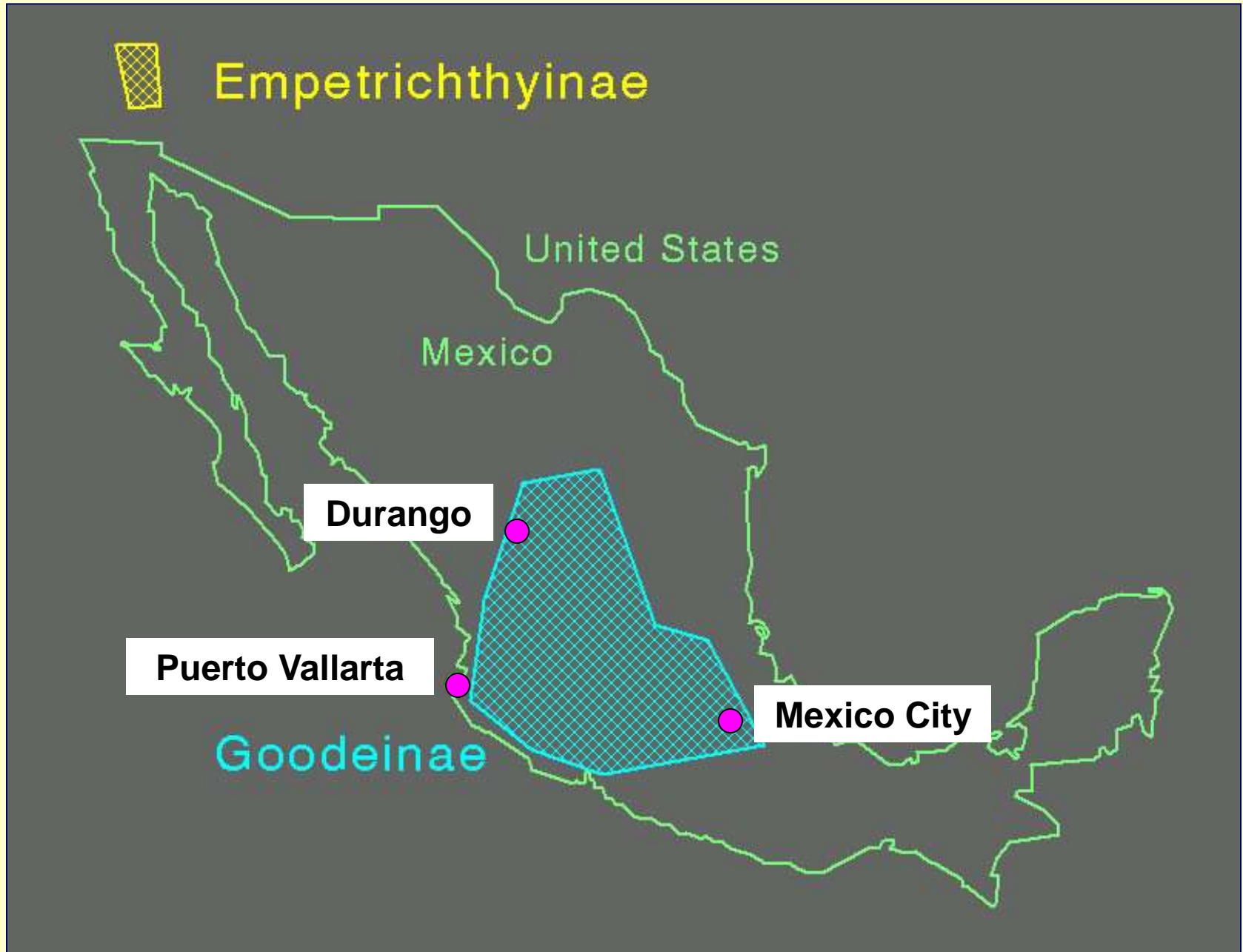
Conservation Initiatives to Preserve a Highly Endangered Sub-Family of Freshwater Fishes



Sorting Goodeids from La
Mintzita Springs, Michoacán

John Lyons, University of Wisconsin Zoological Museum

Goodeinae: the Mexican Goodeids (Splitfins)



In Mexico, a generalized Goodeid ancestor



Fossilized *Tapatia occidentalis*, Barranca de Santa Rosa, Jalisco; from Pliocene Epoch, at least 2.6 million years BP

gave rise to a rich modern fauna

Evolutionary and ecological diversification



Allotoca dugesi



Allodontichthys zonistius



Manantlán Stream, Jalisco



Lake Pátzcuaro, Michoacán



Amado Nervo Springs, Durango

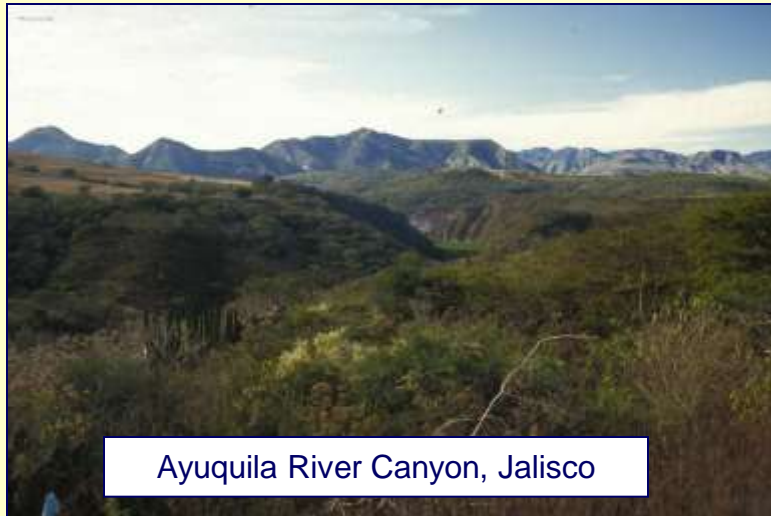


Xenotoca variata



Skiffia lermiae

Goodeid country: geologically active, mountainous, many movement barriers



Result: most species isolated, small ranges

Goodeid country: most densely populated and developed area of México; seasonally arid



Mexico City



Tamazula Sugar Mill, Jalisco



Estorax River, Querétaro



Cuzalapa River, Jalisco

Goodeid threats – 1: Water quantity

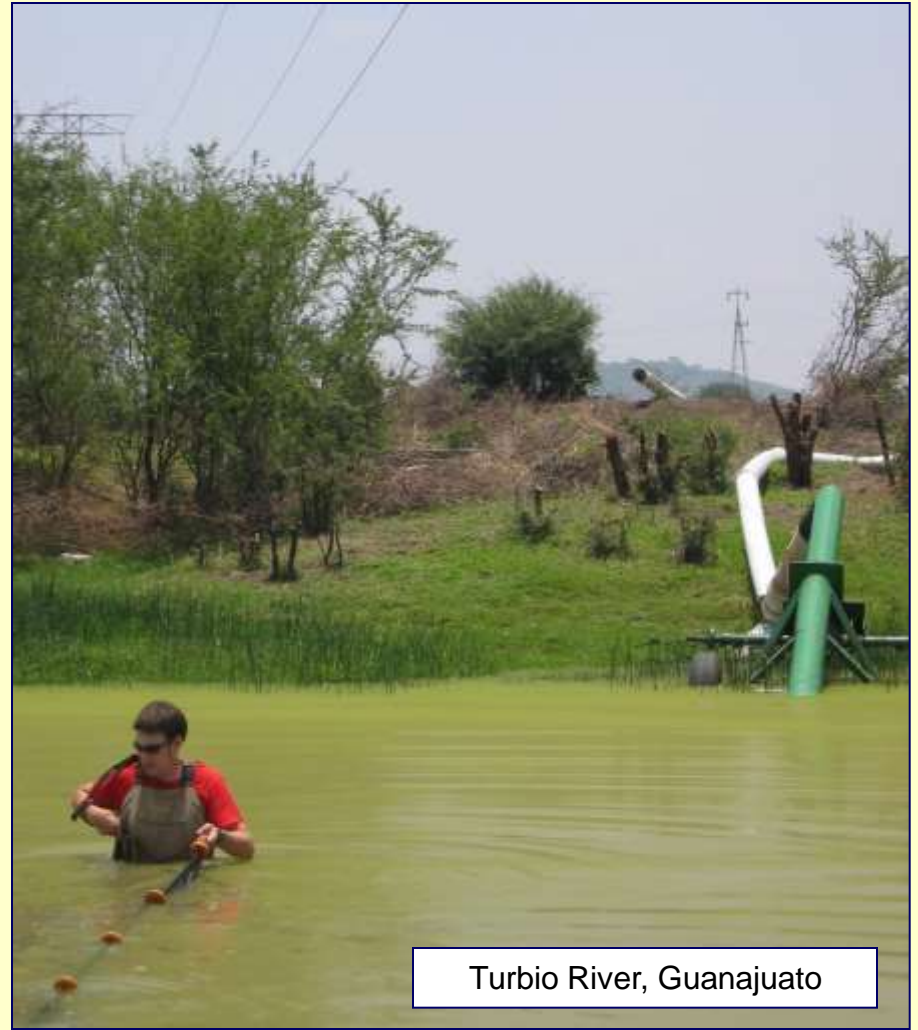
Lake Chapala, normal dry season



Lake Chapala, 1991 drought



Goodeid threats – 2: Water quality



Goodeid threats: Non-native species



Tilapia (*Oreochromis* and *Tilapia* species)



**Largemouth Bass
(*Micropterus salmoides*)**

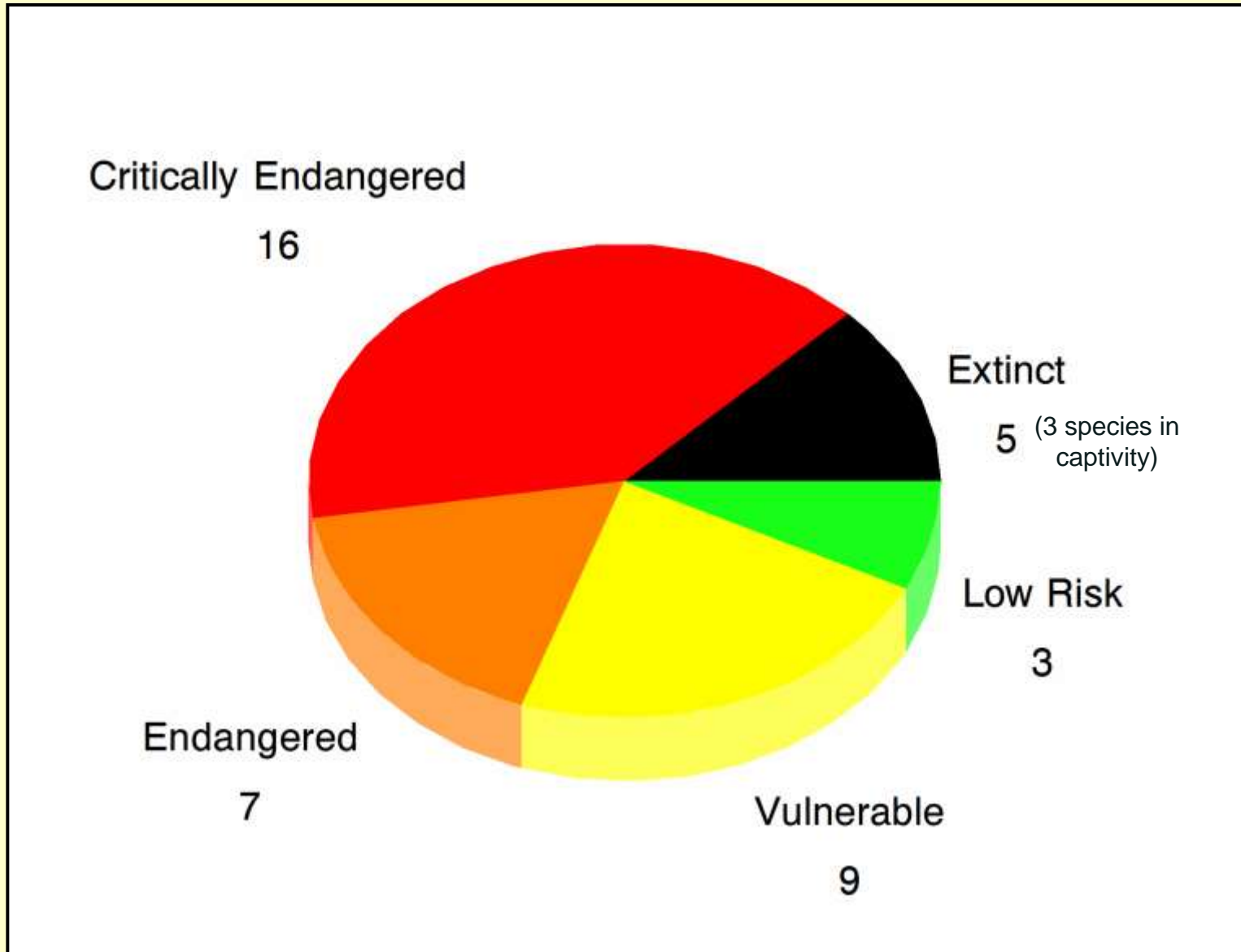


Common carp (*Cyprinus carpio*)



**Variable Platyfish
(*Xiphophorus variatus*)**

Goodeid status (IUCN Criteria) in the wild (2012):



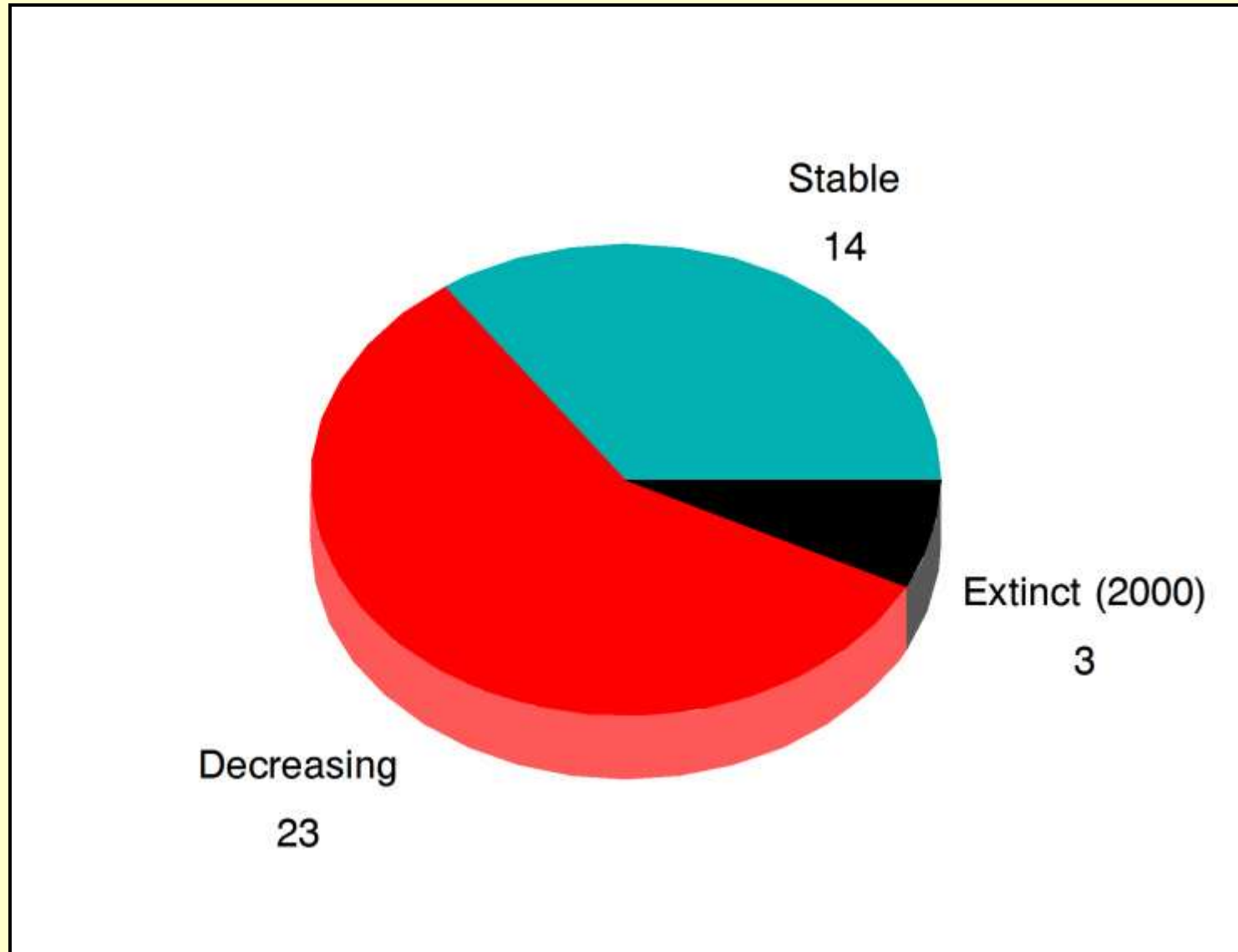
Goodeids in serious trouble

Some endangered Goodeids locally abundant



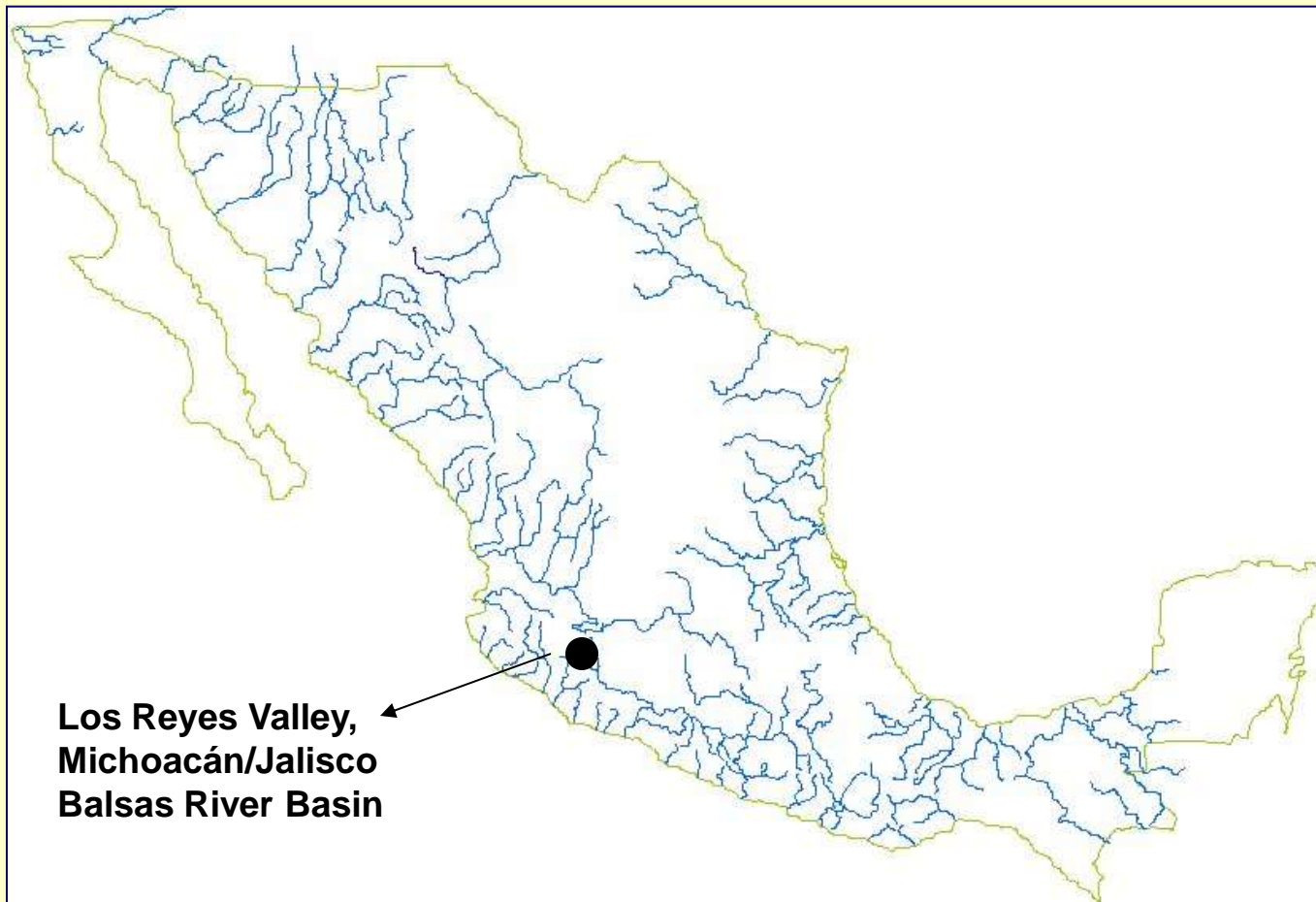
But limited to a few small, vulnerable habitats

Goodeid trends since 2000:



Most species in decline

Declining: *Allotoca regalis* (Crit. Endangered)



Range shrinking rapidly

1980 – 5 areas; 2000 – 3 areas; 2010 – 1 area



Los Reyes Stream, Michoacán – present in 2002, gone by 2008; caused by habitat modifications/diversions for irrigation



Quitupán River, Jalisco – present in 2004, gone by 2010; caused by exotic swordtail *Xiphophorus helleri*?



Huatarillo Stream, Michoacán – present in 2010; last remaining locality, small numbers

Declining: *Allotoca meeki* (Crit. Endangered)



Introduced predator drives drastic decline



Originally: Lake Zirahuén and tributaries



Mid 1980s, largemouth bass (*Micropterus salmoides*) enter Lake Zirahuén



By 1990s, limited to isolated Lake Opopeo



Mid 2000s, largemouth bass enter Lake Opopeo



By 2011, limited to Lake Opopeo outlet; rare

Disappeared: *Allodontichthys polylepis* (Ext?)



Water diversions, groundwater pumping, plus natural drought have spelled doom



De la Pola River

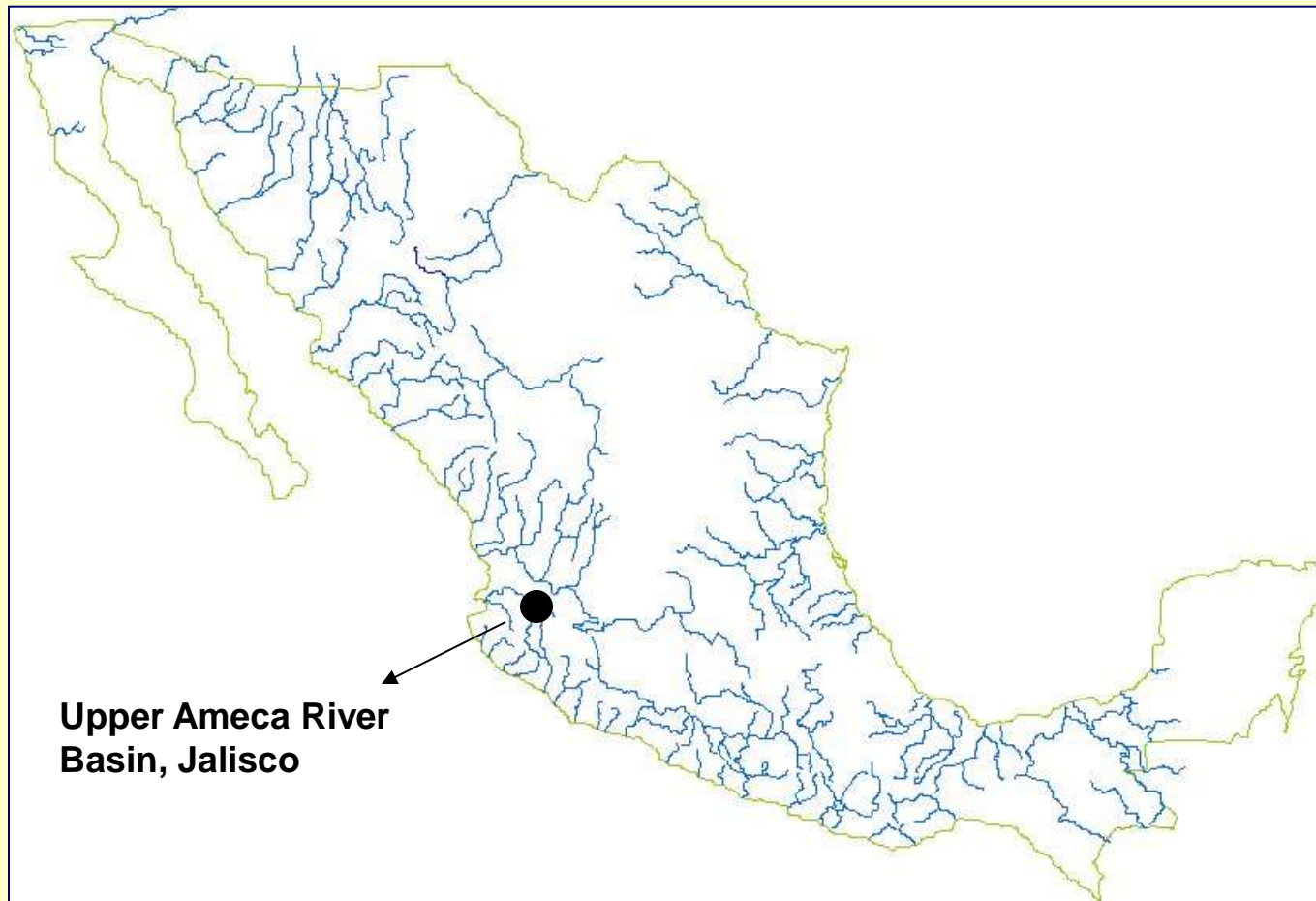
A riffle dweller. Human water use reduced stream flow, riffle habitats, and populations. A 2001 drought finished the species.

Known from only three streams. Last confirmed capture in 2000. None in 2002, 2004, 2006, and 2008 surveys.



Diabolos Stream

Disappeared: *Allotoca goslinei* (Extinct?)



Driven extinct by a non-native competitor?



Allotoca goslinei was known from only one location, the tiny Potrero Grande Stream, Jalisco....



Xiphophorus helleri (green swordtail) invaded the stream between 2000 and 2004....

Allotoca goslinei quickly eliminated

Year	<i>Allotoca goslinei</i>	<i>Xiphophorus helleri</i>
2000	90	0
2004	7	120
2006	0	298
2007	0	259

Catch in standard 200-meter-long electrofishing survey

Stable?: *Zoogoneticus tequila* (Crit. End.)



Hobbyist rumors of its demise greatly (?) exaggerated



For now.....



Conserving Goodeids

1) Protect best remaining habitats for each species

“Spring” species easiest; small habitats an advantage



La Angostura springs,
Lake Zacapu, Michoacán

Alloophorus robustus (Vul)

Allotoca zacapuensis (Crit End)

Goodea atripinnis (Low Risk)

Girardinichthys ireneae (Crit End)

Skiffia lermæ (Endangered)

Xenotoca variata (Low Risk)

Zoogoneticus quitzeoensis (End)

Examples of other key spring/small lake habitats:



Los Negritos Lake,
Michoacán

Chapalichthys encaustus

Vulnerable



Durango Valley springs,
Durango

Characodon audax
Characodon lateralis

Critically Endangered



Hacienda San Sebastian
Stock Tank, Jalisco

"Xenotoca" cf. eiseni

Endangered



Spring protection has many other benefits; easy sell

e.g., drinking or livestock water, recreation



Cupatchiro Springs, Michoacán, is protected as a municipal water supply, helping conserve:

Alloophorus robustus (Vul)

Goodea atripinnis (Low Risk)

Skiffia multipunctata (End)

Zoogoneticus purepechus (End)

**But keeping out non-native species very difficult;
“exotics” are the biggest threat to most springs**

The Cupatchiro Springs already have:

Common carp (*Cyprinus carpio*)

Rainbow trout (*Oncorhynchus mykiss*)

Tilapia (*Oreochromis aureus*) →



Protecting “riverine” goodeids more challenging

Need a watershed approach



Allodontichthys hubbsi

Endangered

Tamazula River, Jalisco



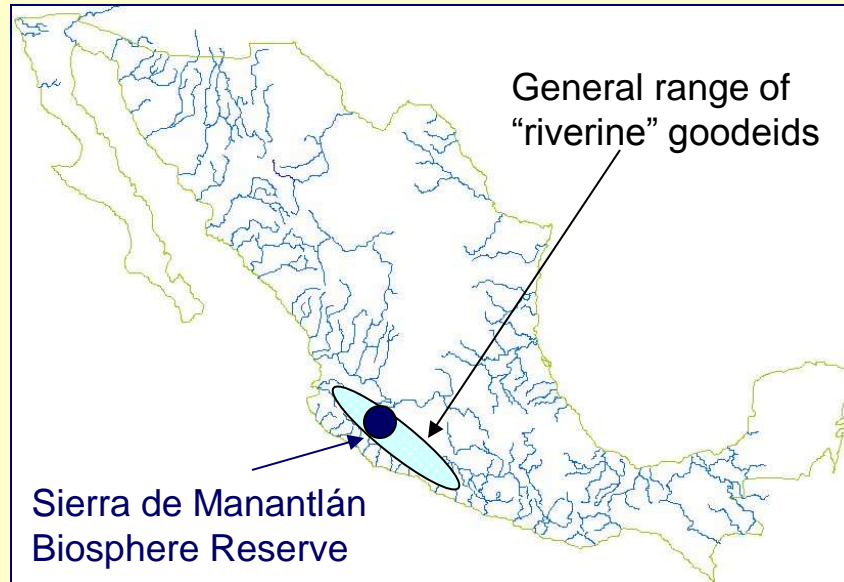
Xenotaenia resolanae

Vulnerable

Cuzalapa River, Jalisco



Existing reserves only cover some species



Sierra de Manantlán Biosphere Reserve

Allodontichthys zonistius (V)

Ilyodon furcidens (LR)

Xenotaenia resolanae (V)



No reserves protect:

Allodontichthys hubbsi (E)

Allodontichthys tamazululae (V)

Ilyodon whitei (V)

Conserving Goodeids

2) Restore key degraded habitats (where practical)

Ayuquila River, Jalisco, example

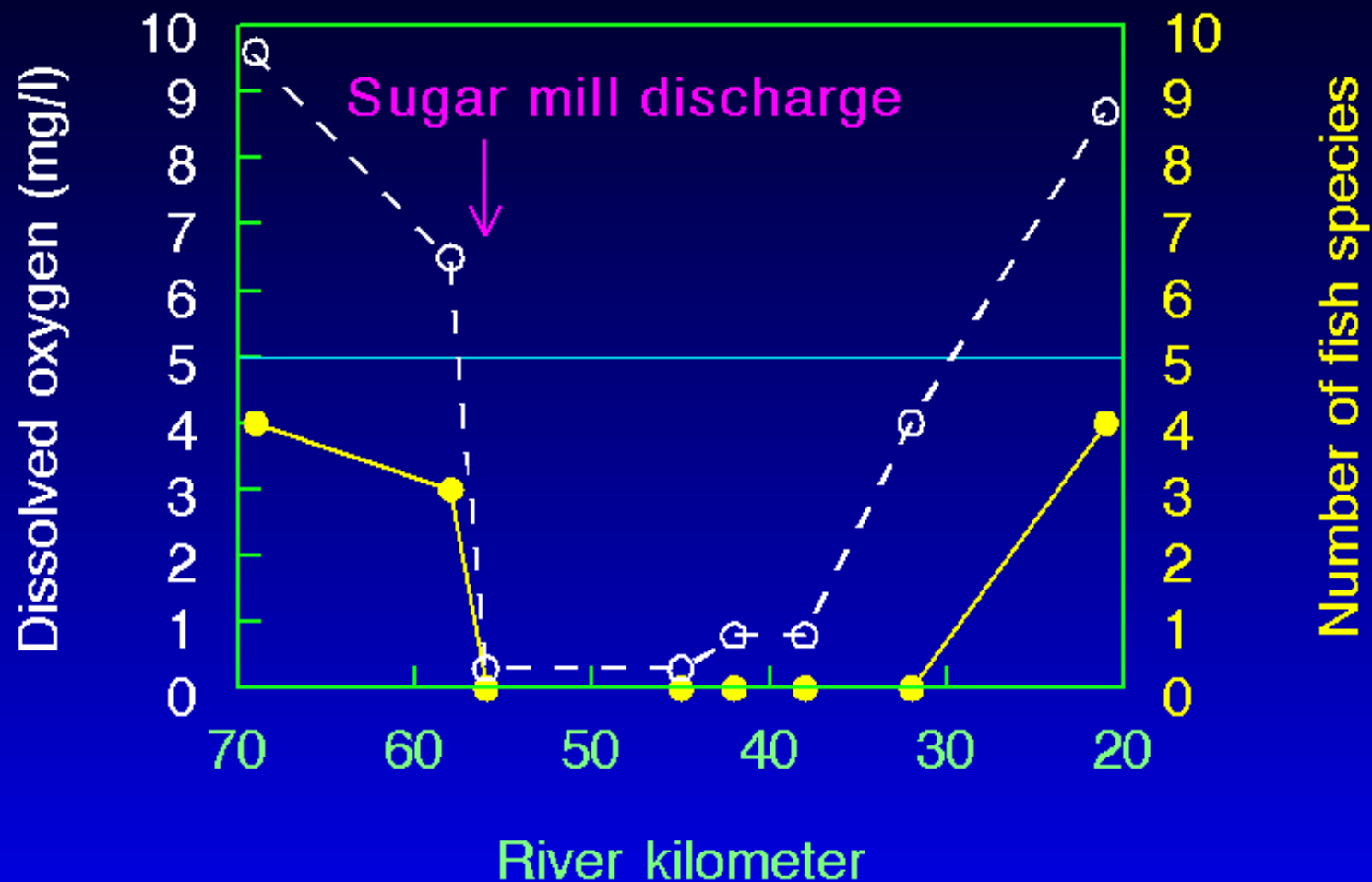


Pre 1999



25 km of the river below the sugar mill was fishless

Ayuquila River Oxygen and Fish: January 1996



1999: Sugar mill wastes diverted to irrigation canals

Passing for about 8 km through canals allows some solids to settle out, some breakdown of wastes; results in less-polluted discharge to river

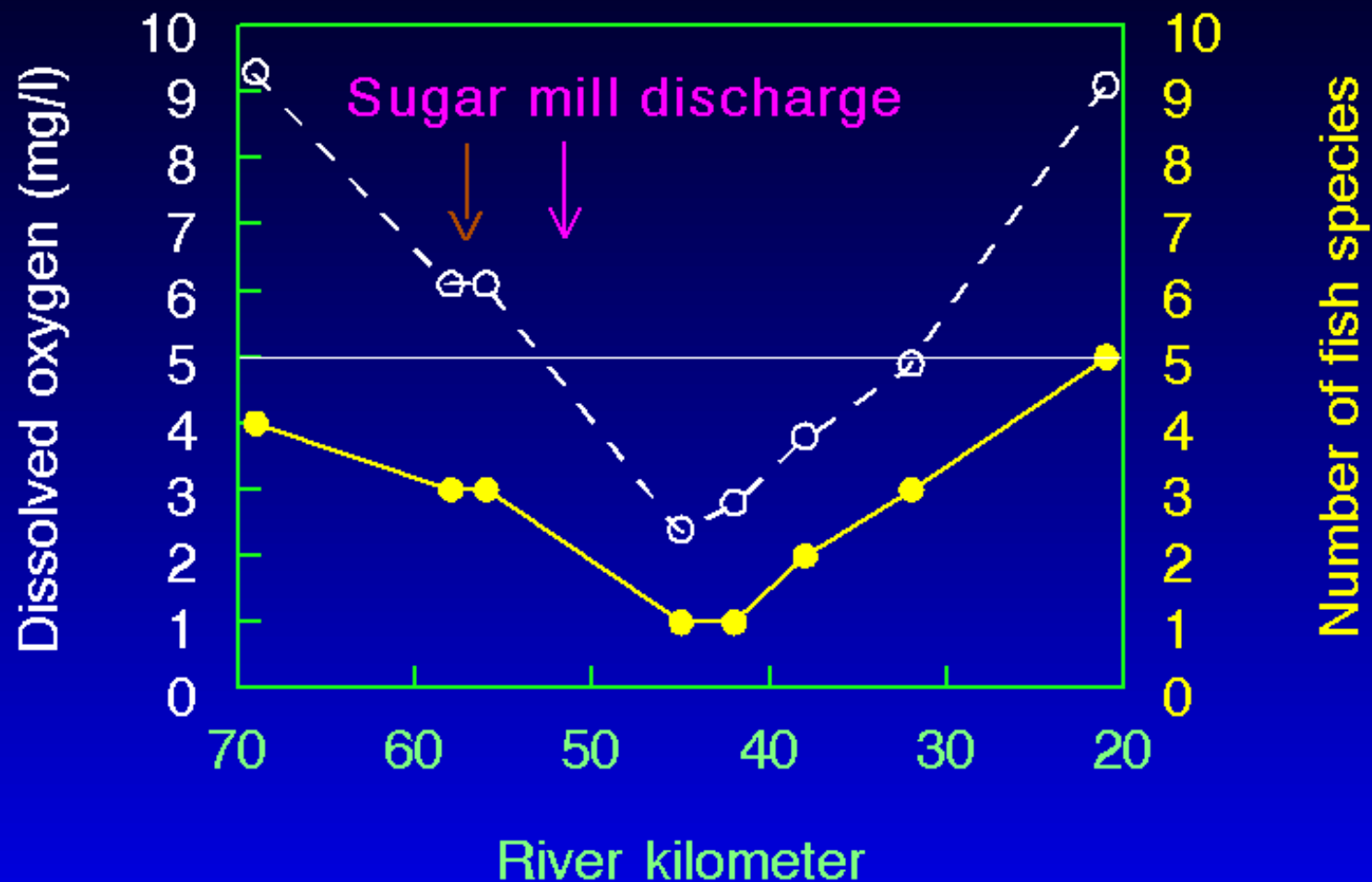


Post 1999



Partial treatment of discharge – partial fish recovery

Ayuquila River Oxygen and Fish: January 2003



***Ilyodon furcidents* has re-colonized river below mill**



Conserving Goodeids

3) Establish and maintain captive breeding colonies



“Fish Ark” Facility
**Universidad
Michoacana de San
Nicolas Hidalgo,
Morelia, Michoacán
(smaller facility in
Monterrey, NL)**

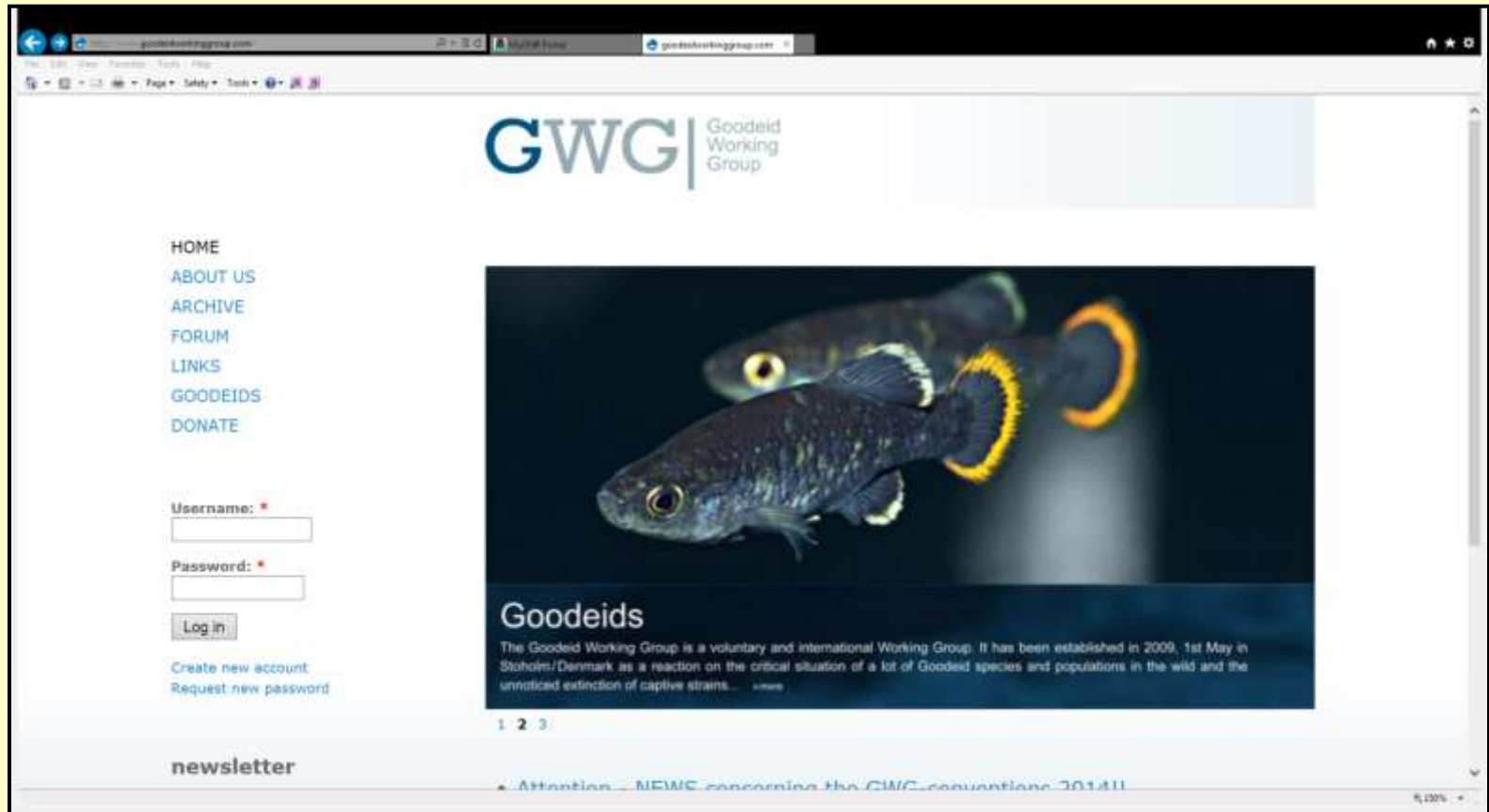


***Goodeid Working
Group (GWG)***
**Supports Fish Ark &
on-the-ground
efforts; facilitates
captive maintenance
by hobbyists,
coordinating with
public aquariums**



Goodeid Working Group:

<http://goodeidworkinggroup.com>

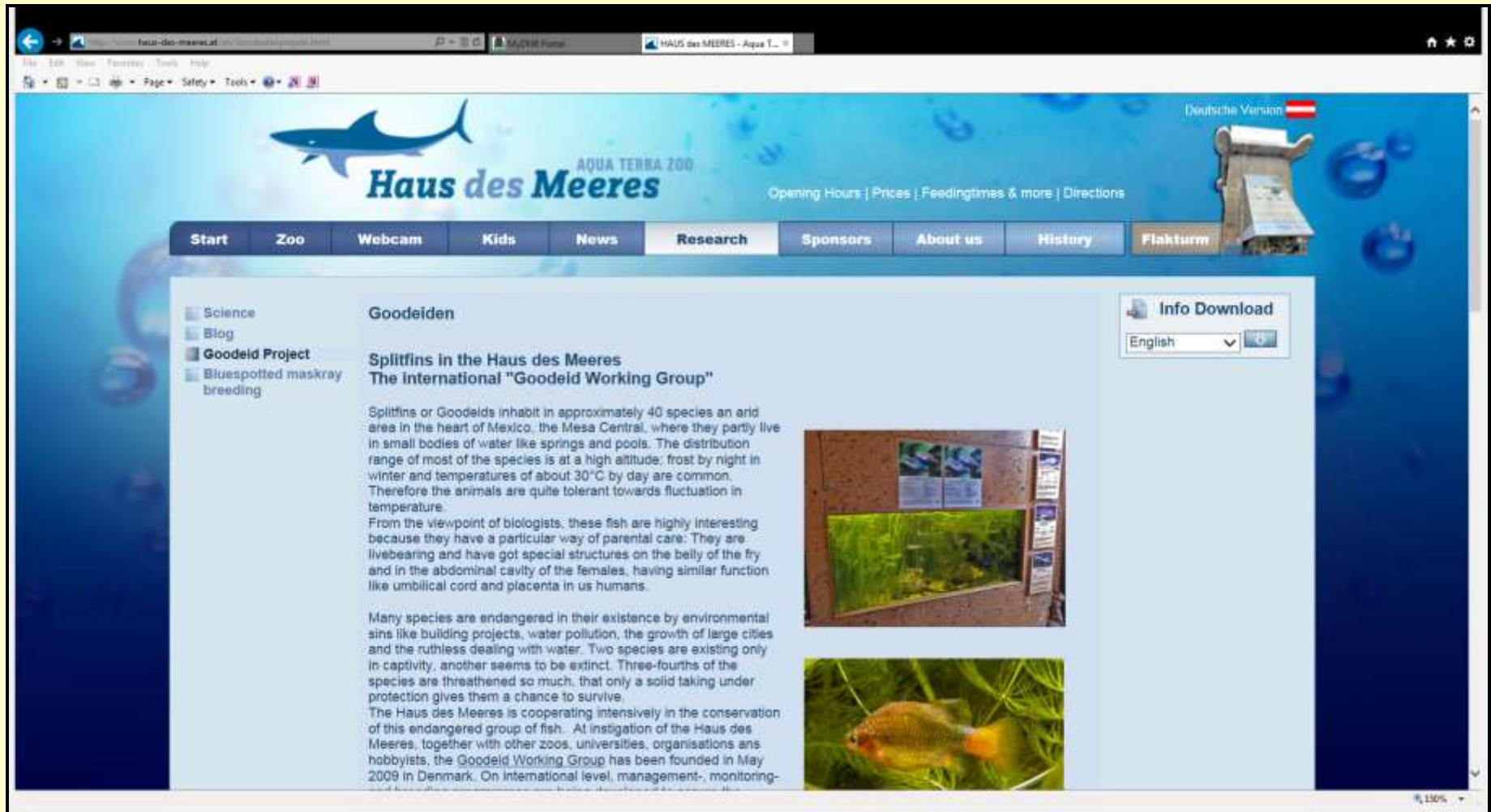


Founded 2009: European (EGWG) & North American (NAGWG) Chapters

Primarily Serious Hobbyists (~75 in ~20 countries)

Collectively maintaining ~37 of 40 Mexican Goodeid species

EGWG Cooperates with 10 Public Zoos/Aquariums in Europe to maintain ~35 Goodeid species



The screenshot shows the website of the Haus des Meeres Aquarium. The header features the aquarium's logo, which includes a shark and the text "AQUA TERRA ZOO Haus des Meeres". Navigation links include "Start", "Zoo", "Webcam", "Kids", "News", "Research", "Sponsors", "About us", "History", and "Flakturm". A "Deutsche Version" link with a German flag is also present. The main content area is titled "Goodeiden" and contains the following text:

Goodeiden

Spitfins in the Haus des Meeres
The international "Goodeid Working Group"

Spitfins or Goodeids inhabit in approximately 40 species an arid area in the heart of Mexico, the Mesa Central, where they partly live in small bodies of water like springs and pools. The distribution range of most of the species is at a high altitude: frost by night in winter and temperatures of about 30°C by day are common. Therefore the animals are quite tolerant towards fluctuation in temperature.

From the viewpoint of biologists, these fish are highly interesting because they have a particular way of parental care: They are livebearing and have got special structures on the belly of the fry and in the abdominal cavity of the females, having similar function like umbilical cord and placenta in us humans.

Many species are endangered in their existence by environmental sins like building projects, water pollution, the growth of large cities and the ruthless dealing with water. Two species are existing only in captivity, another seems to be extinct. Three-fourths of the species are threatened so much, that only a solid taking under protection gives them a chance to survive.

The Haus des Meeres is cooperating intensively in the conservation of this endangered group of fish. At instigation of the Haus des Meeres, together with other zoos, universities, organisations and hobbyists, the Goodeid Working Group has been founded in May 2009 in Denmark. On international level, management-, monitoring-

On the right side of the text, there is an "Info Download" section with a language dropdown menu set to "English". Below the text, there are two photographs: the top one shows a large aquarium tank with a sign, and the bottom one is a close-up of a small, colorful fish (a Goodeid) swimming in green water.

e.g., *Haus des Meeres* ("House of the Sea") Aquarium, Vienna, Austria

NAGWG hoping to partner with North American aquariums via Association of Zoos & Aquariums (AZA) Animal Programs

The screenshot shows the AZA Animal Program Database interface. The top navigation bar includes links for HOME, MEMBERSHIP, ACCREDITATION, ANIMAL CARE & MANAGEMENT, CONSERVATION, EDUCATION, CONFERENCES & MEETINGS, and PROFESSIONAL DEVELOPMENT. The main content area is titled 'Animal Program | Freshwater Fishes TAG'. It displays program details: Program Type: TAG, Taxon: Fish, Website: (empty box), Associated TAG: Freshwater Fishes TAG, and Program Leader: Mohan Peter. A table of species is listed below, with a callout box highlighting the 'Freshwater Fishes Taxon Advisory Group (TAG) - Goodeids' and an arrow pointing to the Goodeid species list.

Freshwater Fishes Taxon Advisory Group (TAG) - Goodeids

Common Name	Scientific Name
Argens	Haplochromis sp. argens
Damba, Pinstripe	Paretroplus menarambo
Degeni	Platytaeniodus degeni
Esculentus	Oreochromis esculentus
Goodeid, Opal	Allotoca maculata
Goodeid, White Trim	Zoogoneticus tequila
Ishmaeli	Labrochromis ishmaeli
Killifish, Sakaramyi	Pachypanchax sakaramyi

NAGWG working to expand and re-energize the Goodeid portion of AZA's Desert Fishes Animal Program within the FW Fishes TAG

Benefits of NAGWG/AZA collaboration:

From AZA:

- Ability to maintain/breed greater numbers/diversity
- Population management by professional staff to
 - + maintain genetic diversity
 - + reduce domestication
- Opportunities for public education

Xenophorus captivus
Critically Endangered
Rio Tierra Quemada, SLP



From NAGWG:

- Decades of goodeid-specific husbandry experience
- Availability of many species/ESU's for aquariums
- Contacts and access to Mexican biologists & fish

Most urgent needs for captive rearing:

Extinct in the wild:

Allodontichthys polylepis, *Allotoca goslinei*, *Skiffia francesae**

The most critically endangered in the wild:

*Allotoca maculata**, *Allotoca meeki*, *Allotoca zacapuensis*, *Girardinichthys ireneae*, *Neophorus regalis*, *Xenophorus captivus**, *Zoogoneticus tequila**

* Priorities for AZA Desert Fishes Conservation Program (along with *Ameca splendens*)



Allotoca maculata, Magdalena Lake, Jalisco

But all Goodeids warrant captive rearing!

Summary and Conclusions

1) Wild Goodeids are in serious trouble; most species are endangered and/or in serious decline

2) Primary threats are water quantity, water quality, and non-native species

3) Conservation requires protection, restoration, and captive rearing

4) GWG looking to collaborate with AZA & individual aquariums to promote goodeid captive rearing

Goodea atripinnis – Low Risk – Presa La Luz, Michoacán

Questions?



Sunrise over Lake Pátzcuaro, Michoacán