Year-long absence of an invasive species in Louisiana: current status of introduced tilapia

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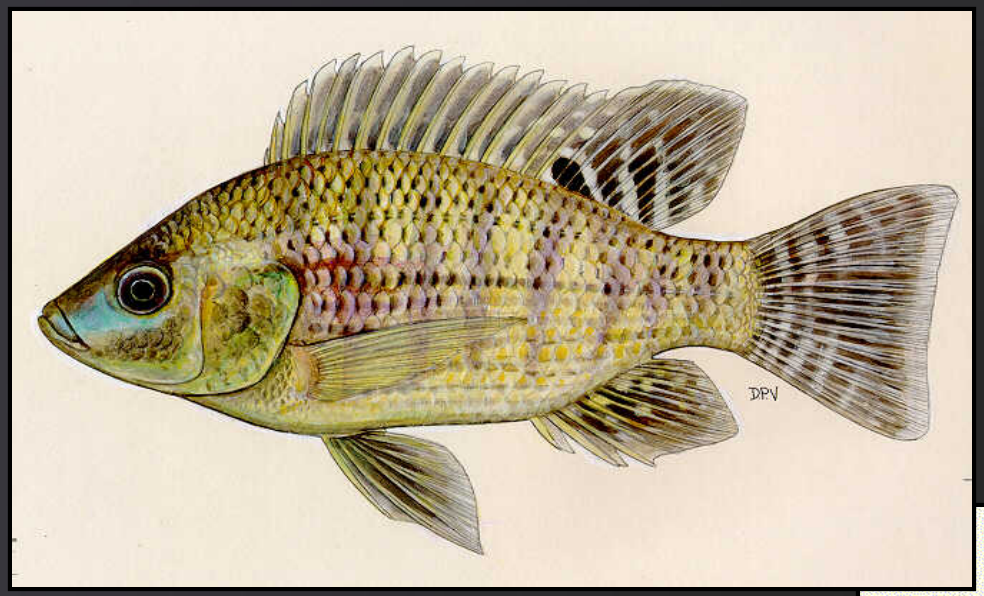
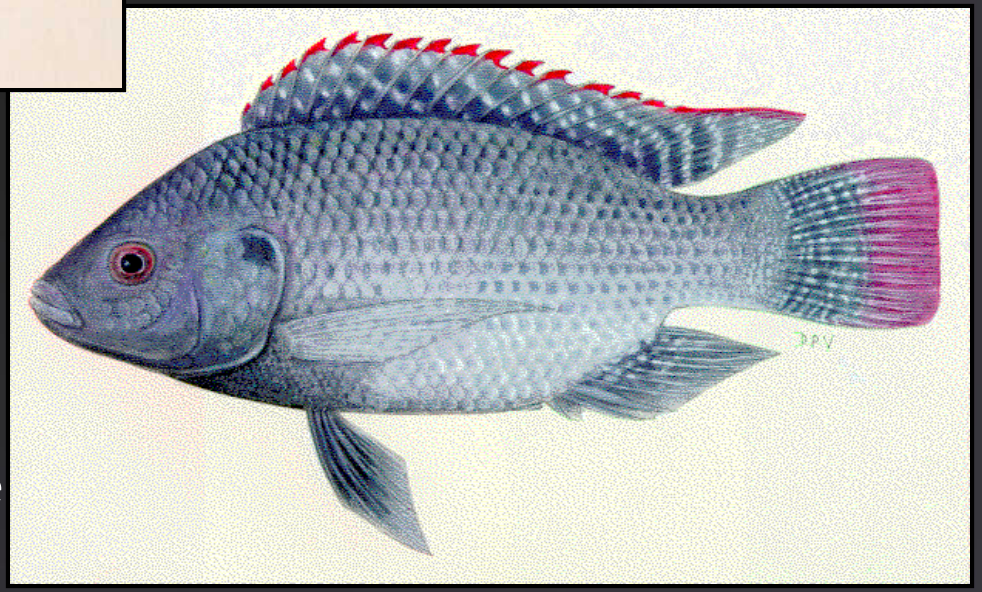
Background



← Cold tolerant

← Salt tolerant

↓



Oreochromis niloticus
X
Oreochromis aureus

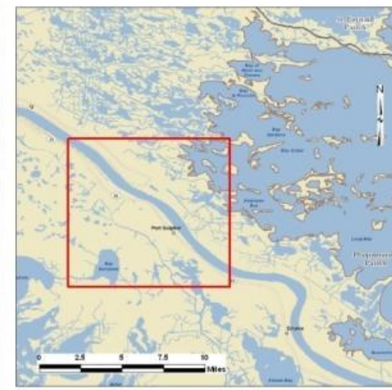
(LSU AgCenter School of Renewable Natural Resources)

Tilapia Sample Sites

Legend

Samples

- Absent
- Not Sampled due to Vegetation
- RG Cichlid
- Present
- Affected Waterbodies
- Tilapia Impact Zone
- State Highway
- Local Roads



Date: June 1, 2009
Author: S. Armand
Sources: LDWF, US Census, USDA NAIP Imagery, LDOTD
M:\InlandFisheries\PortSulphur\LDWF_Tilapiatreatment_spa45_060109.mxd

Rotenone treatment 2009

Canal: 1,039,518 tilapia

Borrow pits: 4,305 tilapia

Roughly 200,000
Rio Grande cichlids

Only one native Lepomis (INDIVIDUAL) recorded

Marsh side of pumps: mostly native fish, a few tilapia

Restocking Efforts

- Most fishes were collected from various areas in the Atchafalaya Basin and the Bonnet Carre spillway
- Approximately…

40 bowfin

360 alligator gar

4,530 catfishes

300 spotted gar

760 sunfishes

115 largemouth bass

… were stocked into the Port Sulphur canal July through August (2009)

Two cold winters

- January 2010 - Freezing temperatures in Port Sulphur
- January and February 2011 – water temperatures similar to previous year (7-10 degrees C)

Location	Date	Water Temp (°C)	Salinity (ppt)
Canal	1/6/2010	6	-
Drain Pipe	1/6/2010	12	-
Canal	1/9/2010	4	-
Drain Pipe	1/9/2010	9	-
Canal	1/11/2010	6	2.2
Drain Pipes	1/11/2010	13	1.7
Marsh	1/11/2010	6	4.9

Temperature Tolerance

- Lethal limits between 6-8 degrees Celsius
- Disoriented at 10 degrees Celsius
- Recovery after exposure to cold dependent on time

Hours at 10 °C	Mean temp (SD)	# recovered	# dead
48	9.4 ± 0.3	10	2
96	8.9 ± 0.2	1	11
96	9.5 ± 0.2 C	2	10
144	10.1 ± 0.3	7	5
144	9.49 ± 0.2	0	12

Courtesy of Dr. Chris Green, Louisiana State University, Ag Center

Native success

- Recruitment of stocked *Lepomis* observed soon after stocking (late 2009)

- Native small fishes repopulated rotenoned areas
  - *Cyprinodon* first, then *Gambusia* and *Poecilia*
  - Repopulated from where??

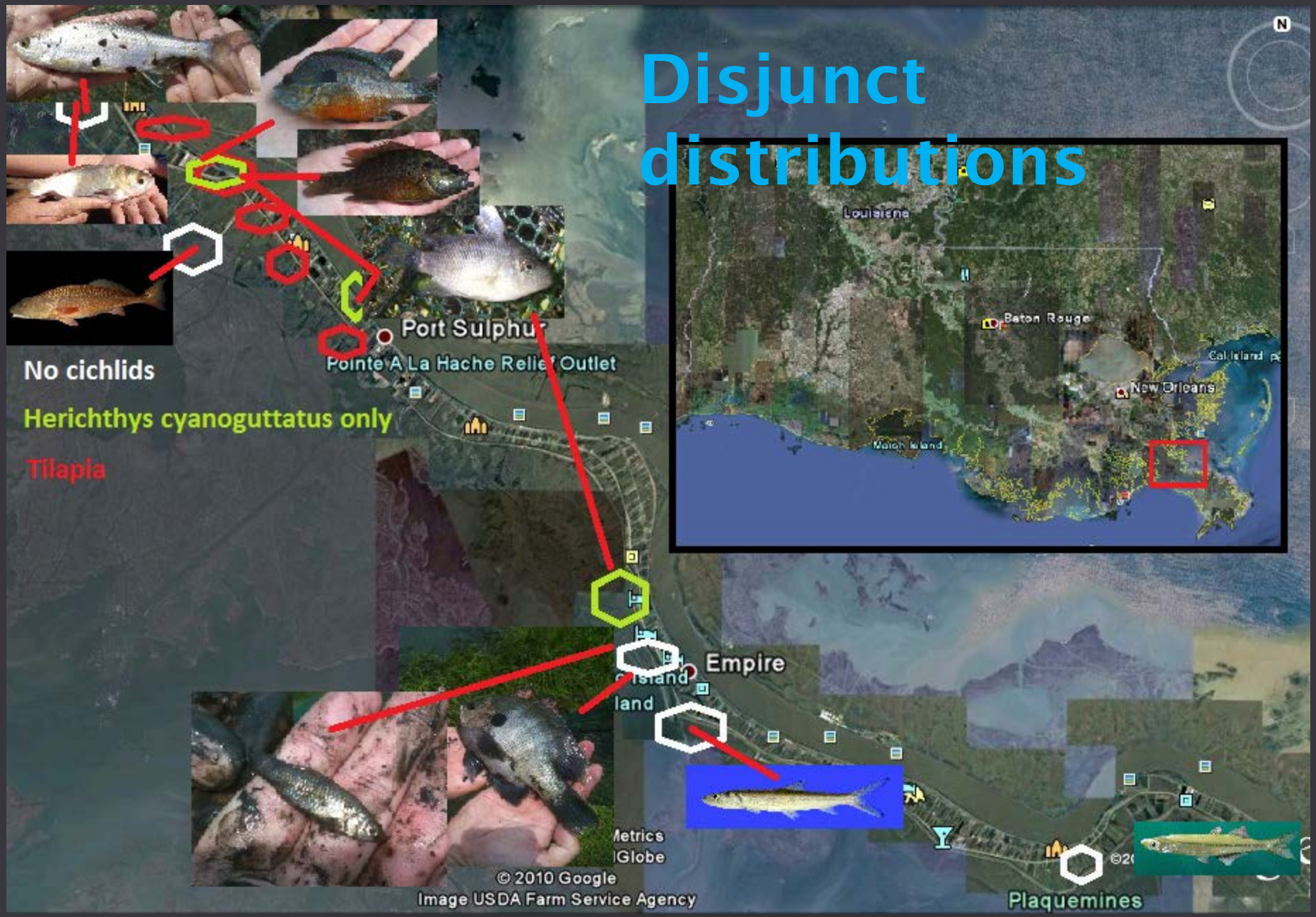
- Other species observed to reproduce: *Ameiurus*, *Micropterus*

- Habitats outside of rotenone zone had a variety of communities (tarpon, ladyfish, brackish species, coppernose bluegill, Rio Grande cichlids, silver carp…)

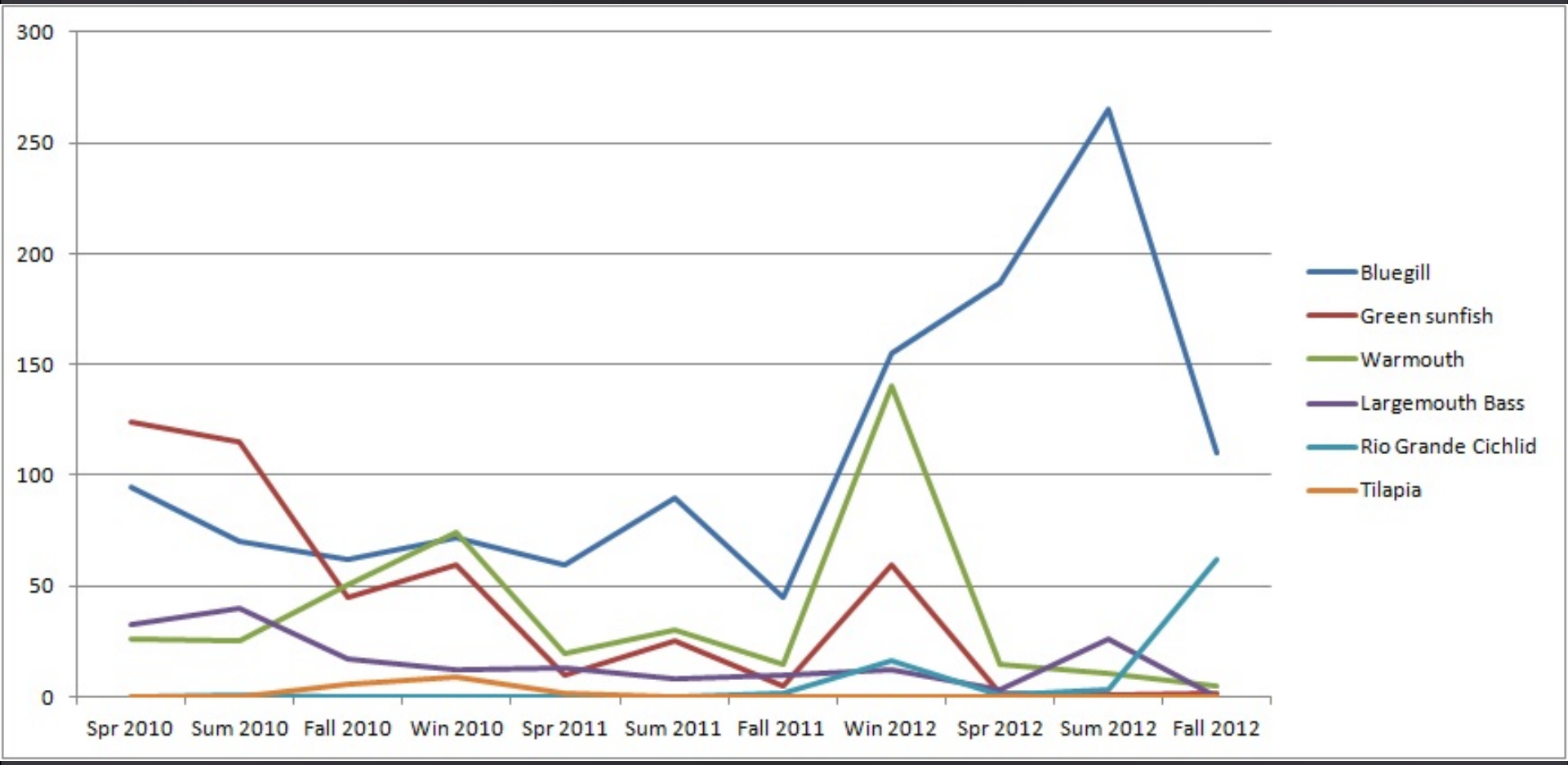
Recent Tilapia Captures

Tilapia caught after 10 months of no tilapia.
Striped Mullet also appeared at this time (?)

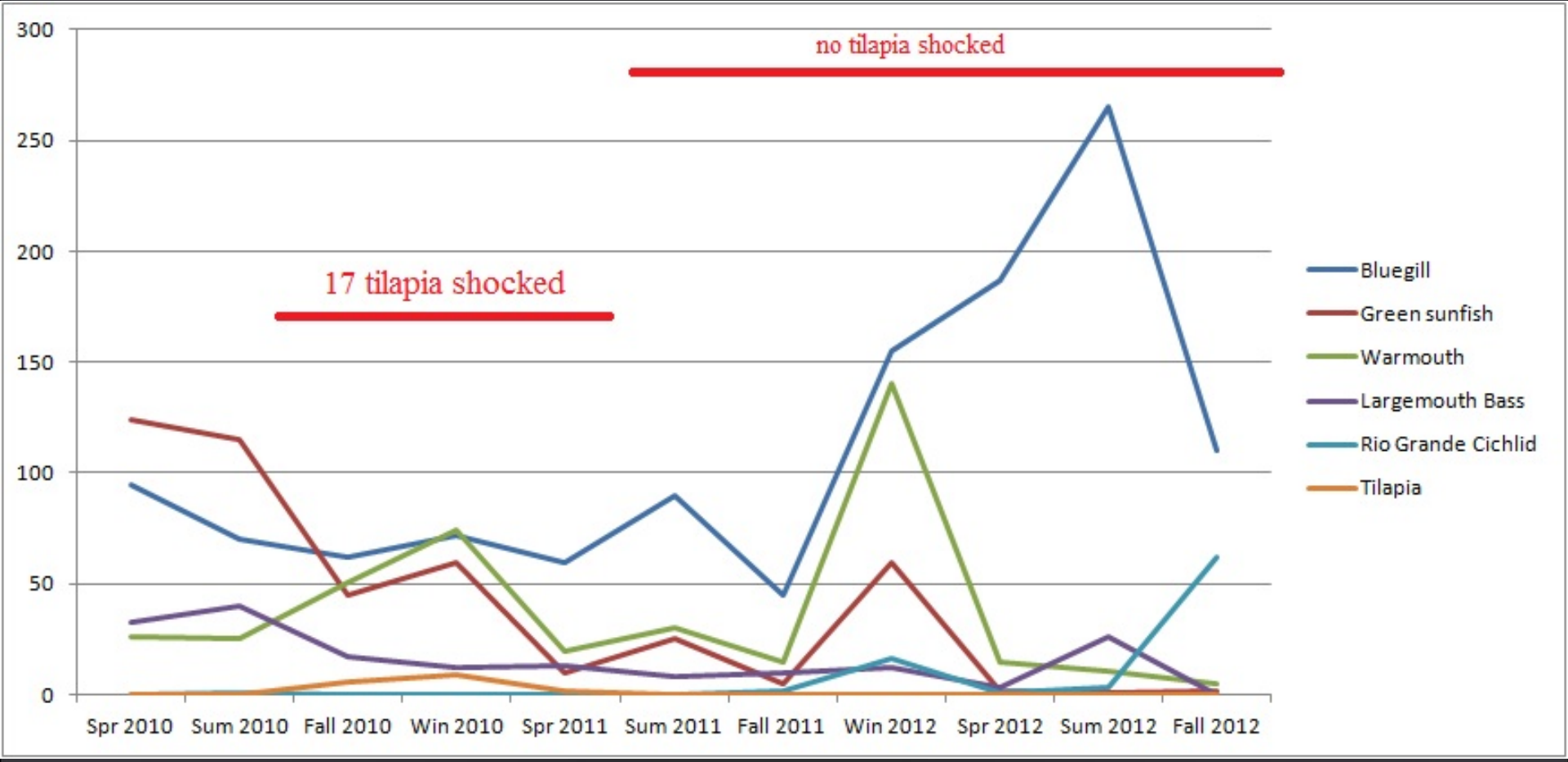
Entire study area


Disjunct distributions
No cichlids
Herichthys cyanoguttatus only
Tilapia
Port Sulphur
Pointe A La Hache Relief Outlet
Louisiana
Baton Rouge
New Orleans
Empire
Plaquemines
© 2010 Google
Image USDA Farm Service Agency

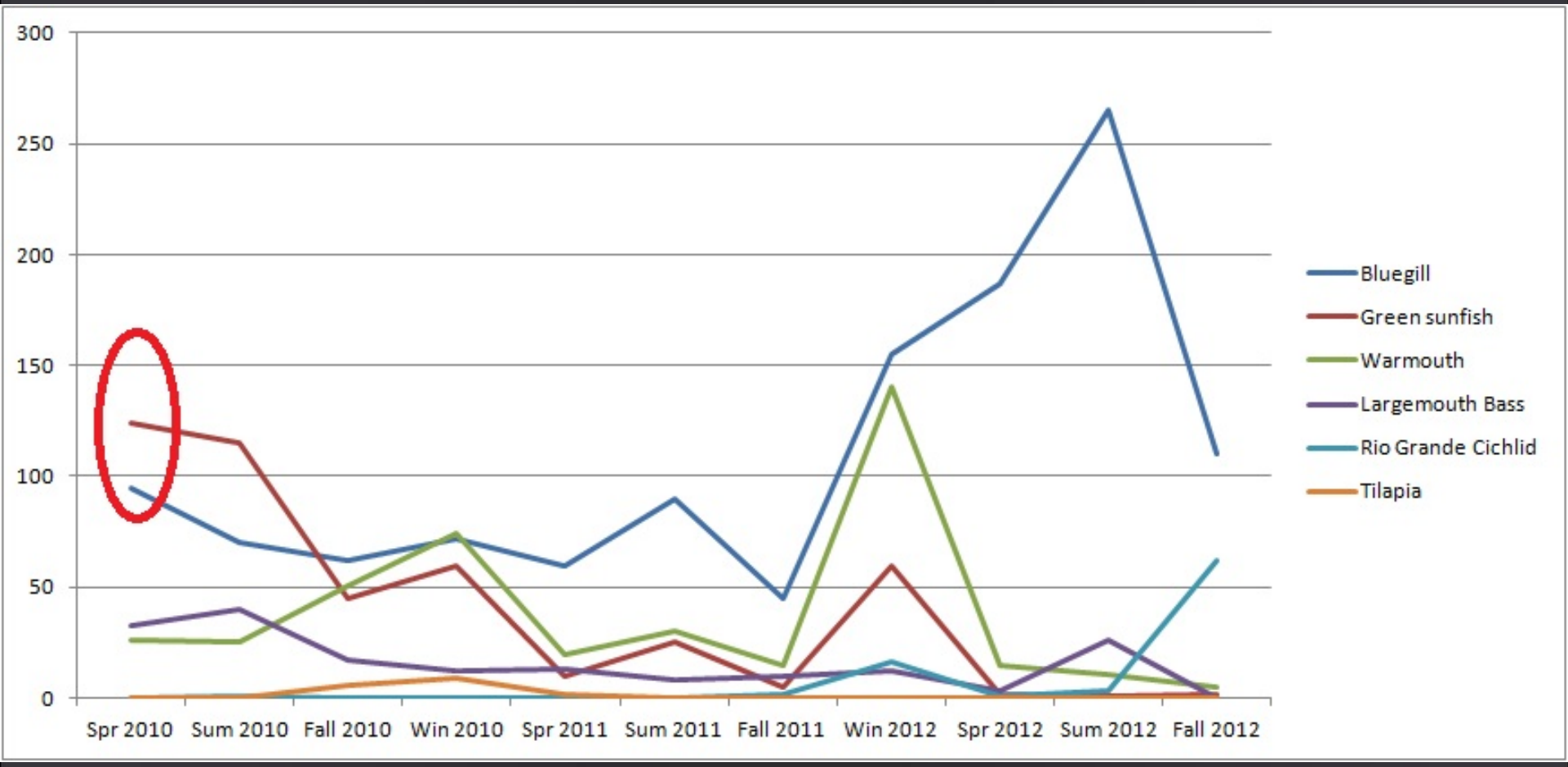
Centrarchids and Cichlids
Hwy 23 Canal (2010-2012)



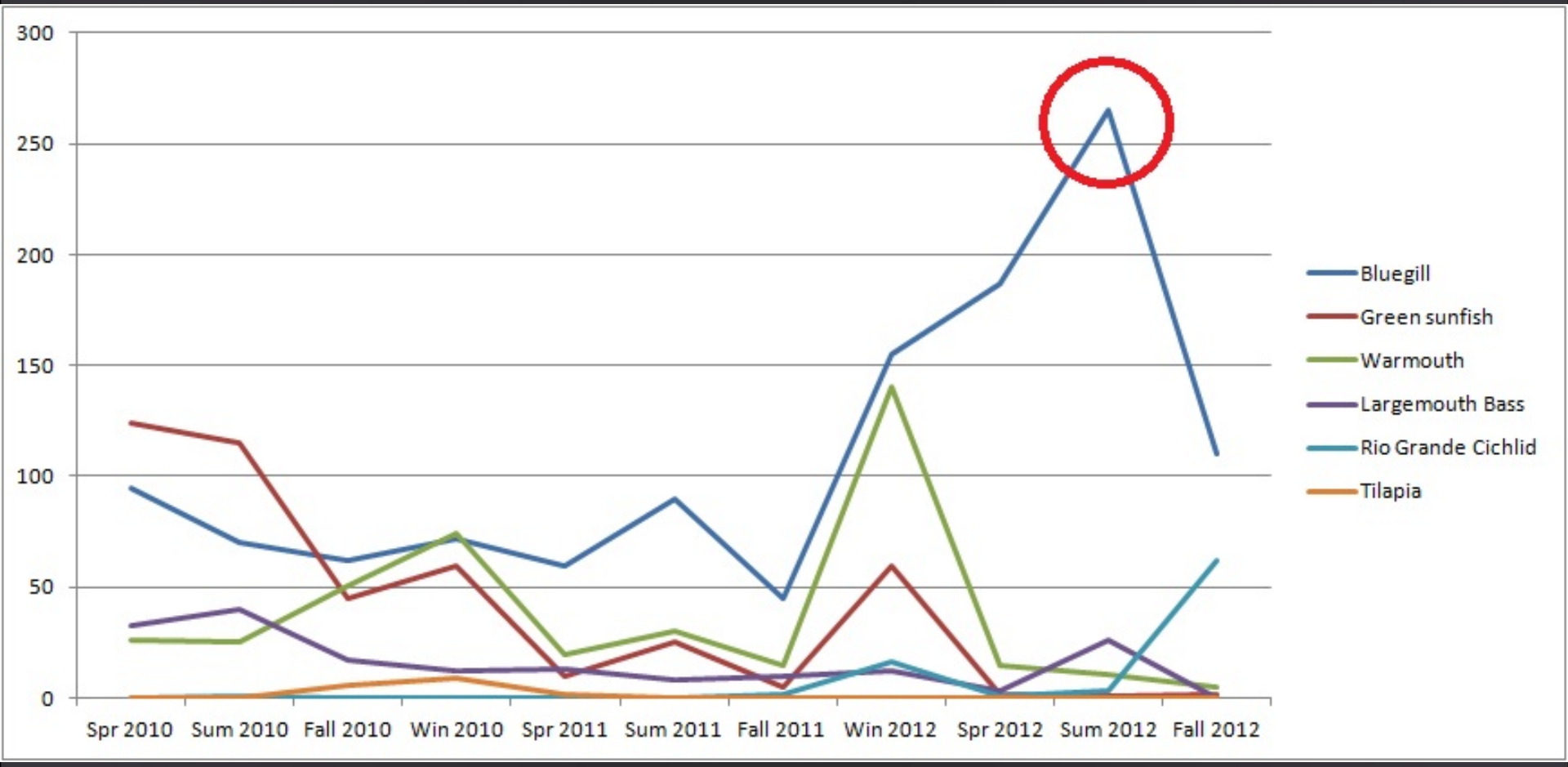
Tilapia (*Oreochromis*) from 2010-2012



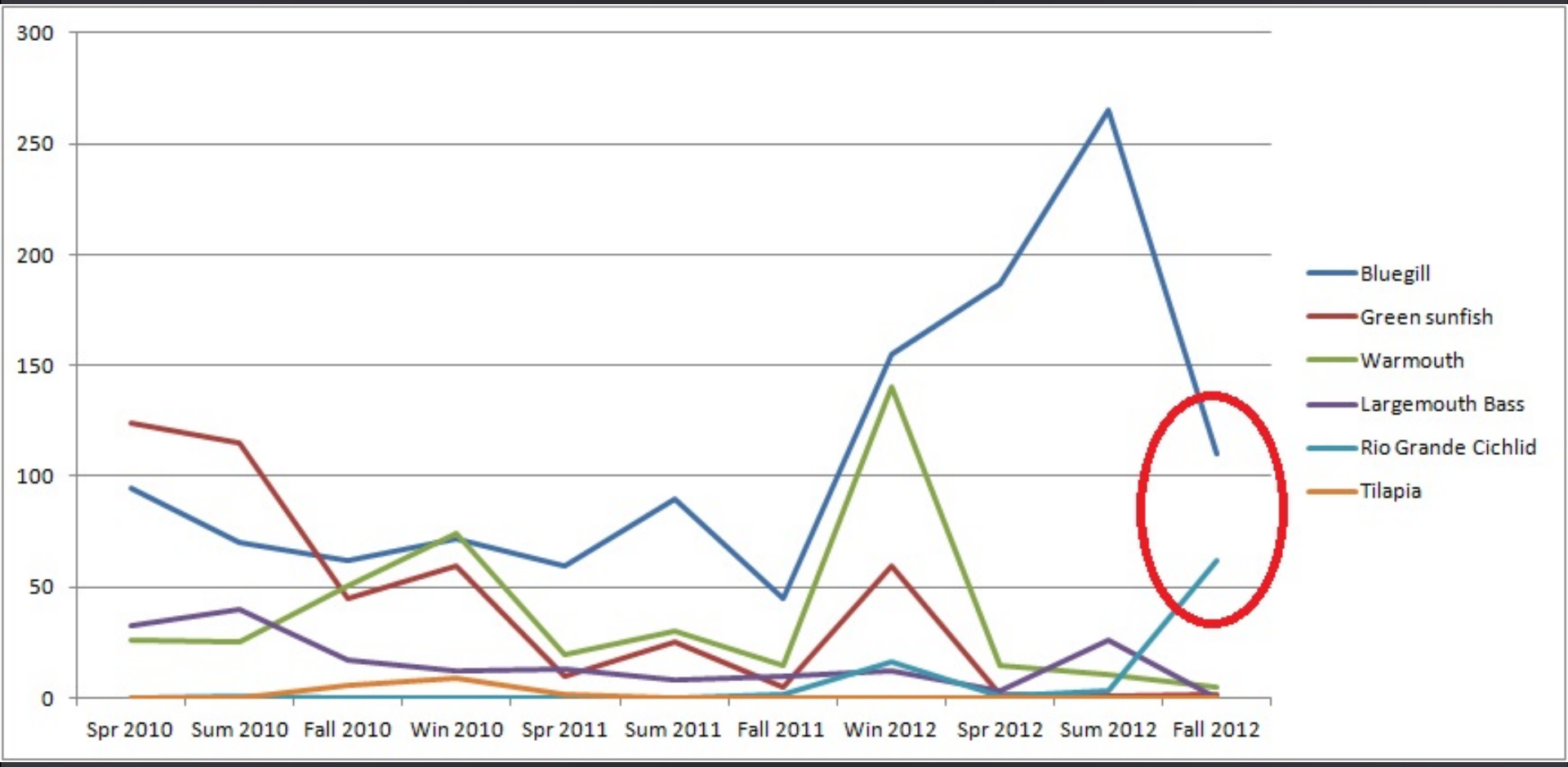
Initial abundance of green sunfish (*L. cyanellus*)



Eventual dominance of bluegill (*L. macrochirus*)



Post-Isaac jump in Rio Grande cichlids (*Herichthys cyanoguttatus*)



Tilapia in 2009-2010

- **2009**
- Two tilapia were caught in December (before extreme cold)

- **2010**
- Several were observed in October that evaded capture by electroshocking

- Caught in temperatures below 10 degrees C.

- mature fish (developed gonads), relatively healthy condition (higher than 2009), large amounts of fat bodies, even in December
- Both males and females captured.

- Rio Grande cichlids in rotenone area also caught at this time (Fall/Winter 2010)

Tilapia in 2011-2012

- **2011**
- Two individuals caught in April, Zero in a July sample
  - There was no funding from January 2011 through Oct 2011

- Tropical Storm Lee flooded area in September

- No tilapia caught since April 2011

- **2012**

- ZERO tilapia caught, seasonal sampling includes 3 sites within the original tilapia range and at least 3 outside of this range
  - This sampling has been done October 2011-August 2012

- Rio Grande cichlids caught consistently in small numbers
  - Except for one pond that was never treated (has ONLY cichlids)
  - Numbers suddenly rose after Isaac
- Post-Isaac… Flooding and Rios good and bad (City Park/Arabi)

R.I.P. tilapia in Louisiana?

Reasons for optimism

- 18 months with no tilapia seen or reported
- sampling has been most intense and efficient (and in the most locations) in the last 12 months.
- also, some cichlid avoidance of electrofishing has been observed. However, Rio Grande cichlids are being shocked up
- Many factors worked against tilapia (managed and natural)…

R.I.P. tilapia in Louisiana?

Possible causes

- Rotenone
  - reduced numbers to a level that was either difficult to recover from, or susceptible to biotic/abiotic factors
- Stocked Fish
  - Stocked fish increased in numbers and had multiple reproductive events for several species (all *Lepomis*, *Micropterus*, gar, catfish, etc.)
  - Aggressive and predatory fish were chosen
- Cold
  - Two of the coldest winters occurred immediately following eradication.
  - Rio Grande cichlid numbers in the state dramatically decreased during this time (without any other management)
- Bottleneck effect?
  - Either from rotenone, from initial stock, or both
  - In lab, one quarter of all F1 offspring have gill deformities

R.I.P. tilapia in Louisiana?

Noteworthy

•They were caught after rotenone treatment and before the first cold winter (December 2009)

•They were caught after the two cold winters (including one fish with eggs in her mouth).

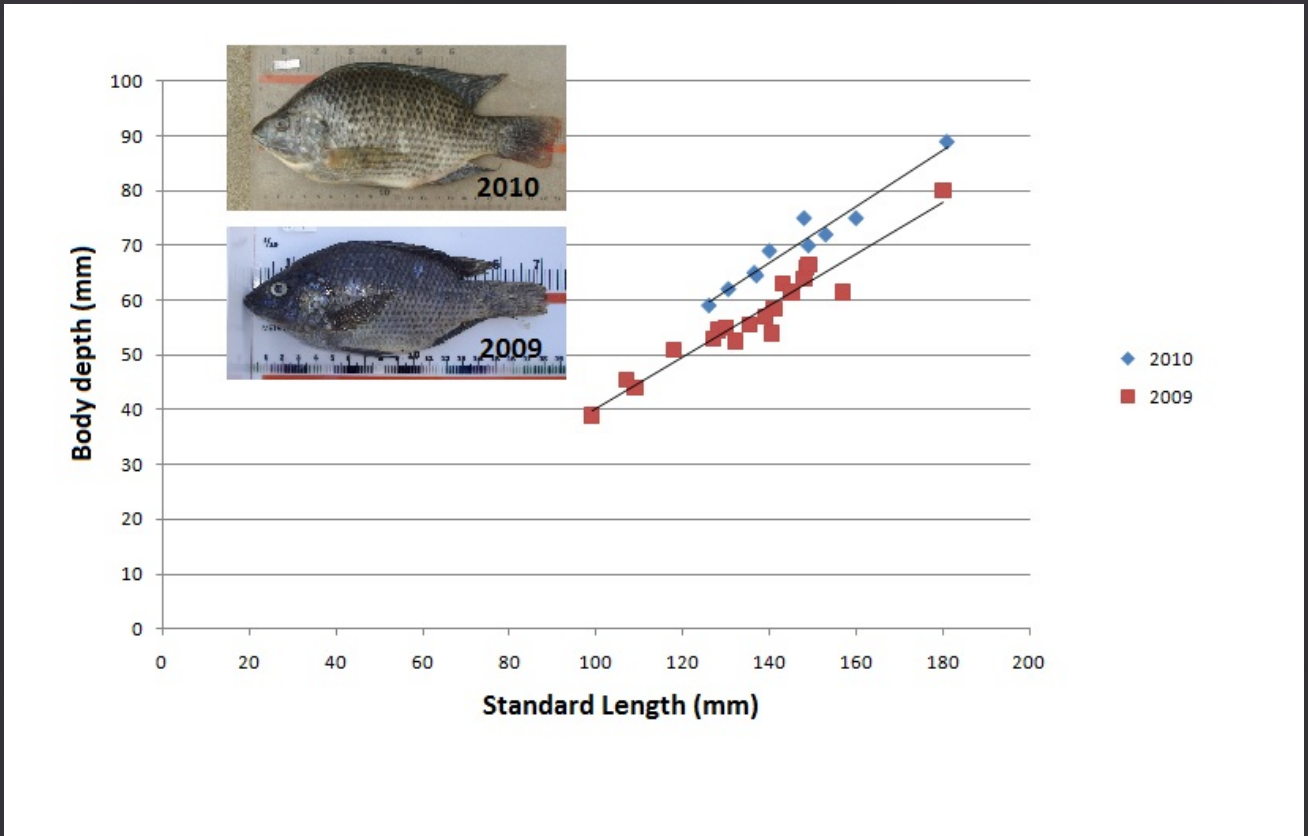
•The next winter (2011-12) had temperatures 10 degrees WARMER. (20 degrees Celsius in January)

•Rio Grande Cichlids were absent in 12 months of samples and have now resurfaced.

•Flooding from Tropical Storm Lee and Hurricane Isaac mean that bodies of water have been connected multiple times.

•Can we know what happened to them?
•Evidence is difficult to come by, but there was one significant change between tilapia before and after eradication efforts…

Morphology change in tilapia



- Body-height/Body-length of pre-rotenone tilapia
  - Always less than 45%
- Body-height/Body-length of 2010 tilapia
  - Always greater than 45%

Some associated with project (Ph.D.s, field experts) even had trouble identifying these fish

2009

2010

Reasons for body depth change

Unfortunately, this isn't exactly a smoking gun

Body depth changes can occur for a number of reasons

Stocking of predatory fish has been shown to affect body depth, and swimming performance in prey fish (carp with pike, Domenici et al. 2008)

Body depth can also be affected by condition

- 2009 tilapia were overcrowded
- 2009 tilapia were reproducing heavily
- It is possible that this is why they were less 'deep-bodied'

Future research

Monitoring is ongoing until funding ends in August 2013

Sites within and outside of the rotenoned areas will continue to be monitored

Management plans should be considered if populations return

- in particular if there appears to be a tie to Rio Grande cichlids "paving the way" (invasive meltdown theory)

- Possible plans? More predatory stocking
  - Bluegill are now dominant stocked fish
  - Bluegill are least piscivorous of large fish stocked
  - Rotenone if necessary

Cooperators

- Dr. Martin O'Connell
- Chris Schieble
- Louisiana Department of Wildlife and Fisheries
- Volunteer field help (Manalle Al-Salamah, Sierra Riccobono, Lyndon Coghill, Patrick Smith)