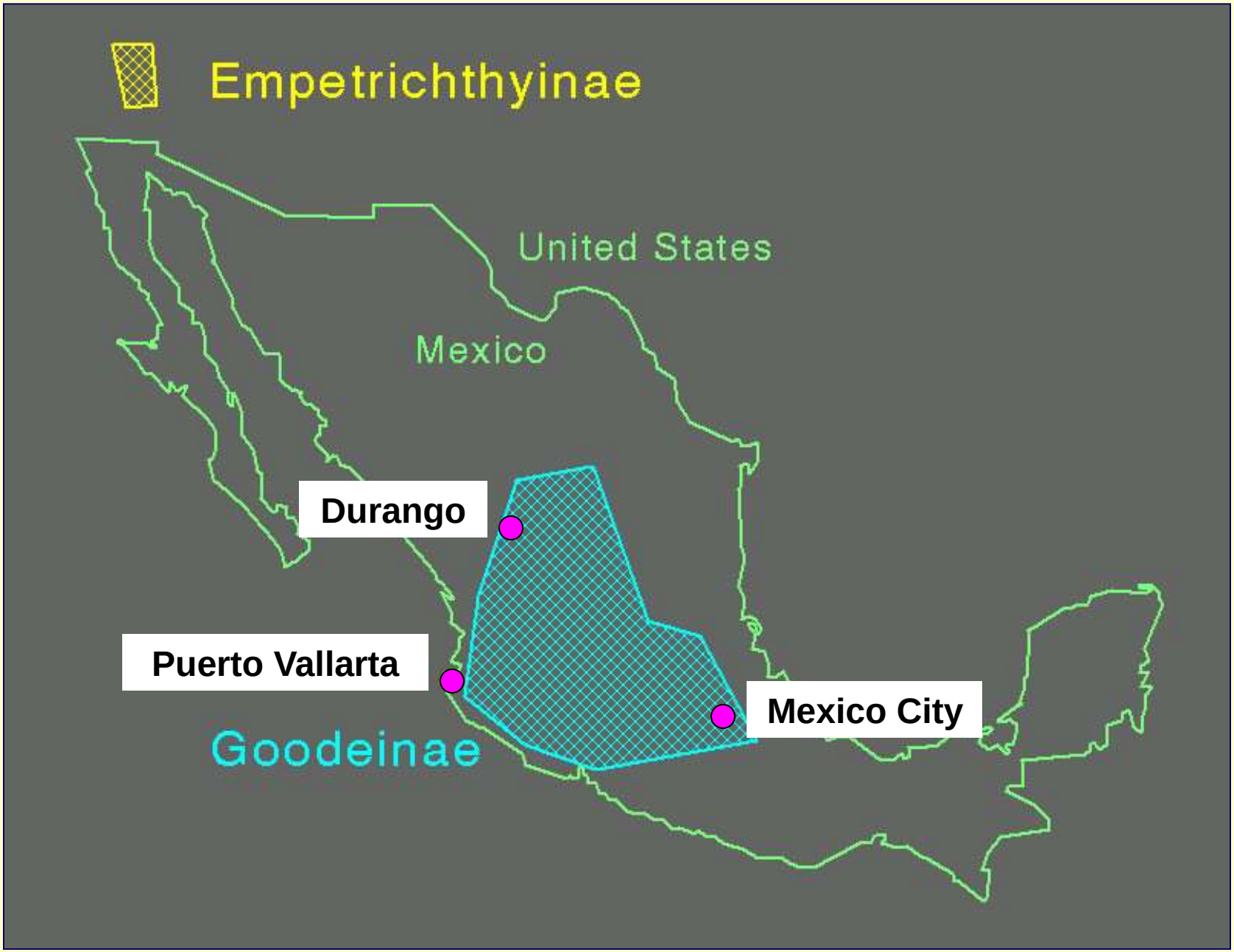
Will Mexican Goodeids survive this century?

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

Manantlán Stream, Jalisco

Lake Pátzcuaro, Michoacán

Amado Nervo Springs, Durango

Goodeid country: geologically active, mountainous, many movement barriers

Colima Volcano, Colima

Juanacatlán Waterfall, Santiago River, Jalisco

Ayuquila River Canyon, Jalisco

Orizaba Peak, Veracruz

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

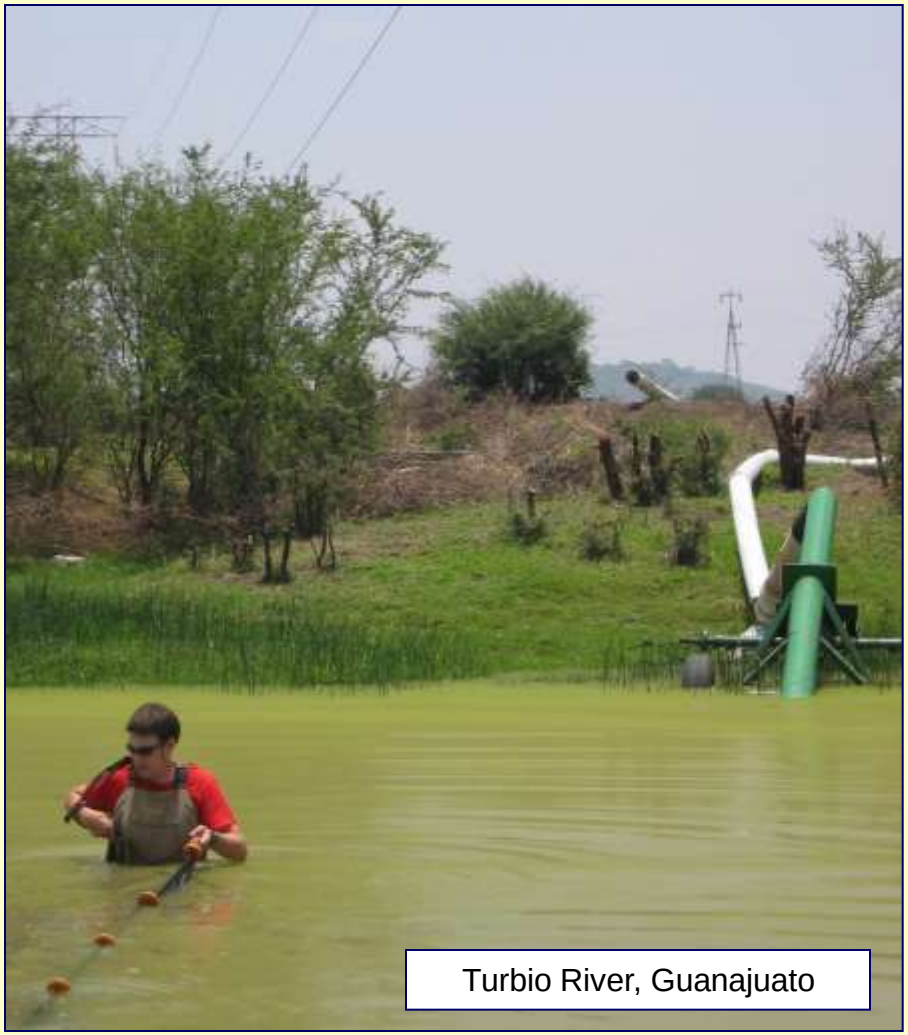
Lake Chapala, normal dry season

Lake Chapala, 1991 drought

Goodeid threats – 2: Water quality

Lerma River, México

Ayuquila River, Jalisco



Turbio River, Guanajuato

Goodeid threats: Non-native species

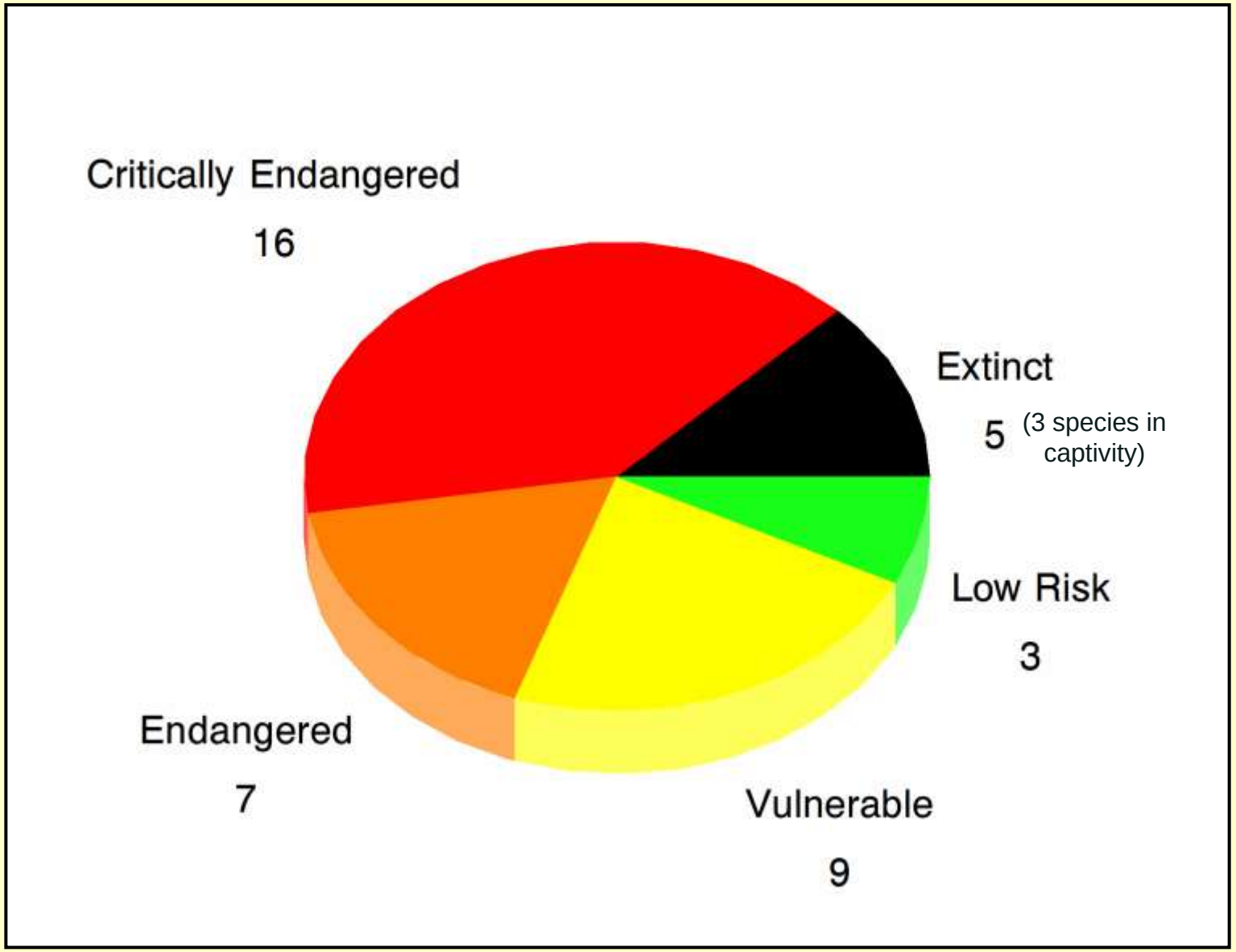
Tilapia (*Oreochromis and Tilapia* species)

Largemouth Bass
(*Micropterus salmoides)*

Common carp (*Cyprinus carpio*)

Variable Platyfish
(*Xiphophorus variatus*)

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



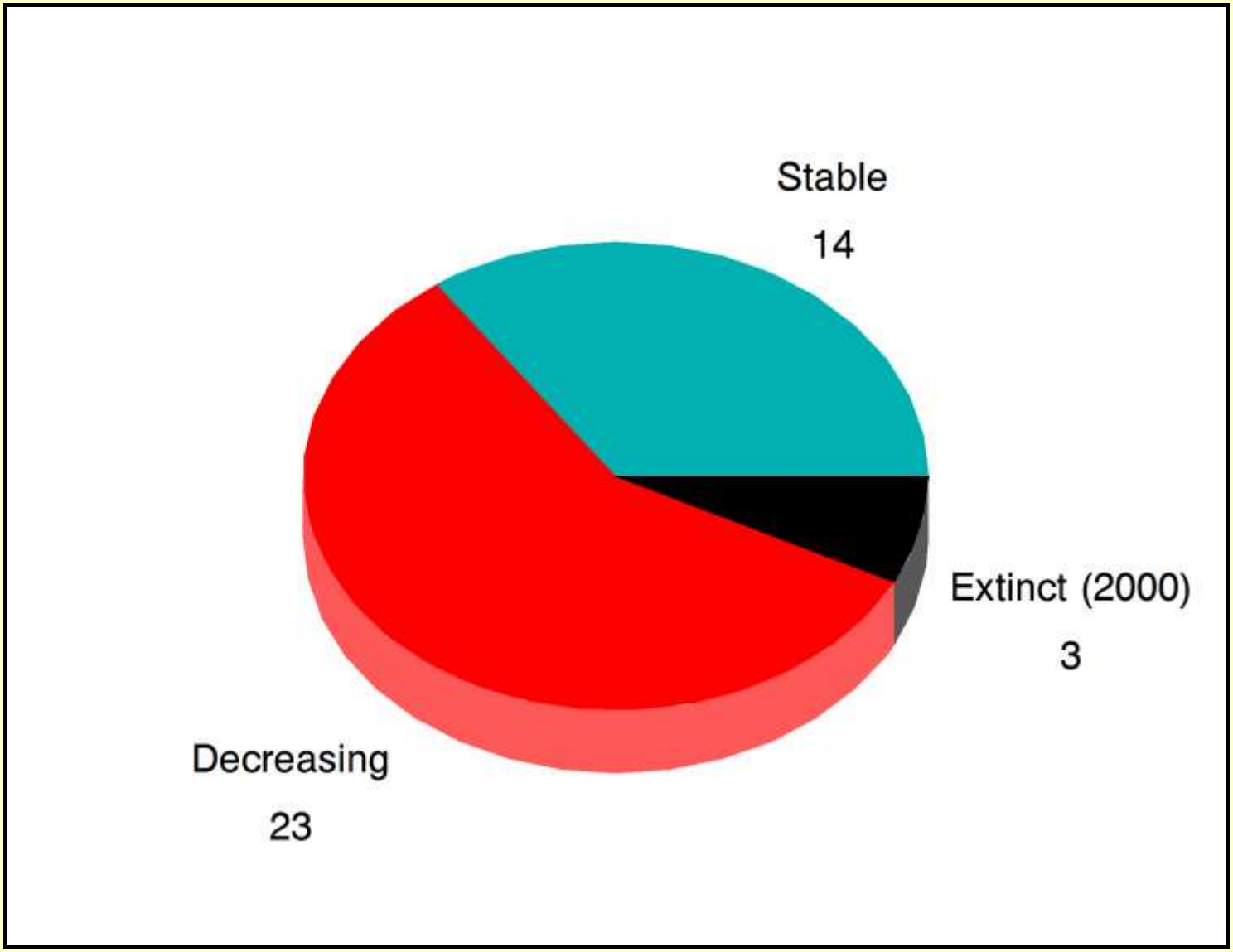
Goodeids in serious trouble

Some endangered Goodeids locally abundant

Goodeids in La Luz springs, Michoacán

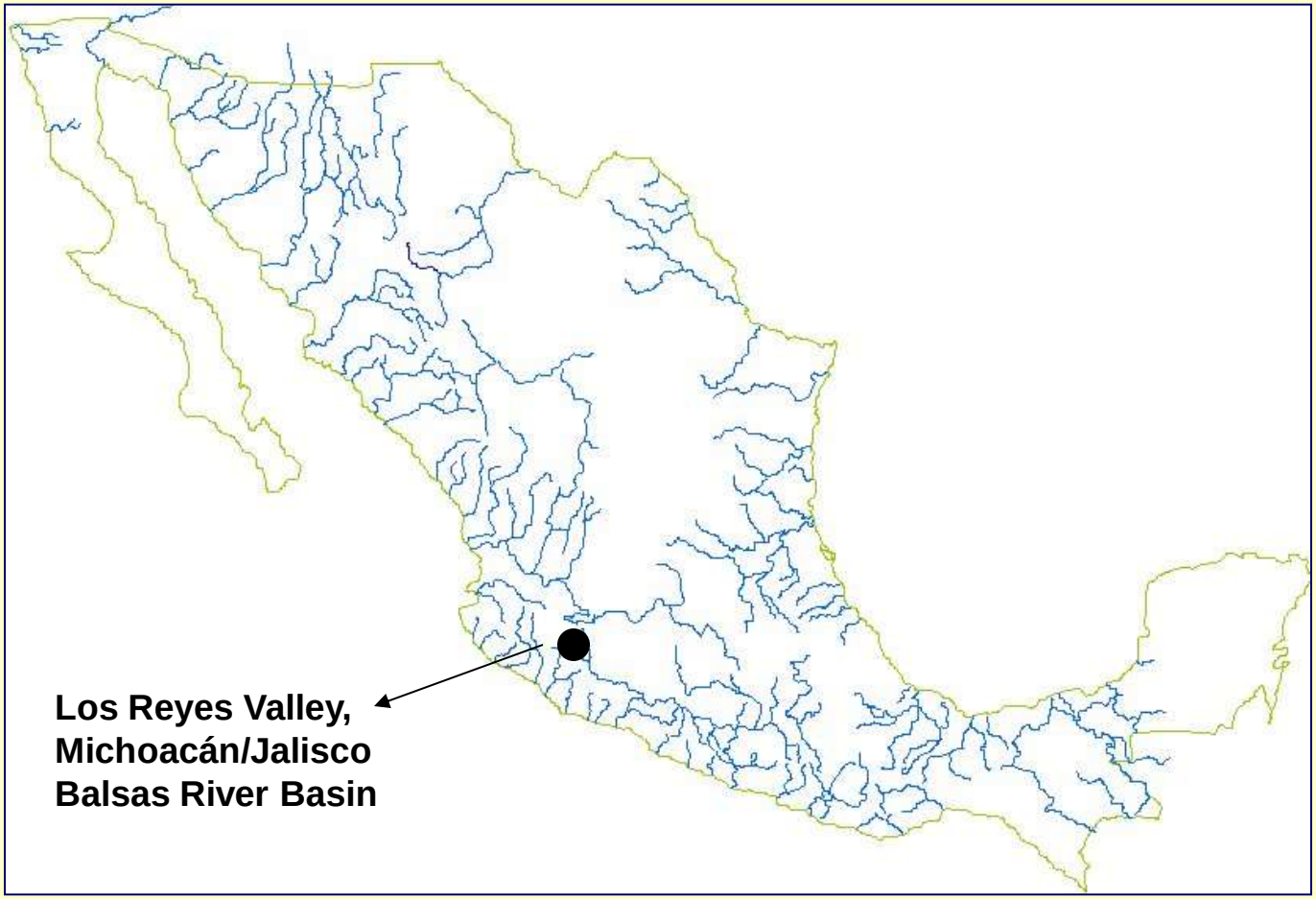
But limited to a few small, vulnerable habitats

Goodeid trends since 2000:



Most species in decline

Declining: *Allotoca regalis* (Crit. Endangered)



Range shrinking rapidly

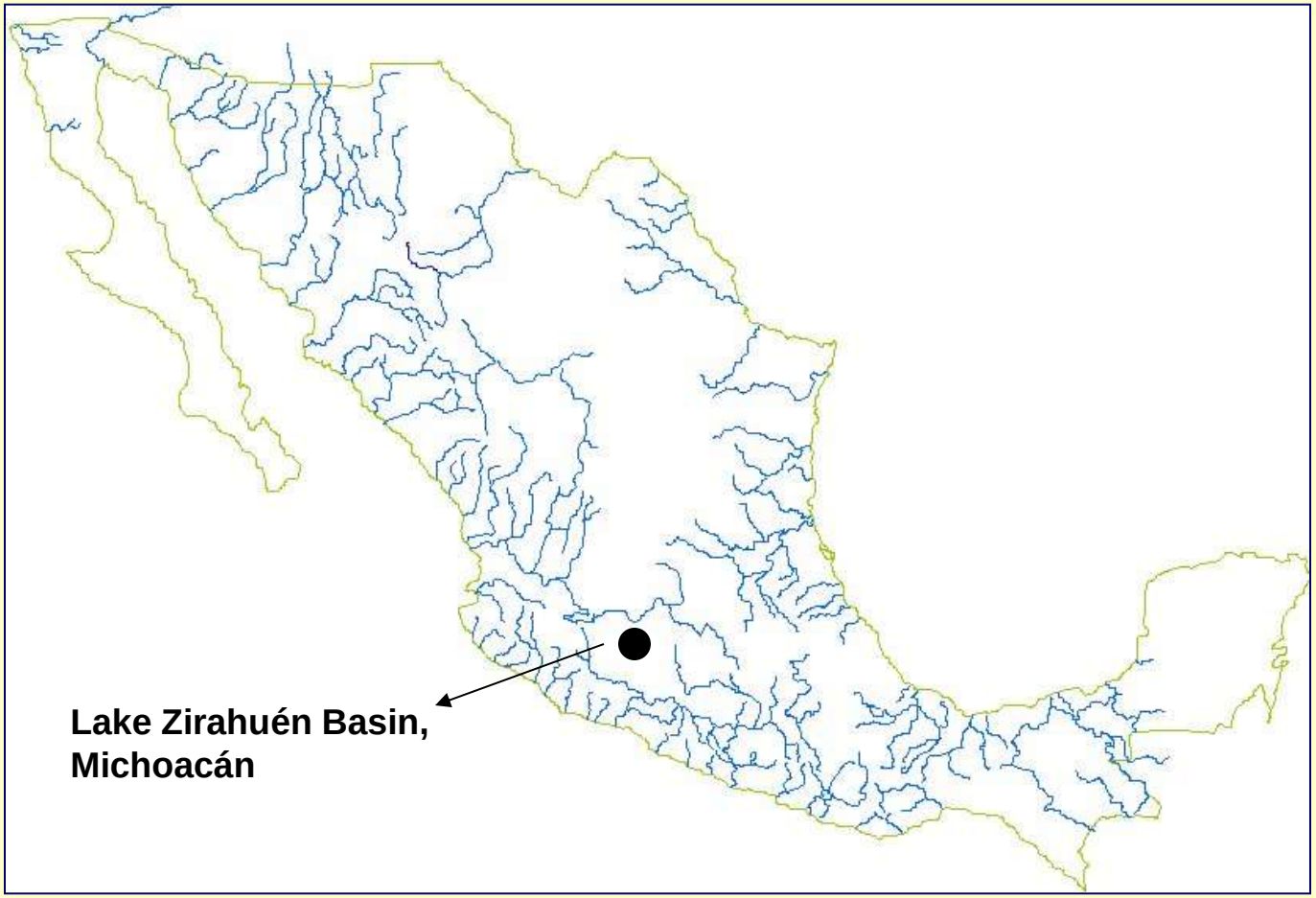
1980 – 5 areas; 2000 – 3 areas; 2010 – 1 area

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

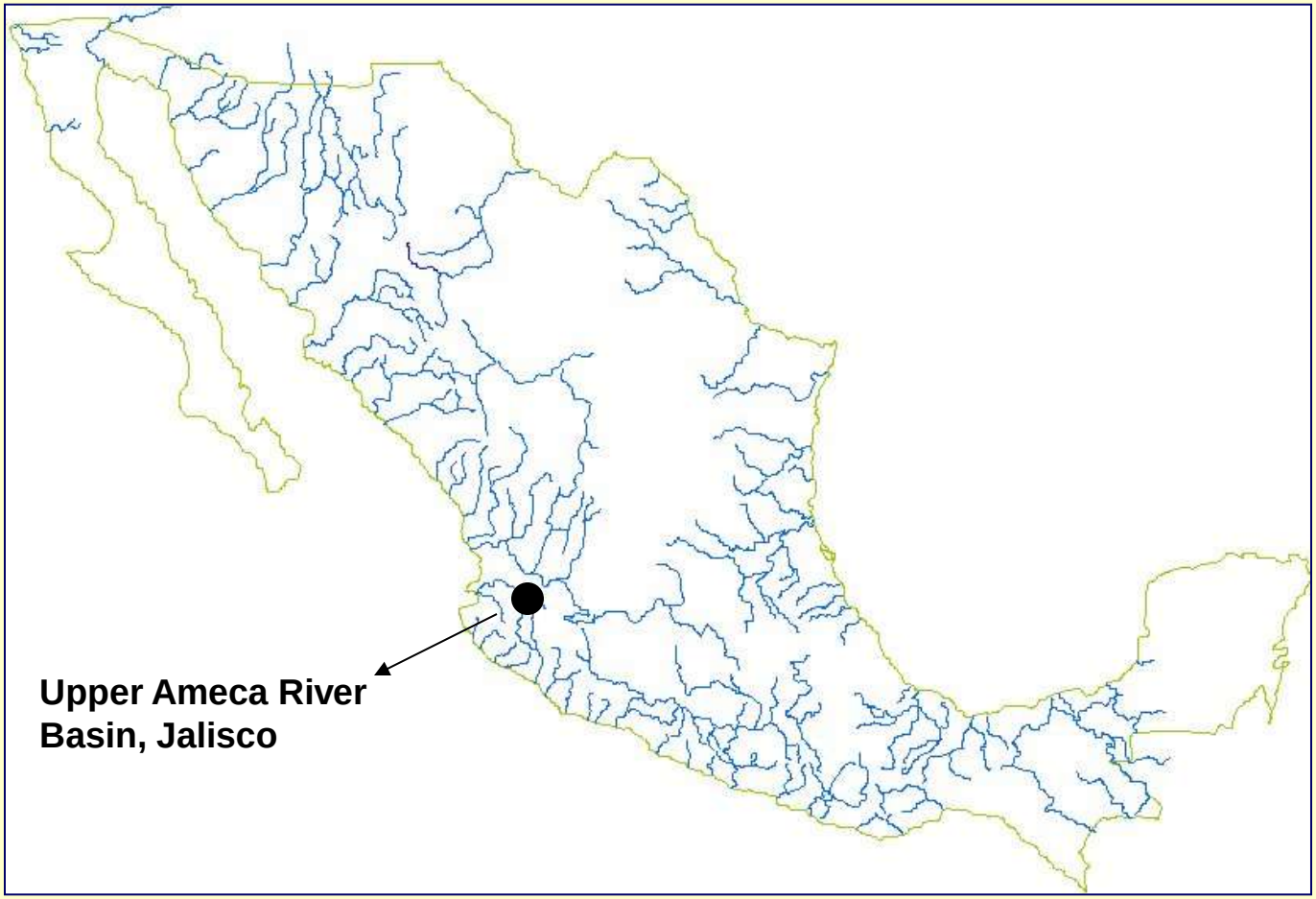
Mid 1980s, largemouth bass (*Micropterus salmoides*) enter Lake Zirahuén

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

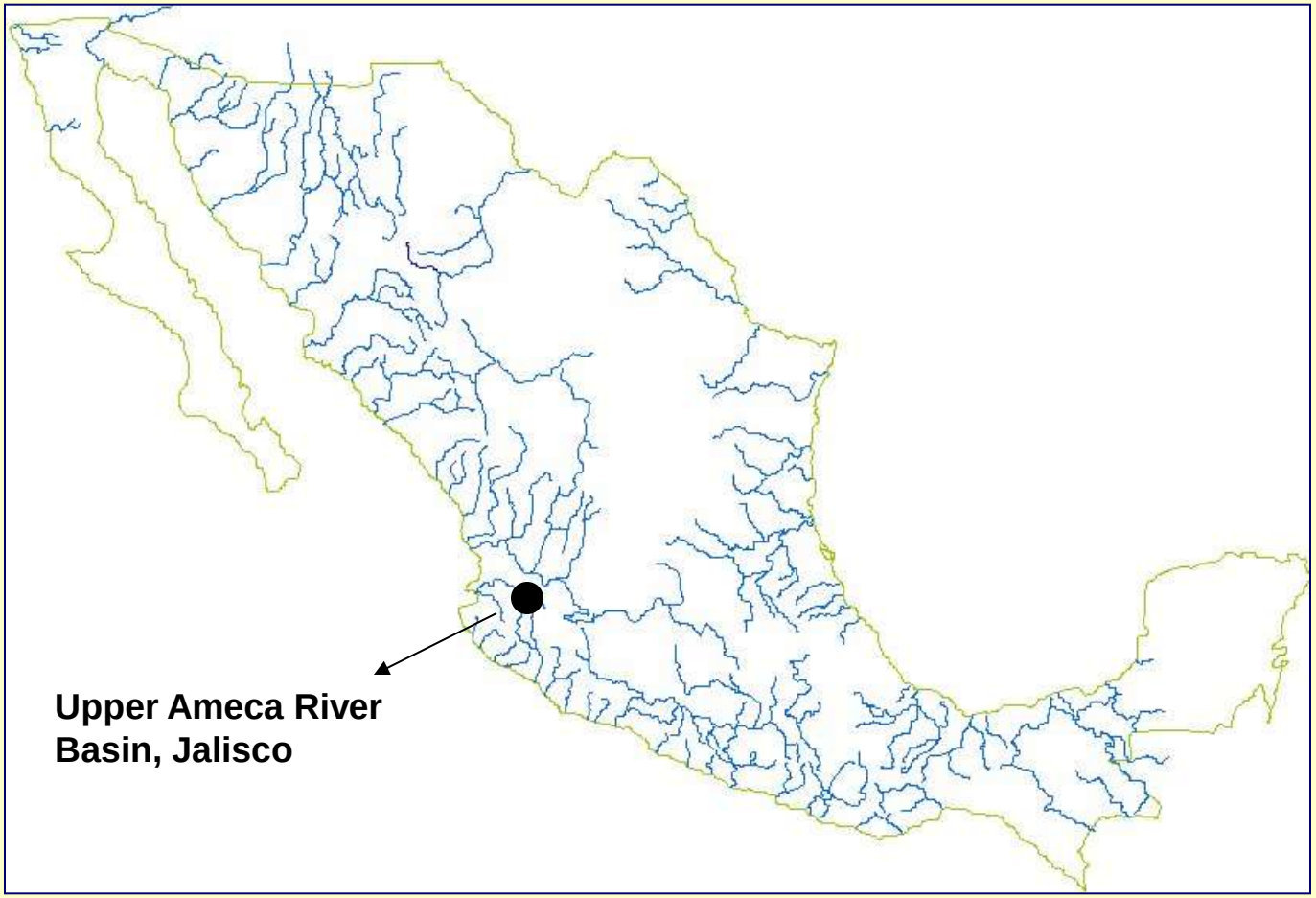

De la Pola River

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….**

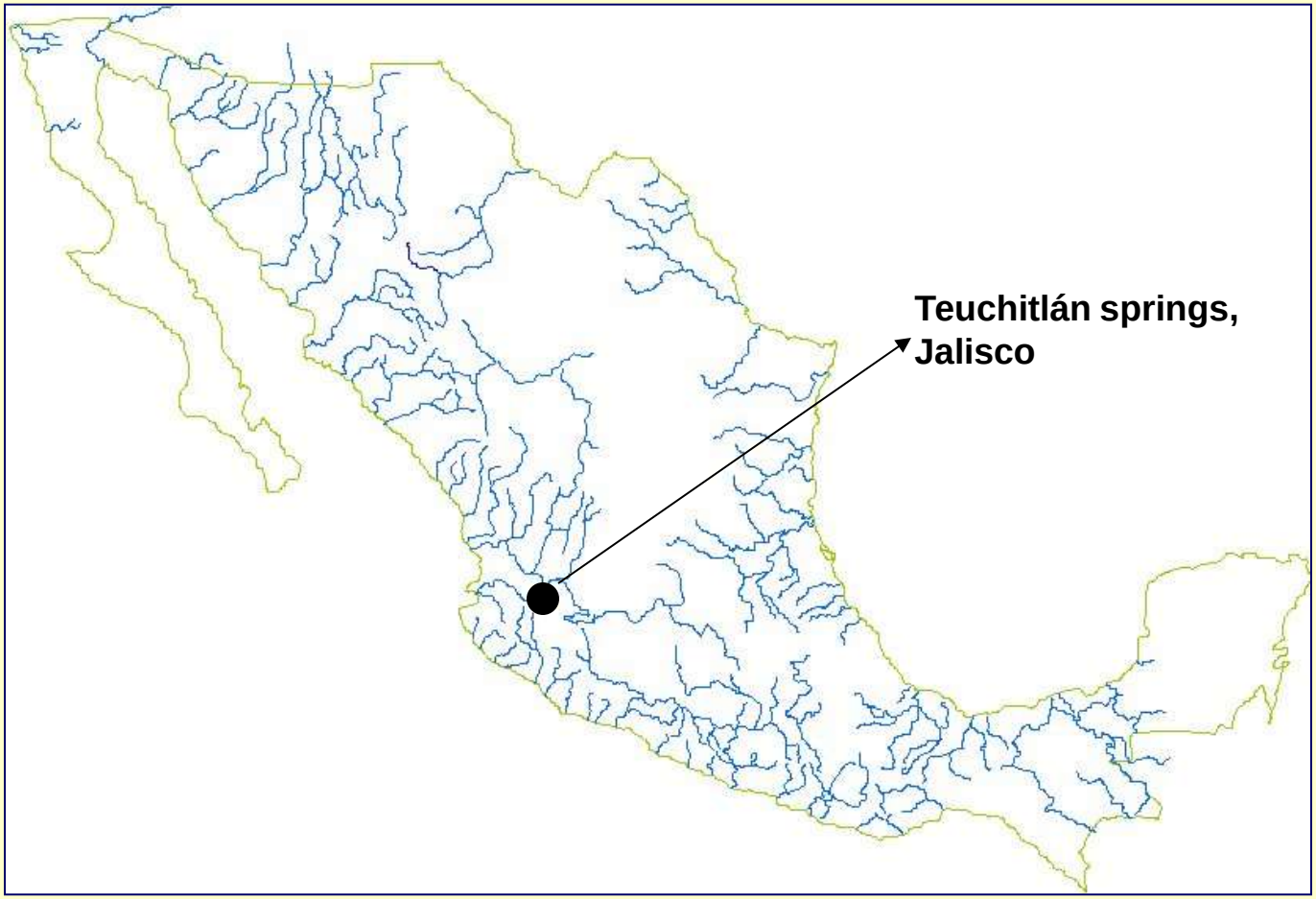
Xiphophorus helleri **(green swordtail) invaded the stream between 2000 and 2004….**

Allotoca goslinei quickly eliminated

Year	*Allotoca goslinei*	*Xiphophorus helleri*
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)**
- ***Girardinicthys ireneae*** **(Crit End)**
- ***Skiffia lermae*** **(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

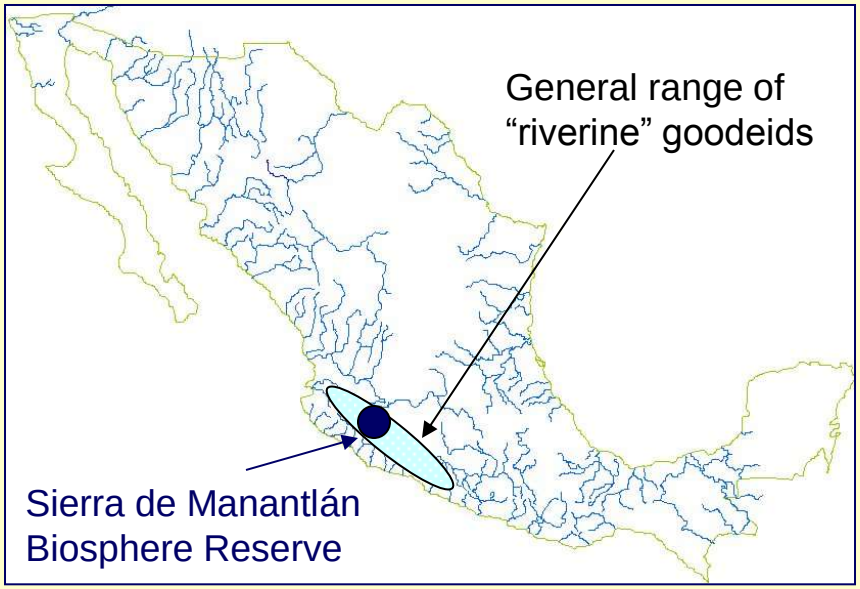
Tamazula River, Jalisco

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 tamazlulae* (V)**

***Ilyodon whitei* (V)**

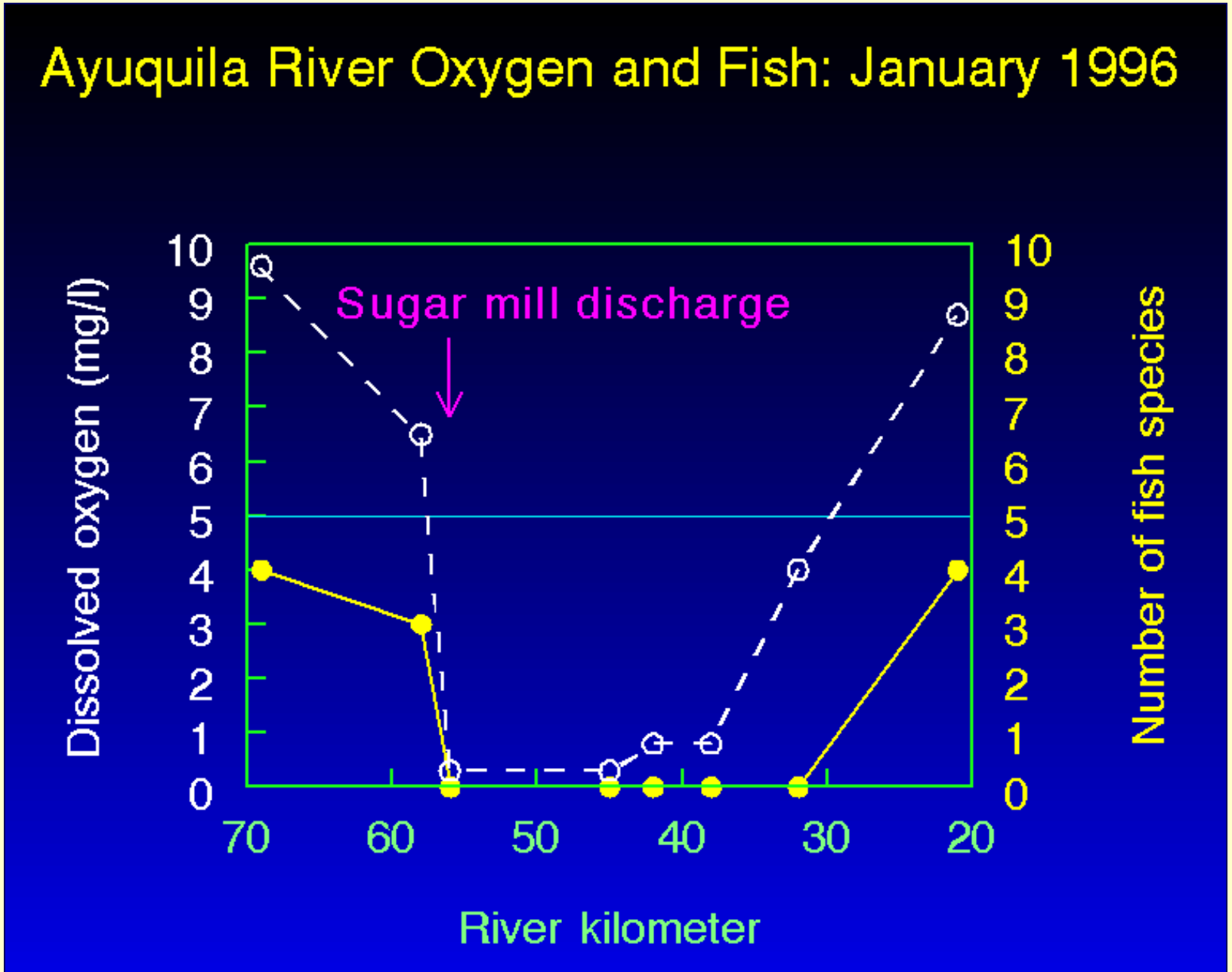
Conserving Goodeids

2) Restore key degraded habitats (where practical)

Ayuquila River, Jalisco, example

Pre 1999

25 km of the river below the sugar mill was fishless

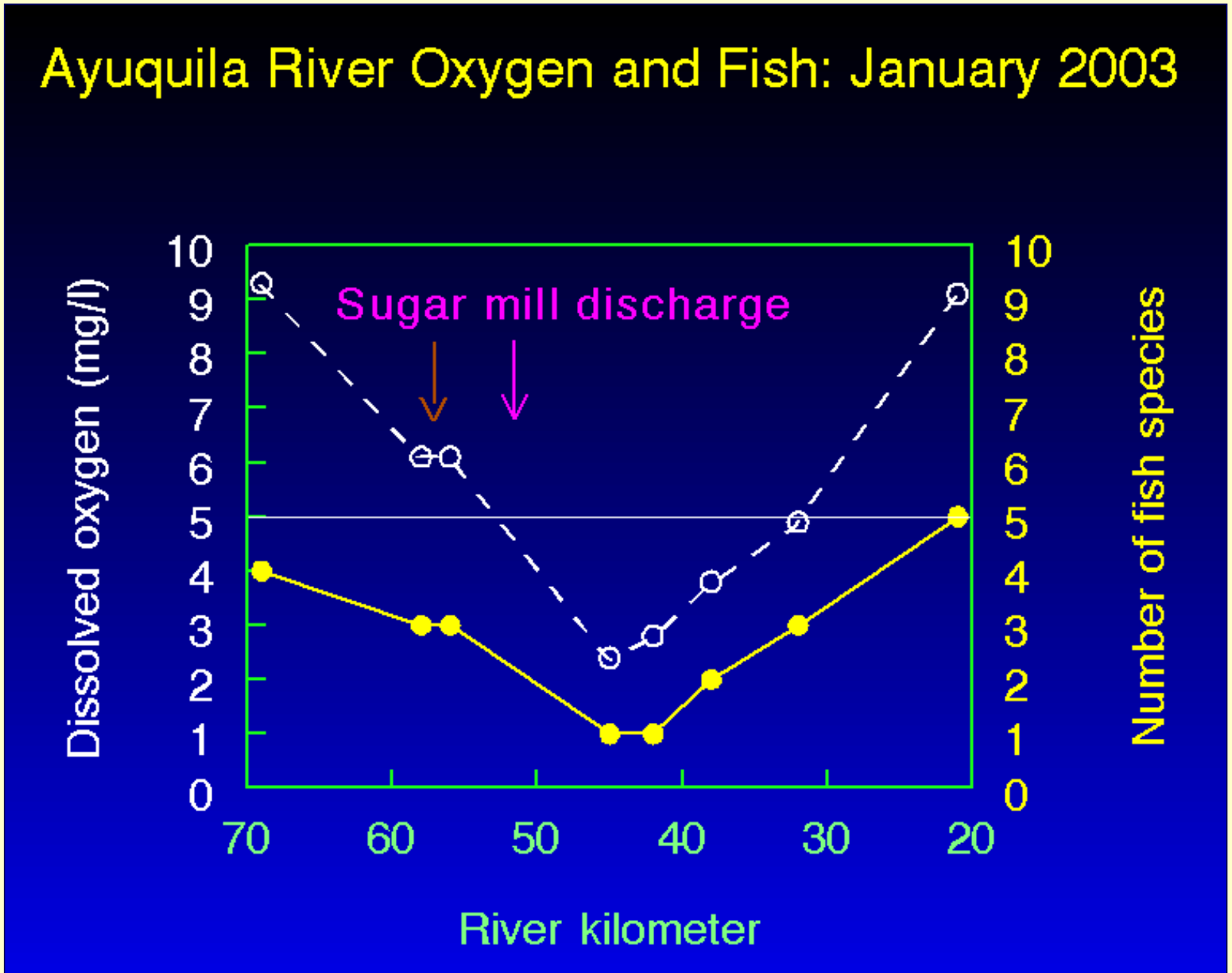


1999: Sugar mill wastes diverted to irrigation canals

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



Ilyodon furcidens has re-colonized river below mill

Conserving Goodeids

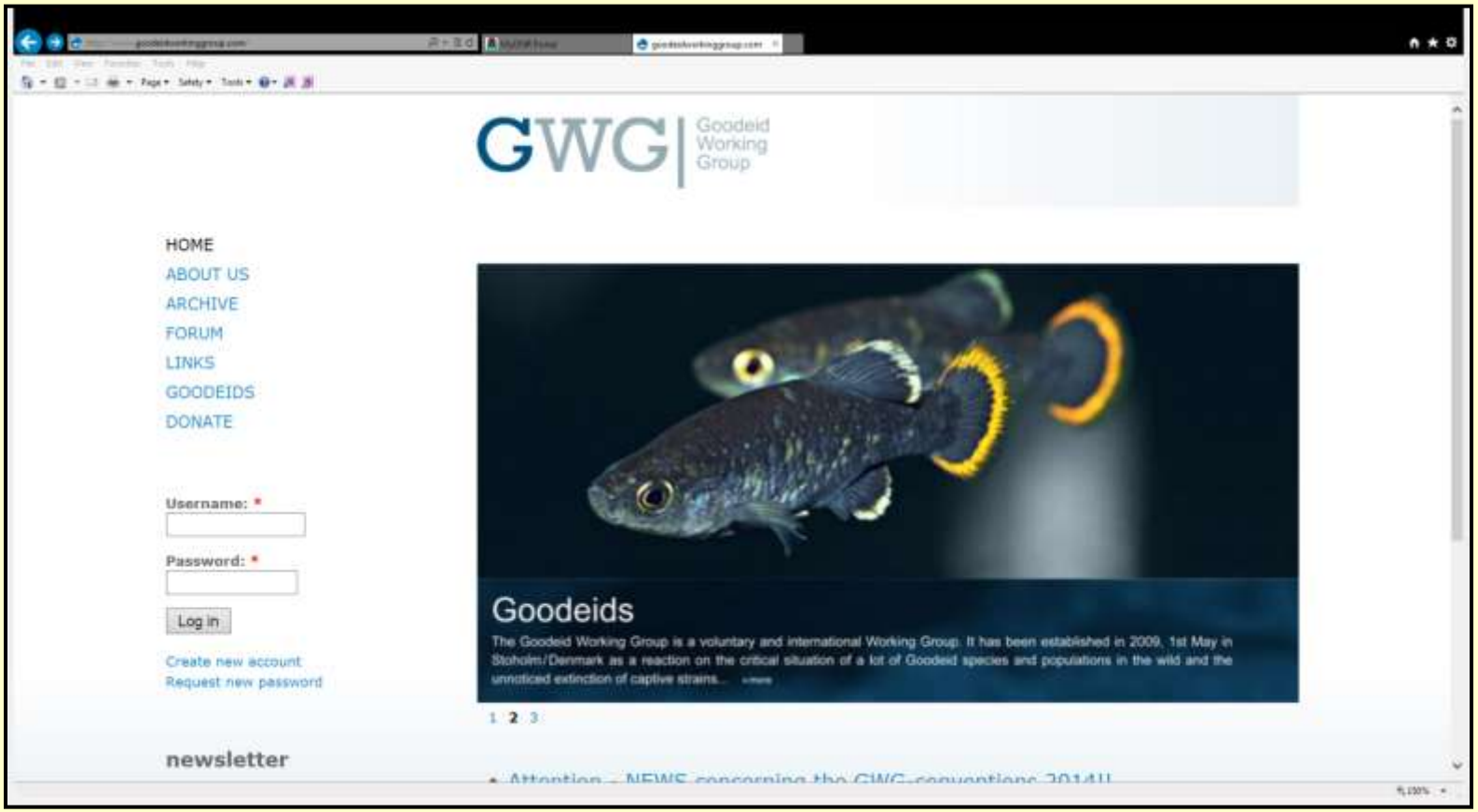
3) Establish and maintain captive breeding colonies

"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

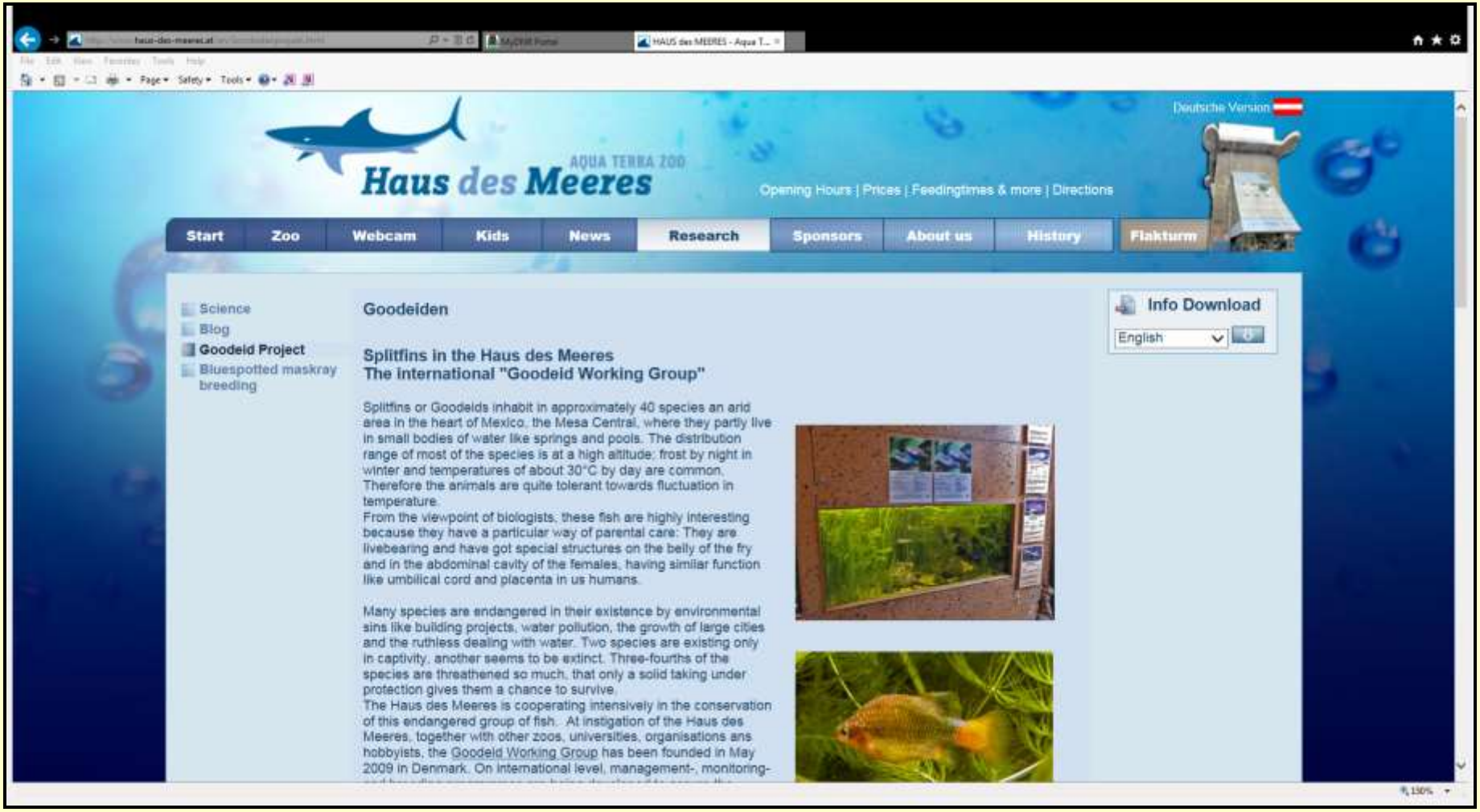


Founded 2009: European (EGWG) & North American (NAGWG) Chapters

Primarily Serious Hobbyists (~75 in ~20 countries)

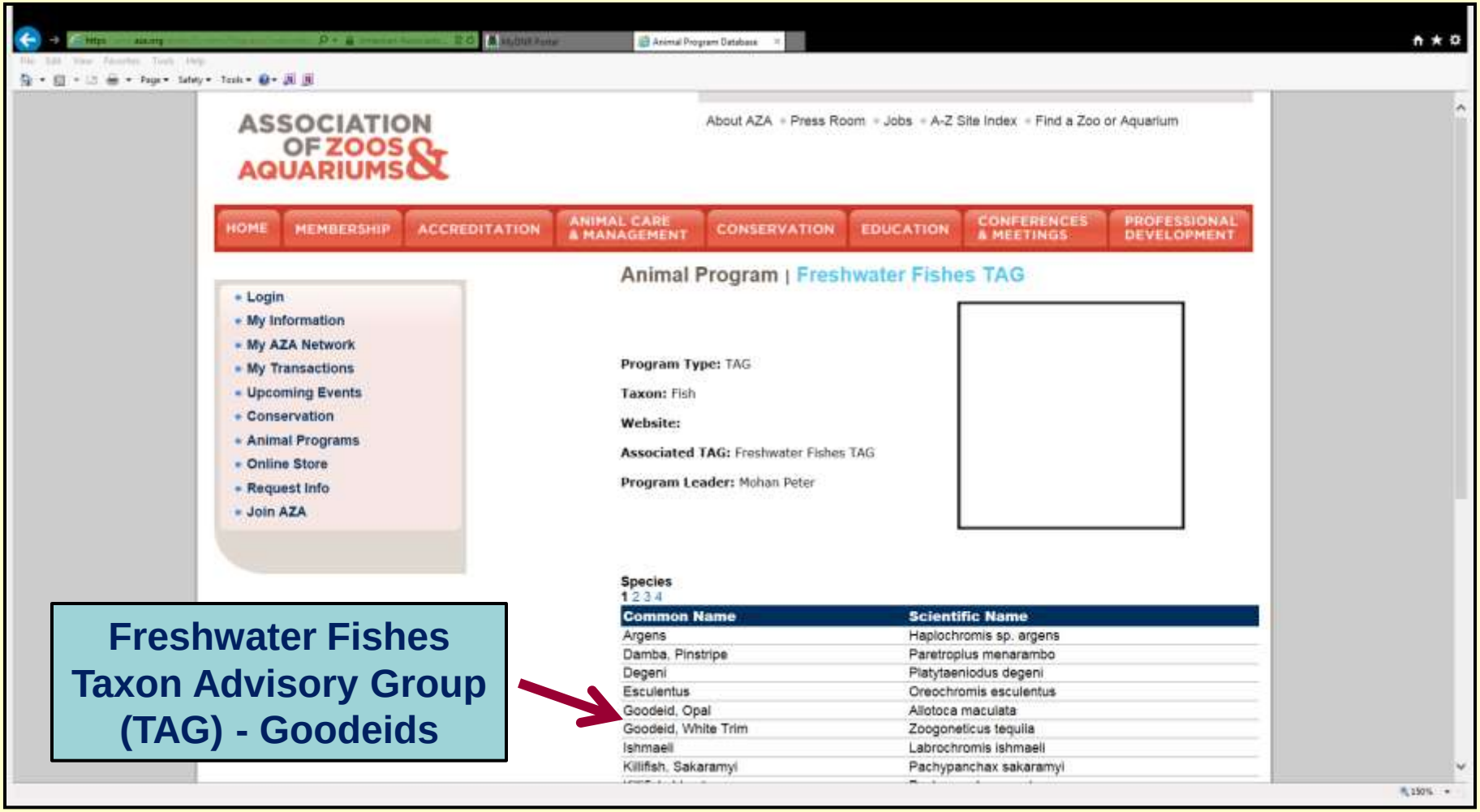
Collectively maintaining ~37 of 40 Mexican Goodeid species

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



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



Freshwater Fishes Taxon Advisory Group (TAG) - Goodeids

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

Xenoophorus 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, Neoophorus regalis, Xenoophorus 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