

Conserving Endangered Mexican Goodeid Livebearers: *The Critical Role of the Aquarium Hobbyist*



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Outline

1) Who are the Goodeids?

- Taxonomic definitions
- Evolutionary relationships

2) Mexican Goodeid biology

- Life history
- Habitats

3) Mexican Goodeid status and conservation

- Impacts and threats
- Some dire statistics

4) How YOU, the hobbyist, can help

- Captive maintenance
- Involvement in ALA and GWG

1) Who are the Goodeids?

A family of fishes (Goodeidae; aka “Splitfins”) in the order Cyprinodontiformes, with two subfamilies:

Goodeinae

~ 40 species (~ 87 ESU's)

Central Mexico

Livebearers

Empetrichthyinae

4 species (8 ESU's)

Southwestern USA

Egg Layers



Skiffia lermae



© Peter Rissler

Crenichthys baileyi

Current Goodeid Distribution



Empetrichthyinae

Family ~ 16.5 million years old; subfamilies split 5-10 million years ago



In Mexico, a generalized Goodeid ancestor

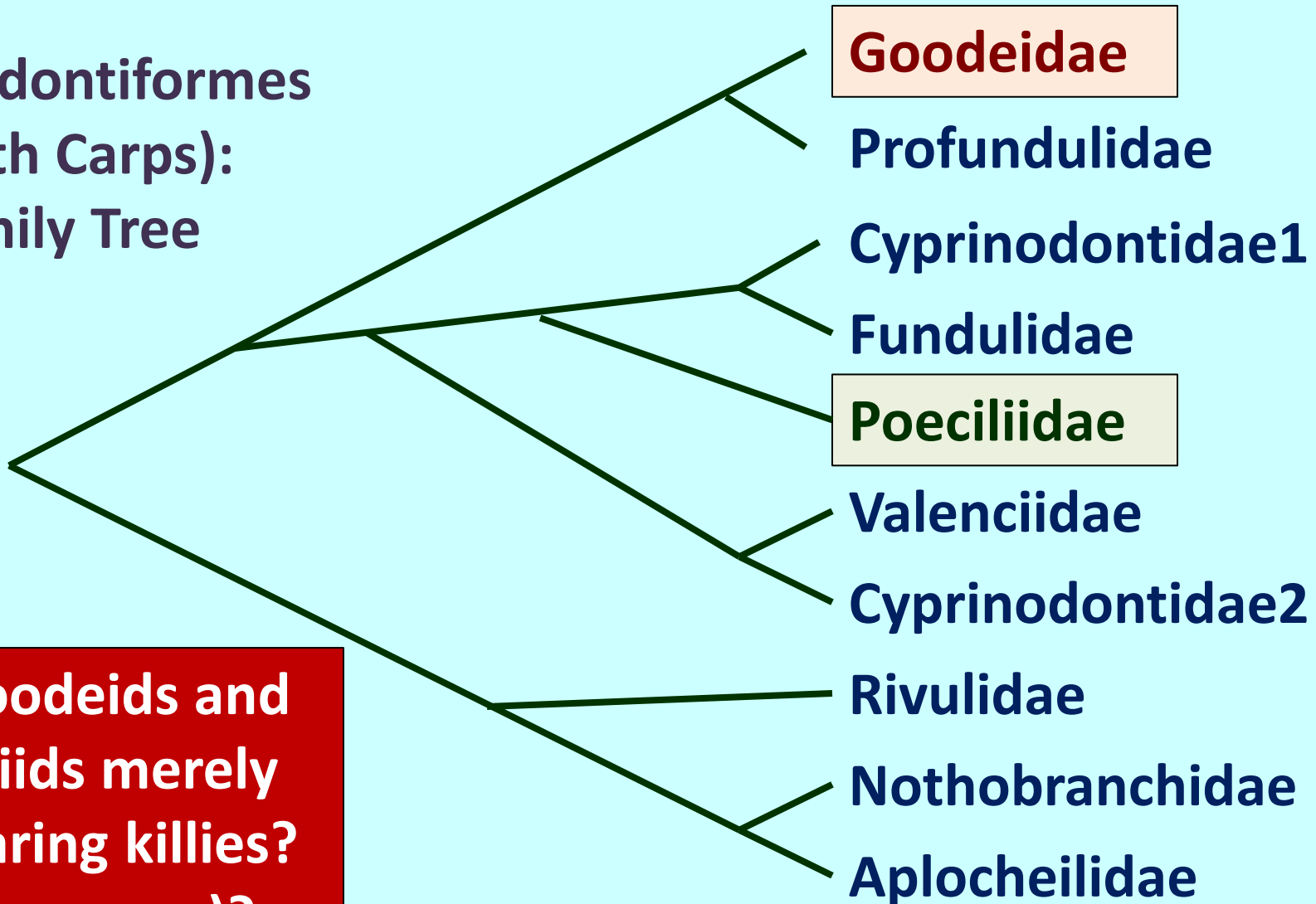


Fossilized *Tapatia occidentalis*, Barranca de Santa Rosa, Jalisco;
from Pliocene Epoch, at least 2.6 million years ago

gave rise to a rich modern fauna

Goodeid Evolutionary Relationships

Cyprinodontiformes
(Tooth Carps):
Family Tree



Are Goodeids and
Poeciliids merely
livebearing killies?
(or vice versa)?

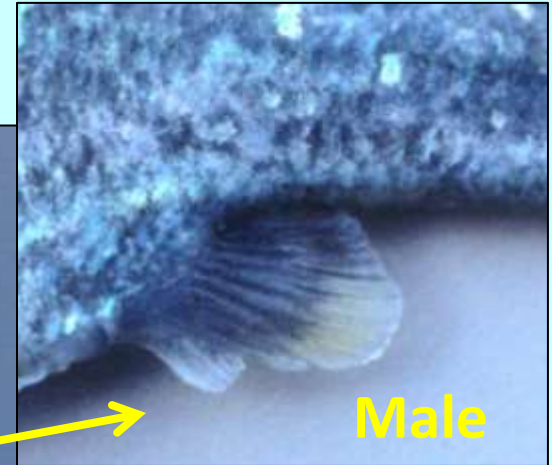
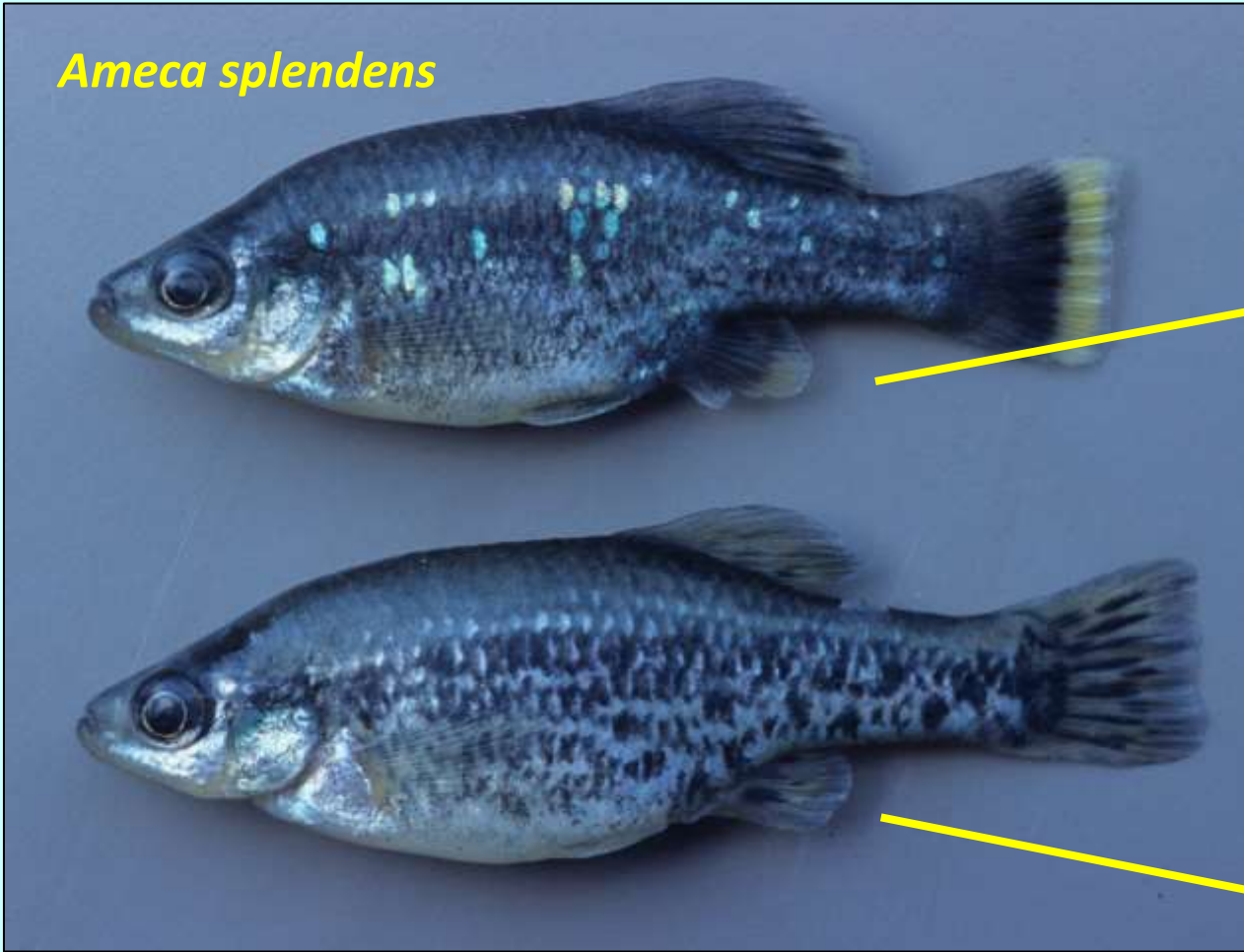
2) Mexican Goodeid Biology

- Small (maximum size 1.5" to 7"; most ~ 2.5")
- Short-lived (mature in 1 year, max age 3-5 years)
- Livebearers (multiple broods per year, 5-25/brood)
- Omnivorous (algae, insects, plankton, detritus)



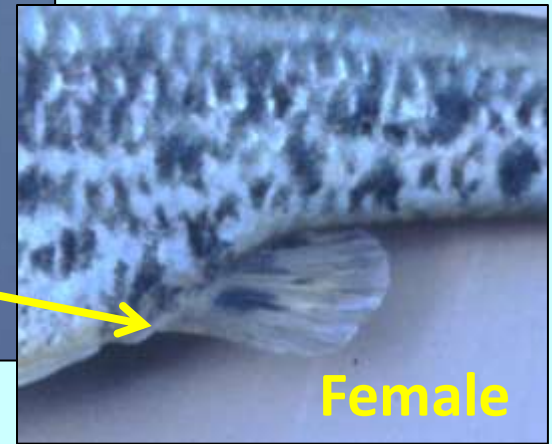
Goodeid Life History

Ameca splendens



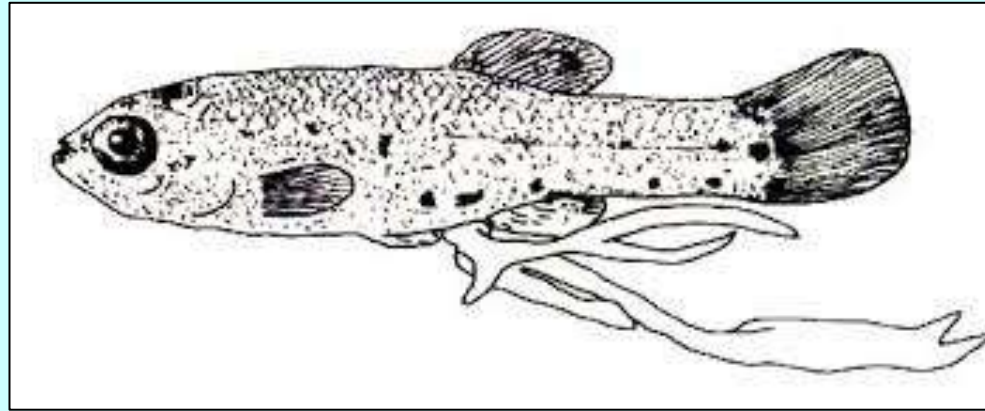
Andropodium

"Splitfins"



Goodeid Life History

**Maternal nutrition of embryos via
placenta-like “trophotaeniae”**



Goodeid Species Occupy Diverse Habitats



Allotoca dugesi



Allodontichthys zonistius



Manantlán Stream, Jalisco



Lake Pátzcuaro, Michoacán



Amado Nervo Springs, Durango



Xenophorus captivus



Zoogoneticus quitzeoensis

Goodeid Habitats



Río Ancho, Aguascalientes



Presa Alvareno, Michoacán



Manantial Cupatchiro, Michoacán



Río Verde, Jalisco

3) Mexican Goodeid Status and Conservation



Xenotoca cf. eiseni
Endangered in the wild

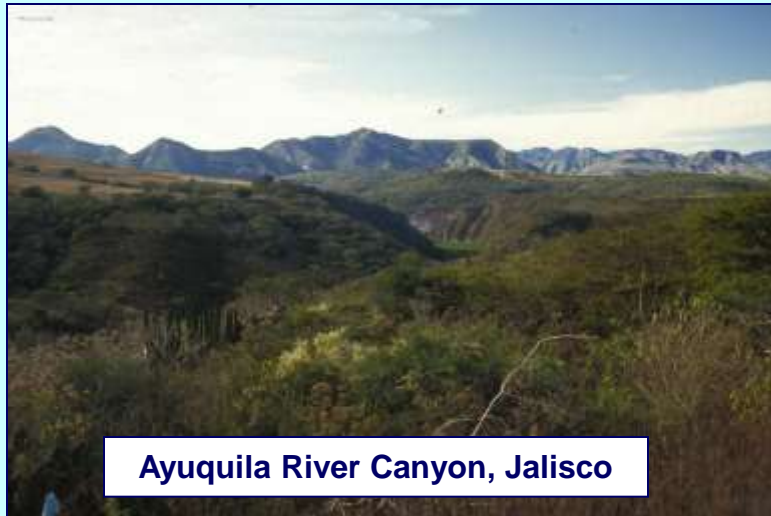
Goodeid Country: Geologically Active, Mountainous, Many Movement Barriers



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 & Developed Area of México; Seasonally Arid



Goodeid Threats – A: Water Quantity

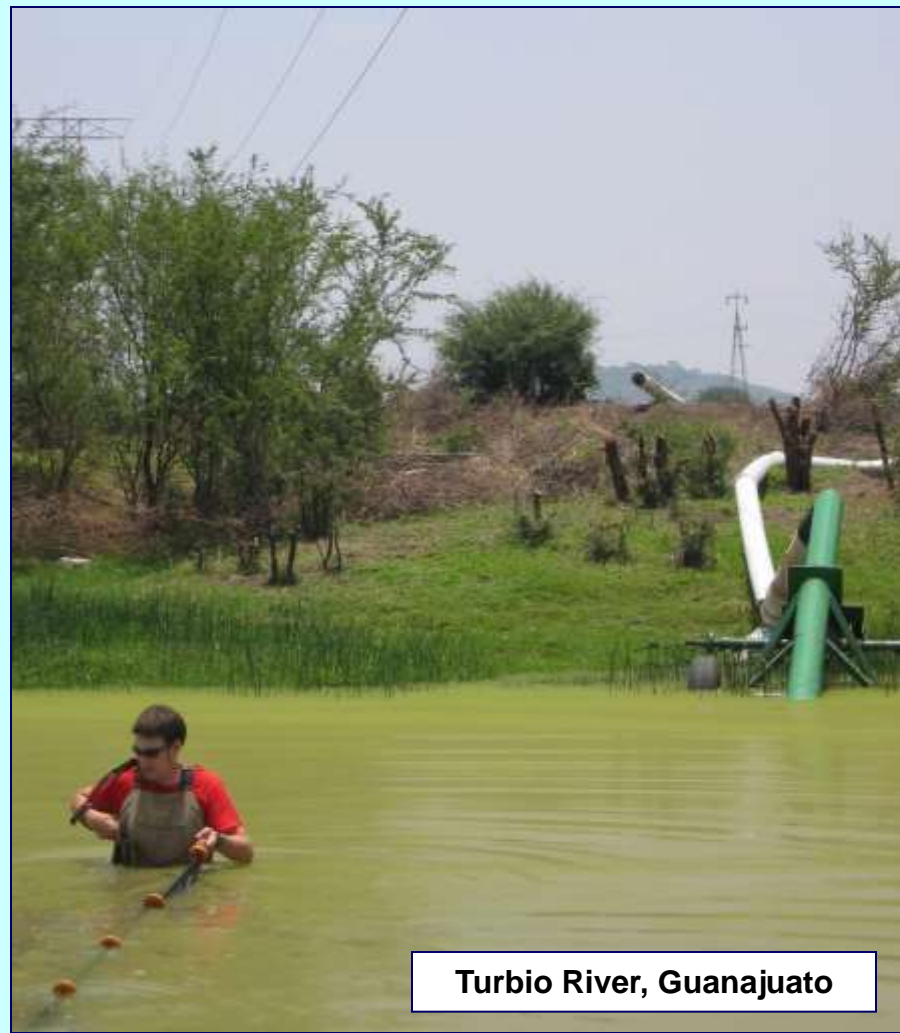
Lake Chapala, largest natural lake in Mexico (420 square miles), during normal (1990) dry season



Lake Chapala, 1991 drought; 40% decline in surface area; 60% decline in volume



Goodeid Threats – B: Water quality



Goodeid Threats – C: Non-Native Species



Tilapia (*Oreochromis* and *Tilapia* species)



Rainbow trout
(*Oncorhynchus mykiss*)

**And many,
many more**

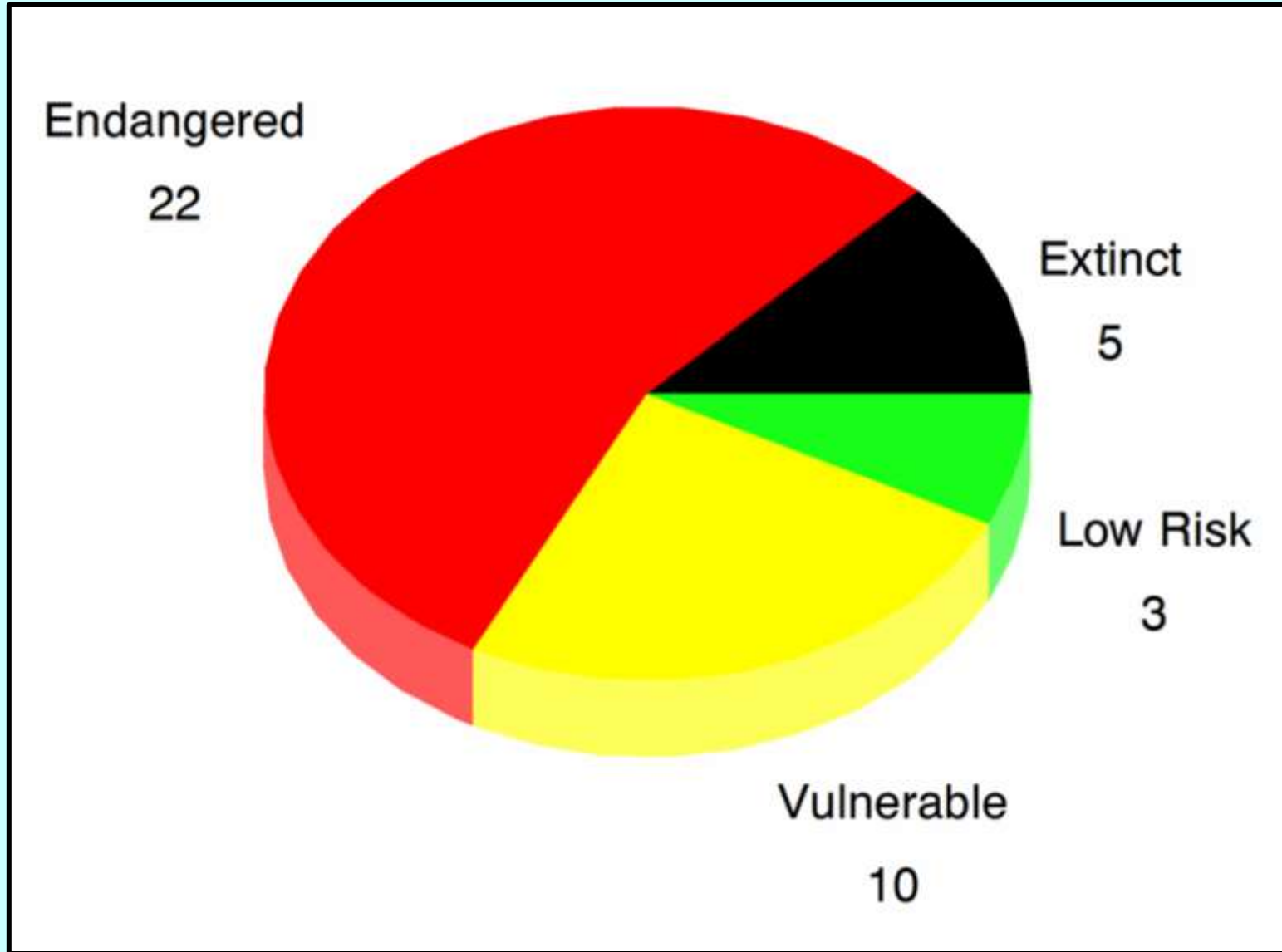


Common carp (*Cyprinus carpio*)



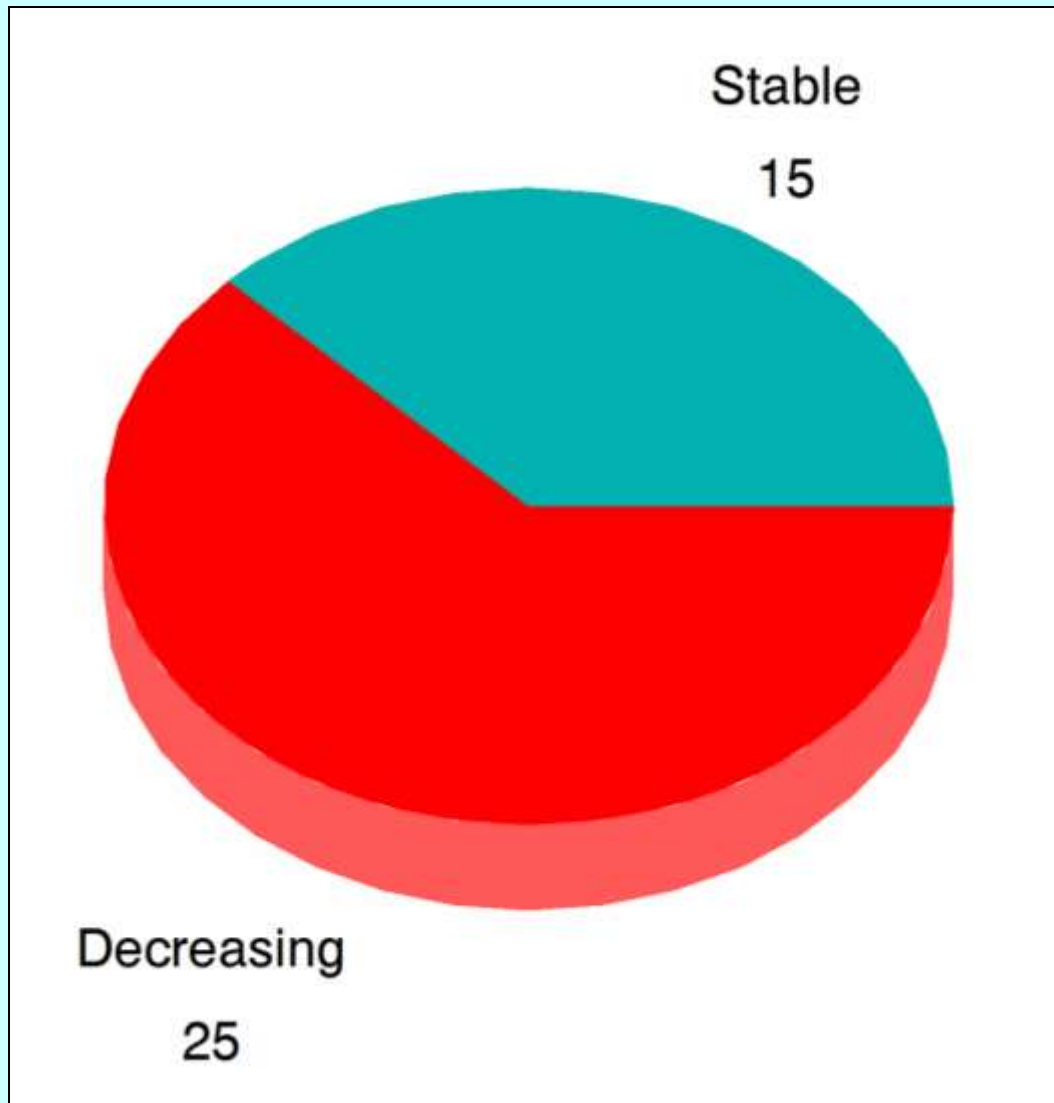
Platyfish (*Xiphophorus variatus*)

Mexican Goodeid Species Wild Status in 2016:



Goodeids in trouble!

Mexican Goodeid Trends 2000-2016:



Two extinctions since 2006

Why are Mexican Goodeids in Trouble?

Case Studies of Rare Goodeids: (*The good, the bad, and the ugly...*)

The Good (kind of):

Butterfly goodeid *Ameca splendens* – new populations

The Bad:

Finescale goodeid *Allodontichthys polylepis* – no water

Balsas allotoca *Allotoca regalis* – habitat and exotics

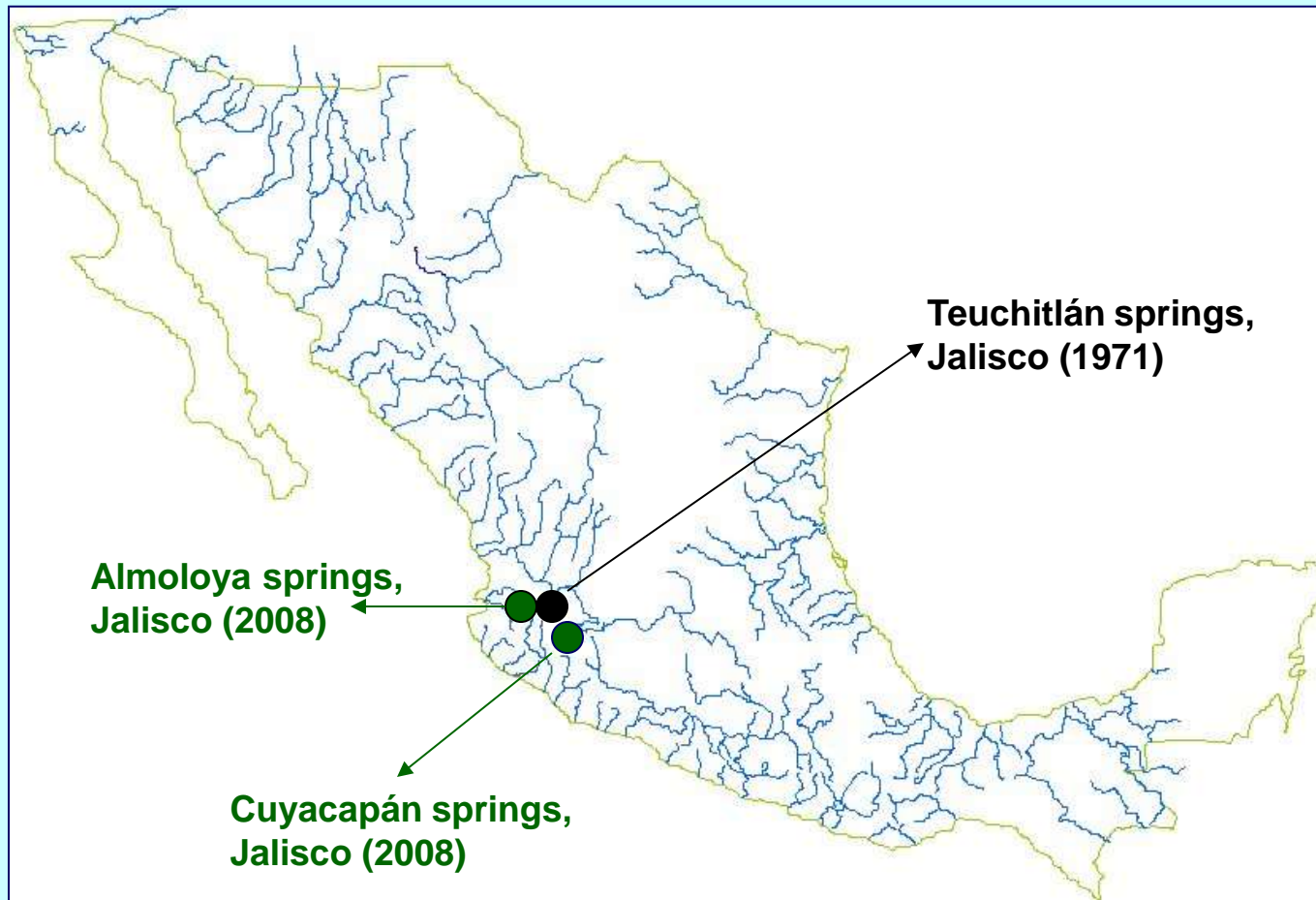
Zirahuén allotoca *Allotoca meeki* – bass attacks

The Ugly:

Banded allotoca *Allotoca goslinei* – extinct?

Crescent zoe *Zoogoneticus tequila* – extinct?

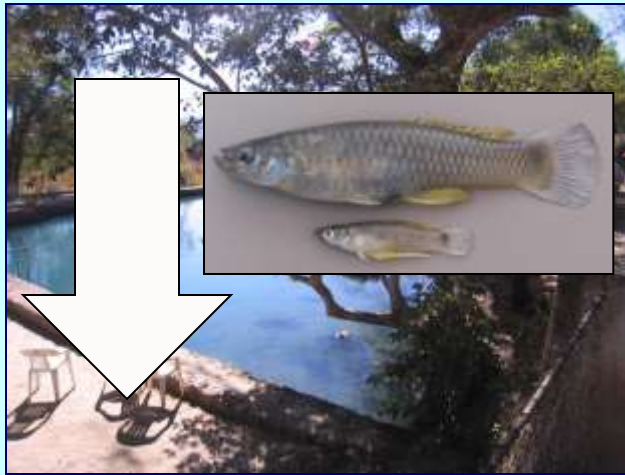
The Good?: Ameca splendens (Endangered)



Ameca splendens habitats – 2008-2016



**Teuchitlán
springs**

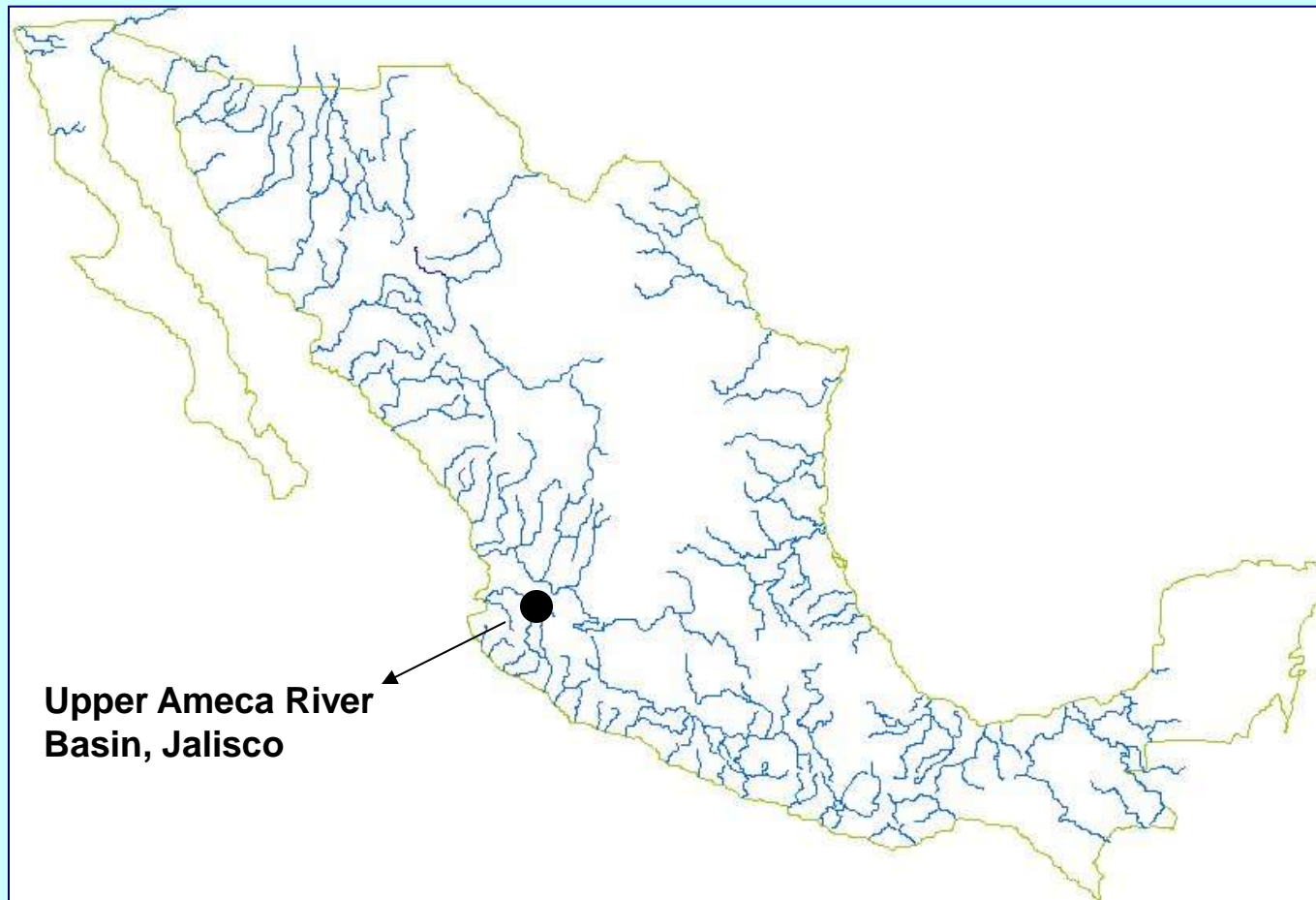


Almoloya springs



Cuyacapán stock tank

The Bad: Allodontichthys polylepis (Endangered)



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



De la Pola River

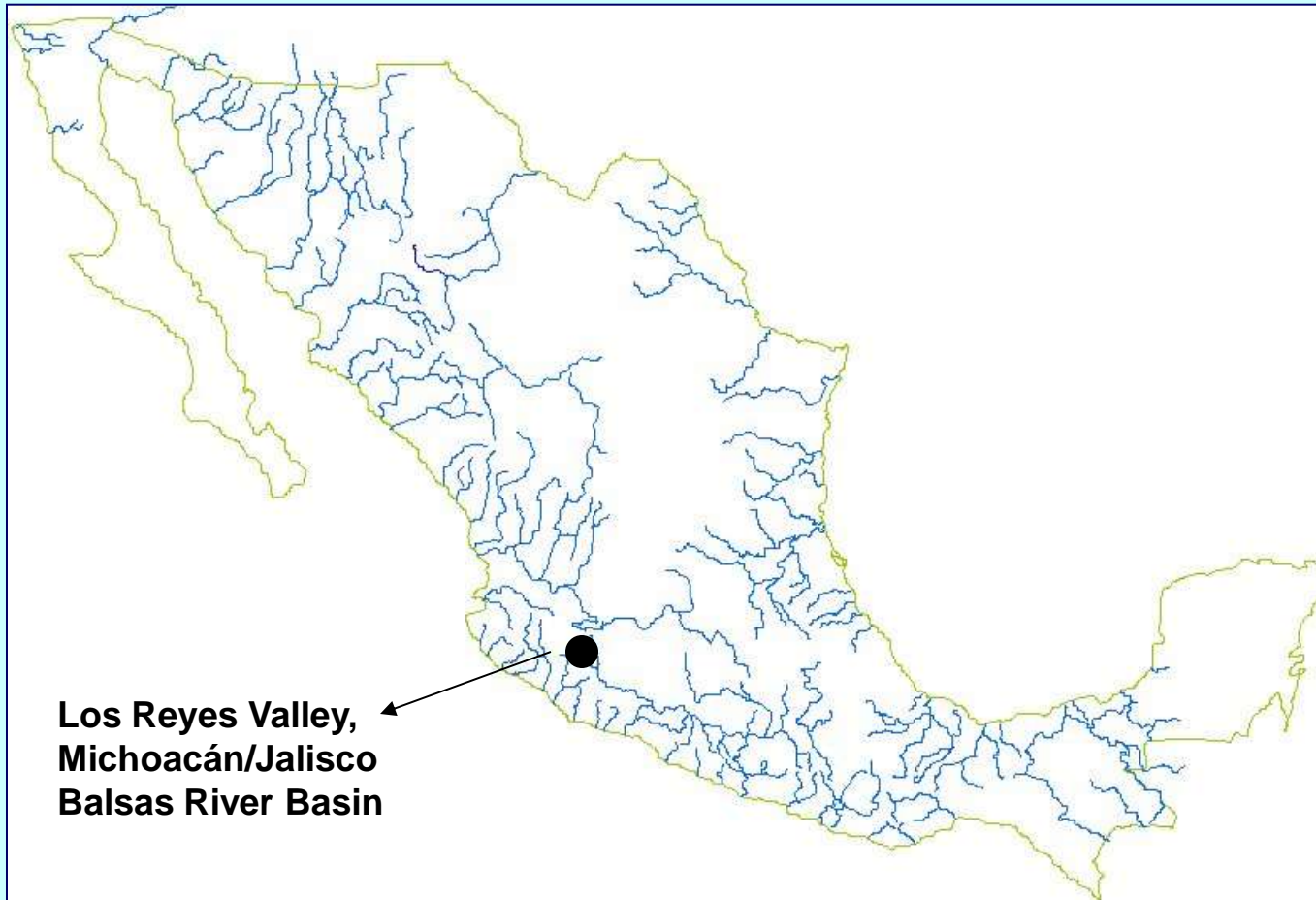
Known from only three streams. Fair numbers in 1997-2000. None in 2002, 2004, 2006, and 2008 surveys. Two fish in 2016

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



Diabolos Stream

***The Bad: Allotoca regalis* (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

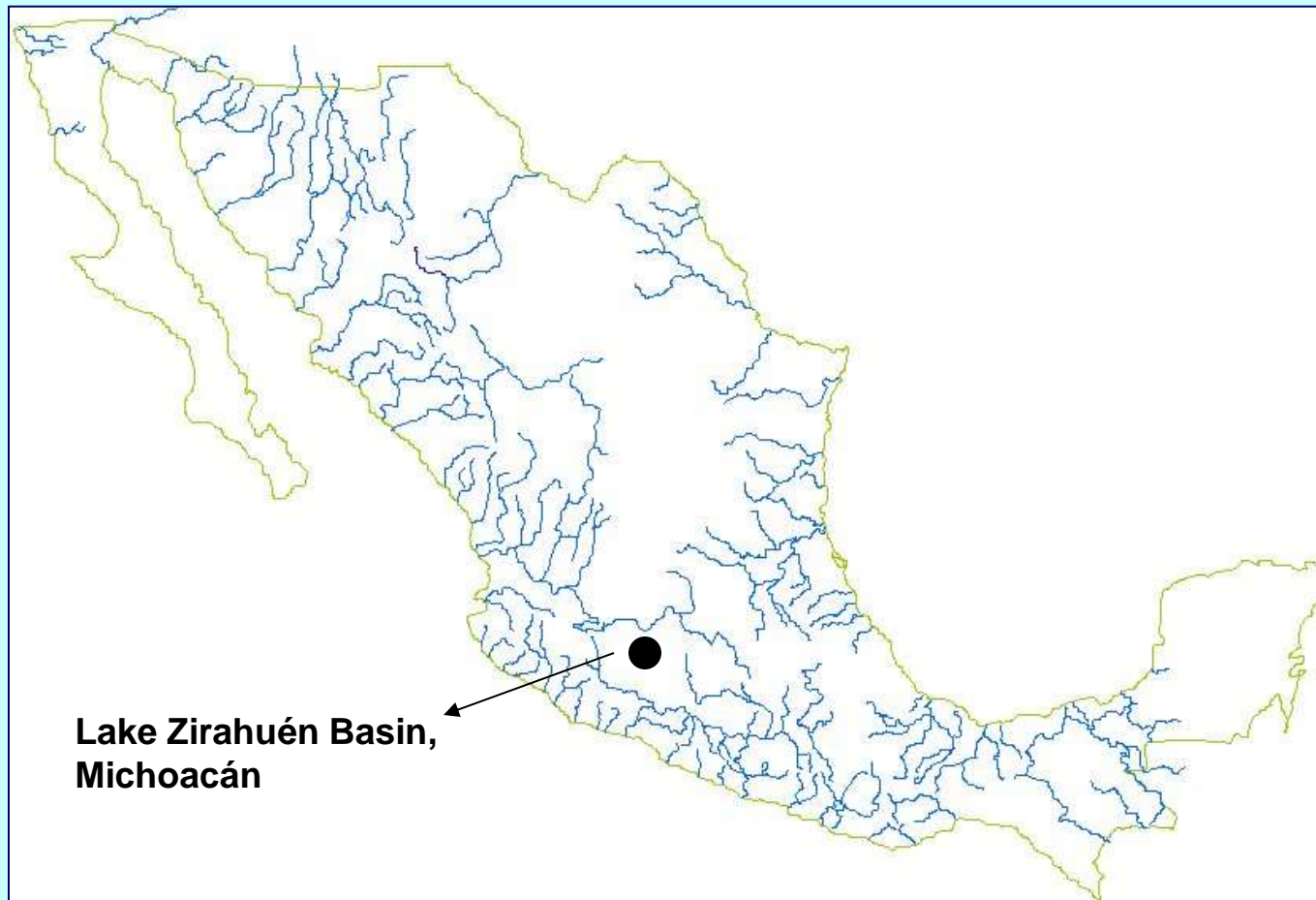


Quitupán River, Jalisco – present in 2004, gone by 2010; caused by exotic swordtail *Xiphophorus helleri*?



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

***The Bad: Allotoca meeki* (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

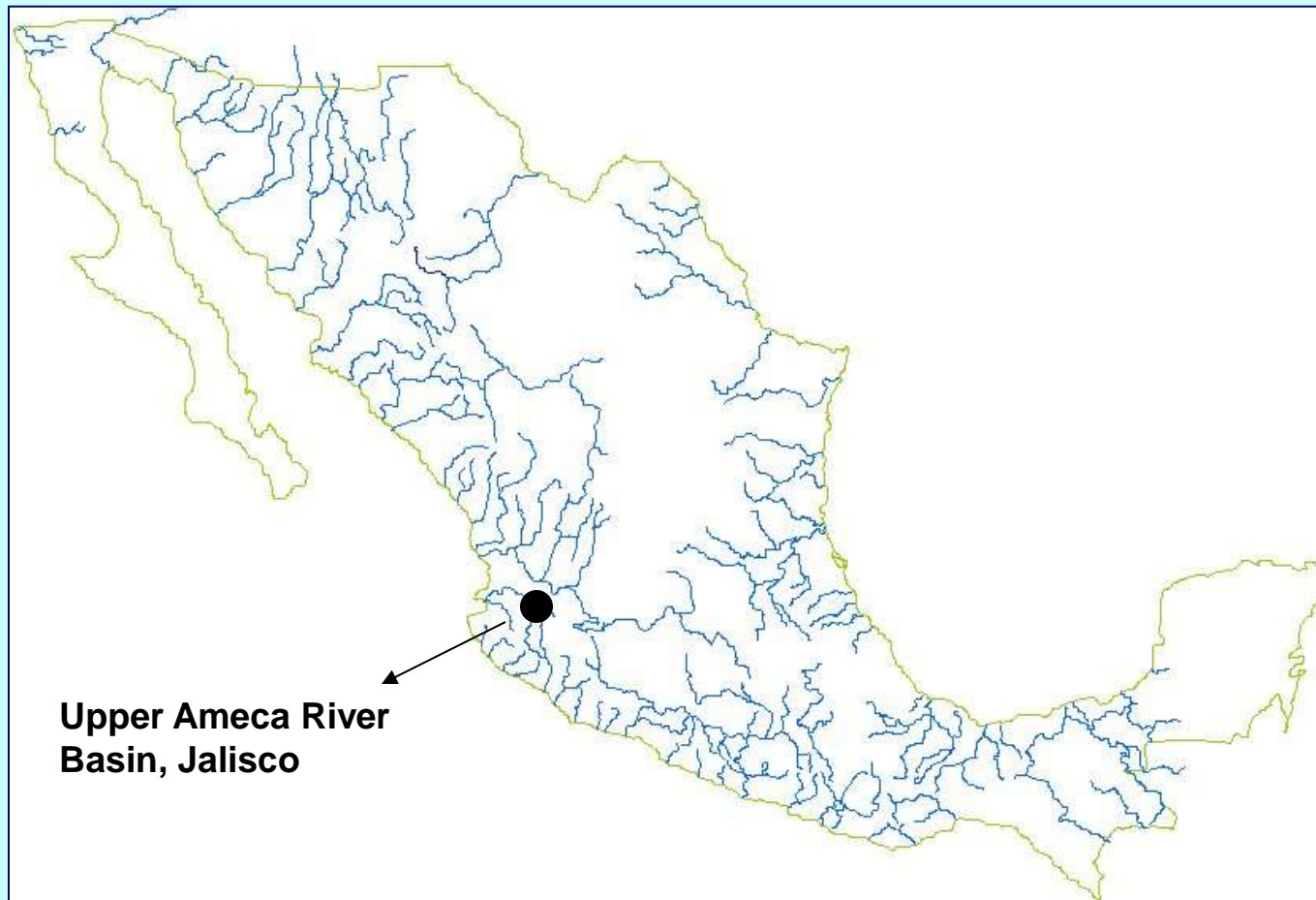


Mid 2000s, largemouth bass enter Lake Opopeo



By 2011, limited to Lake Opopeo outlet; rare

***The Ugly: Allotoca goslinei* (Extinct 2006?)**



Driven extinct by a non-native competitor (Ironically, another livebearer)



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



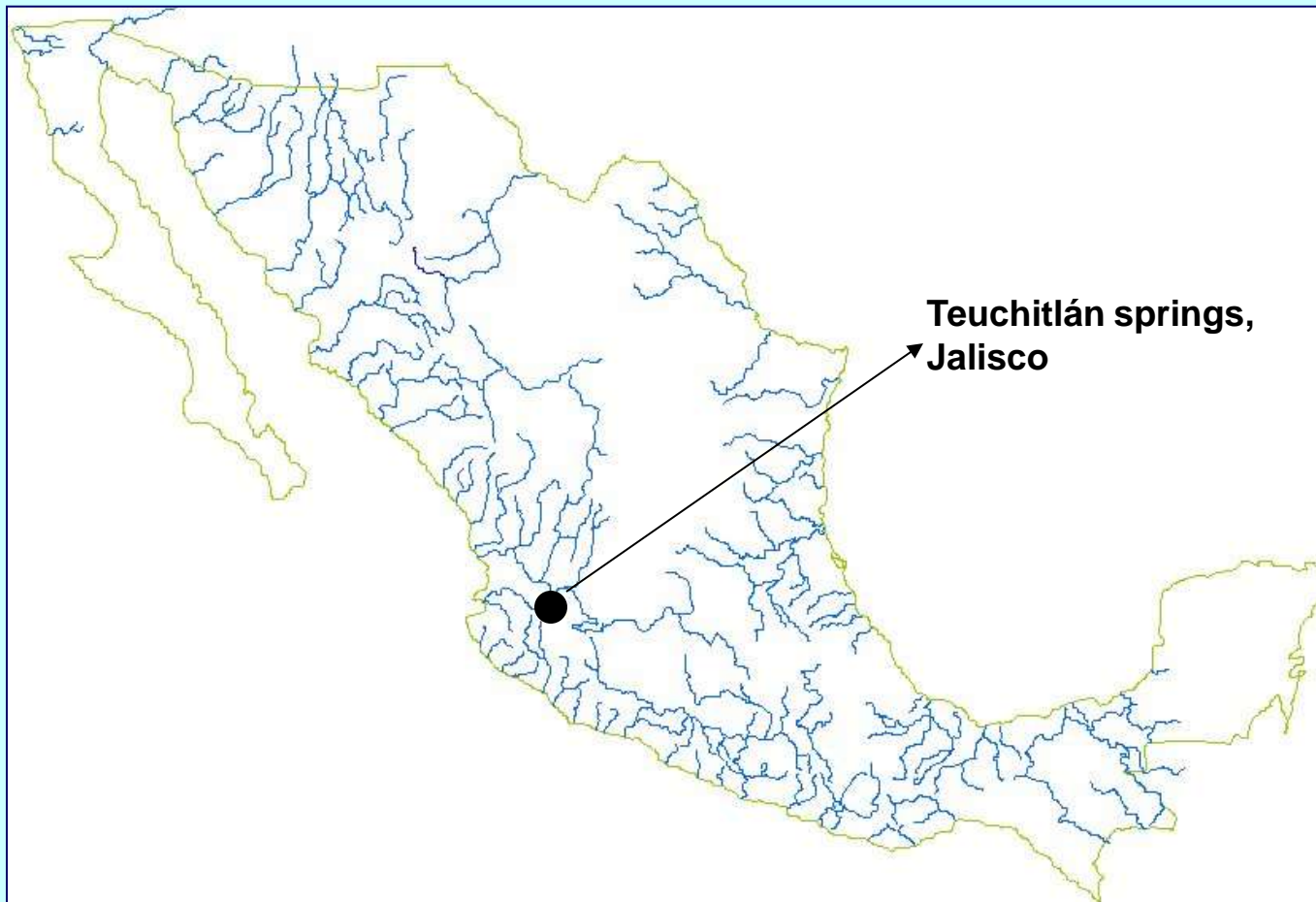
Xiphophorus helleri (green swordtail) invaded the stream between 2000 and 2004....

And *Allotoca goslinei* was 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

***The Ugly: Zoogoneticus tequila* (Extinct 2012?)**



Zoogoneticus tequila: Invasives/Habitat loss



As of 2008 limited to a tiny spring; 50 fish?



Drought in 2011-2012 dried the spring. Upon refilling *Heterandria bimaculata* invaded; **NO** **Z. tequila** in 2013-2016

Conserving Goodeids: What Can We Do?

1) Protect and restore wild habitats and populations



Characodon lateralis

2) Establish and maintain captive breeding colonies

4) How YOU, the Hobbyist Can Help

Few large professional facilities maintain Goodeids



← “Fish Ark” Aqualab Facility, Universidad Michoacana, Morelia, Michoacán, Mexico;

Haus des Merres, Aqua-Terra Zoo, Vienna, Austria →



Tanks of individual hobbyists are ESSENTIAL to keep Goodeids from extinction



Where Can I Find Goodeids?

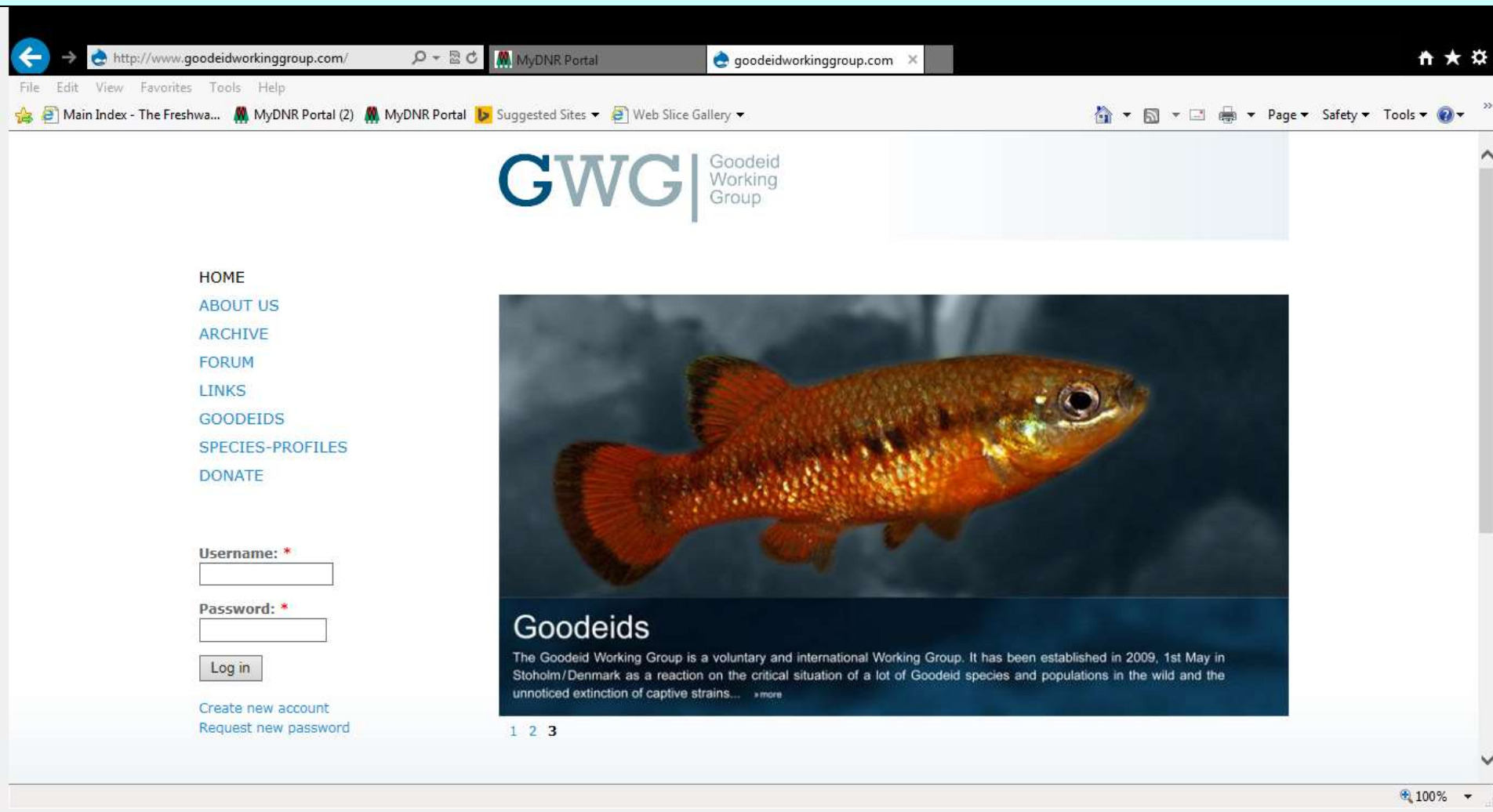


<http://www.livebearers.org/>

\$ 25/year

**Journal “*Livebearers*” and Trading Post;
Annual Convention with auction & sales
(April 28-May 1, 2016, South Bend, IN);
Large Network of Goodeid Hobbyists**

Within ALA : North American branch of *Goodeid Working Group (NAGWG)*



The screenshot shows a web browser window displaying the homepage of the Goodeid Working Group. The browser's address bar shows the URL <http://www.goodeidworkinggroup.com/>. The page features a navigation menu on the left with links to HOME, ABOUT US, ARCHIVE, FORUM, LINKS, GOODEIDS, SPECIES-PROFILES, and DONATE. Below the menu is a login section with fields for Username and Password, and a Log in button. A large image of a Goodeid fish is displayed, with the text "Goodeids" and a brief description below it. The description states: "The Goodeid Working Group is a voluntary and international Working Group. It has been established in 2009, 1st May in Stoholm/Denmark as a reaction on the critical situation of a lot of Goodeid species and populations in the wild and the unnoticed extinction of captive strains... > more". The page number "1 2 3" is visible at the bottom of the content area.

HOME
ABOUT US
ARCHIVE
FORUM
LINKS
GOODEIDS
SPECIES-PROFILES
DONATE

Username: *

Password: *

Log in

Create new account
Request new password

Goodeids
The Goodeid Working Group is a voluntary and international Working Group. It has been established in 2009, 1st May in Stoholm/Denmark as a reaction on the critical situation of a lot of Goodeid species and populations in the wild and the unnoticed extinction of captive strains... > more

1 2 3

<http://www.goodeidworkinggroup.com/>

Overall Conservation Goals of NAGWG

- Support conservation of Goodeids in Mexico in the wild and in captivity (*provide \$, technical support*)
- Foster captive maintenance of rare Goodeids by hobbyists (*provide guidelines, facilitate access to fish*)
- Educate the hobby about Goodeid conservation (*website, club presentations, ALA convention*)



Xenotoca melanosoma

GWG Captive Maintenance Guidelines

Preserve natural genetic, morphological, and ecological diversity within and among populations

1) Encompass within-population diversity and avoid genetic drift and in-breeding depression

2) Encompass among-population diversity and avoid out-breeding depression



Encompassing within-population genetic diversity

Keep large numbers of unrelated individuals

Conservation Biologists
recommend:
50-100 pairs (!!)

What can a hobbyist do?

Keep larger numbers of
fewer species.
Make exchanges among
breeders.
Supplement from wild
stocks if possible.



Encompassing among-population genetic diversity

Avoid mixing fish from distinctive populations

Conservation Biologists call
distinctive populations:

***“Evolutionarily
Significant Units” (ESU)***

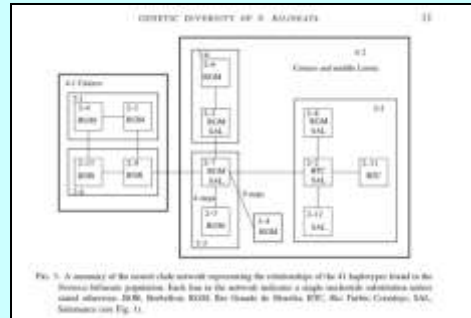
What can a hobbyist do?

**Know the ESU of your fish.
Keep different ESU's separate.
Avoid inter-breeding ESU's.**



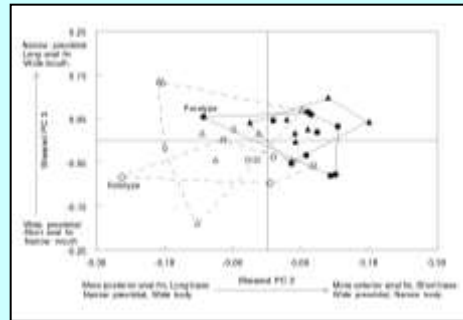
How do we define ESU's?

1) Molecular genetics



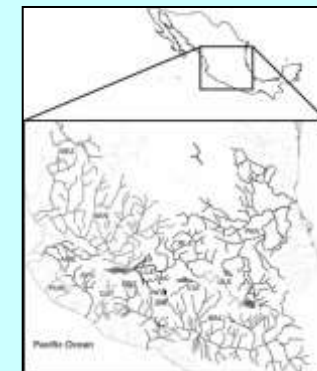
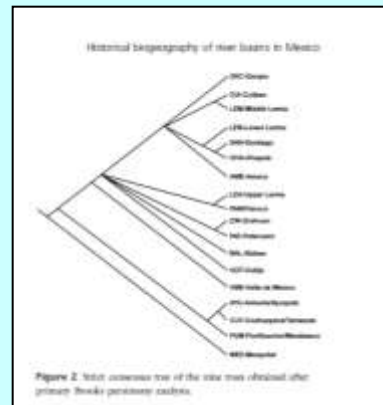
Ornelas García et al. 2012. Genetic diversity... *Neotoca bilineata*. J. Fish Biol. 79

2) Morphology



Lyons 1997 Morphological variation within *Xenotaenia resolanae*... Ichthyological Explorations Freshwaters 7:267-272

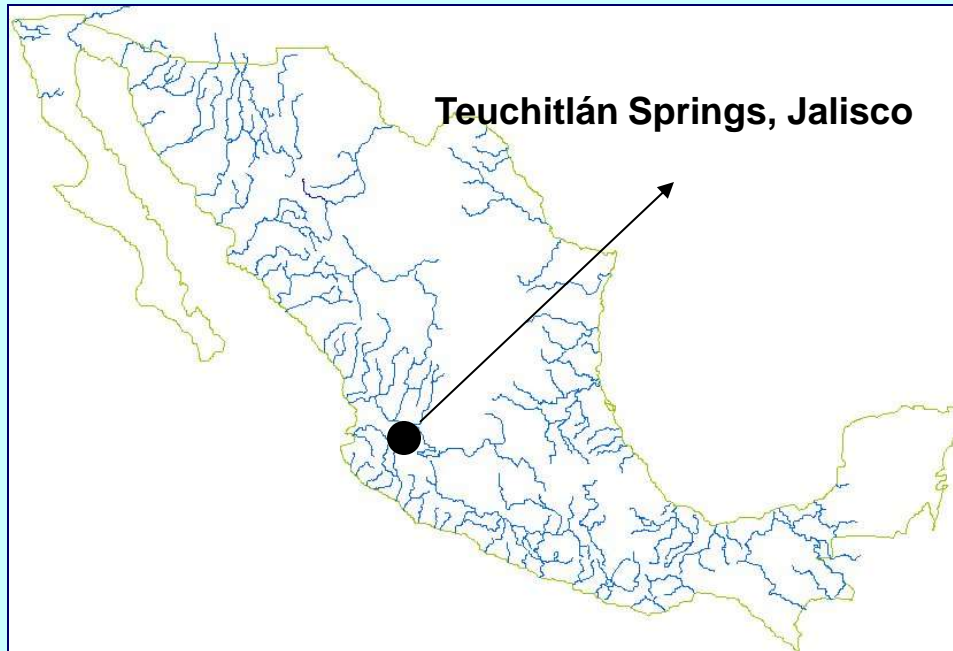
3) Zoogeography



Domínguez Domínguez et al. 2006 Historical biogeography of some river basins in central Mexico as evidenced by their goodeine freshwater fishes... Journal of Biogeography 33:1437-1447

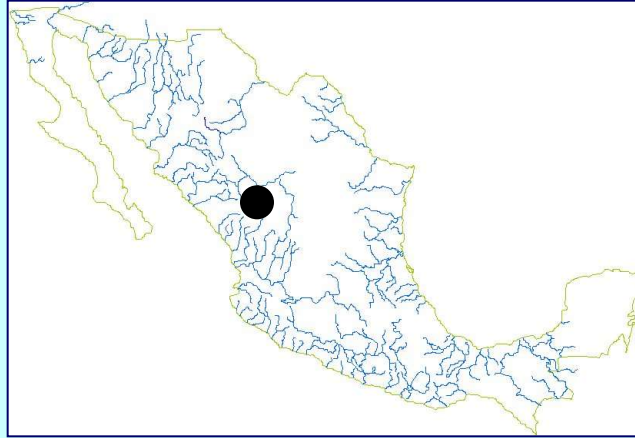
Many species have only one ESU

Often the wild populations are (or were) very small, already in-bred



Others highly differentiated – *Characodon*: 10 ESU's

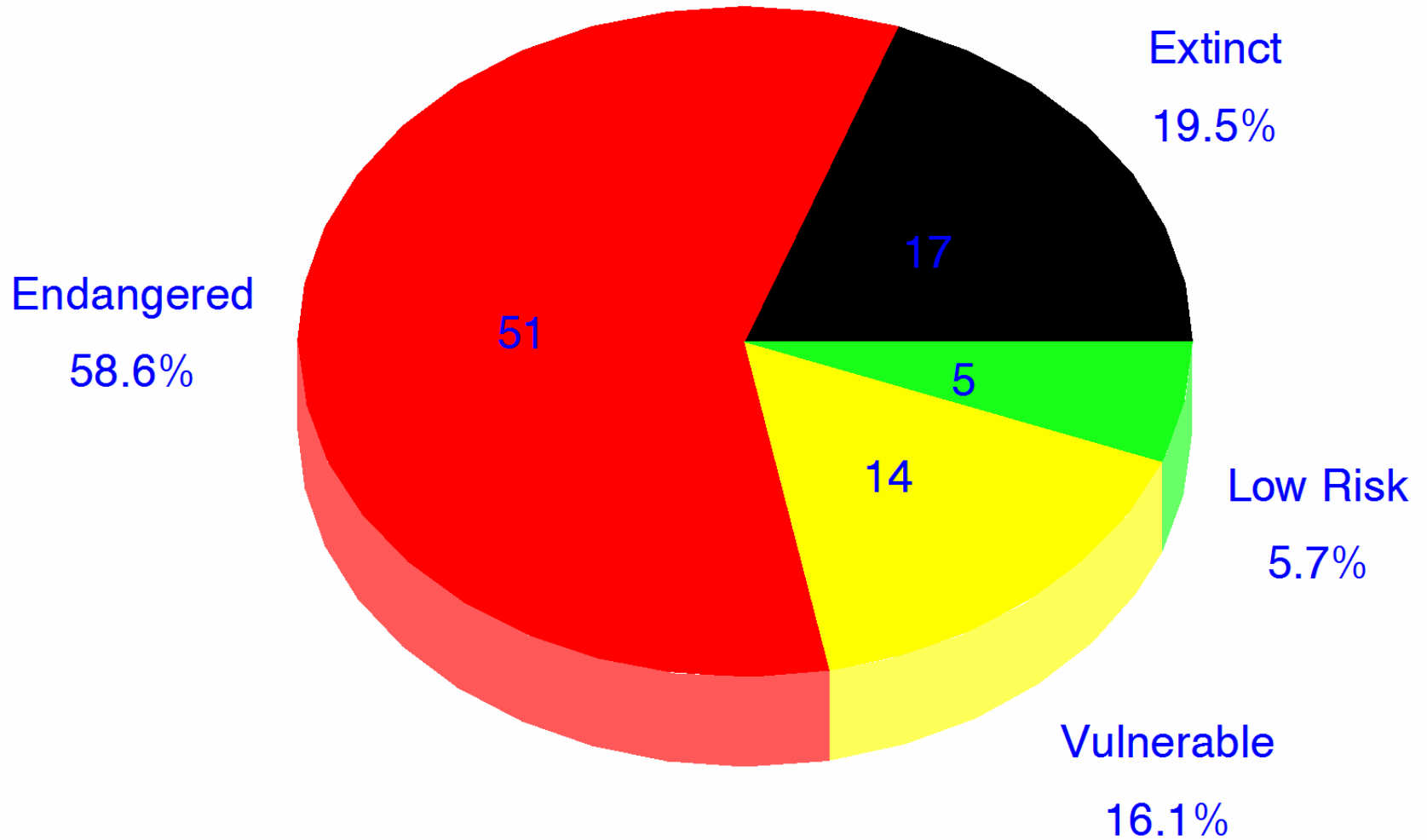
Each group of springs with a unique population



Isolated springs in upper Río
Mezquital basin, Durango



~ 87 ESU's: Most in serious trouble



Proposed NAGWG Captive Maintenance Objectives:

For overall NAGWG:

- Establish & maintain multiple populations of as many ESU's as possible
- Document & track status of captive populations for each ESU



For individual NAGWG members:

- Keep large populations of a few ESU's (rather than small pops of many)
- For each ESU, mix in new fish from other hobbyists & wild as possible
- Let others know what you have and share fish and knowledge
- Keep different ESU's separate; don't mix!!!

Summary and conclusions

- 1) Mexican Goodeids are in serious trouble in the wild
- 2) Captive rearing by hobbyists essential to conservation



Chapalichthys encaustus

- 3) Many challenges to maintain genetic diversity in captivity
- 4) 87 ESU's designated as template to preserve variation
- 5) Join ALA and NAGWG to help!

Questions?



Ilyodon furcidens

Habitat of *I. furcidens*; Río Ayuquila, Jalisco, Mexico