

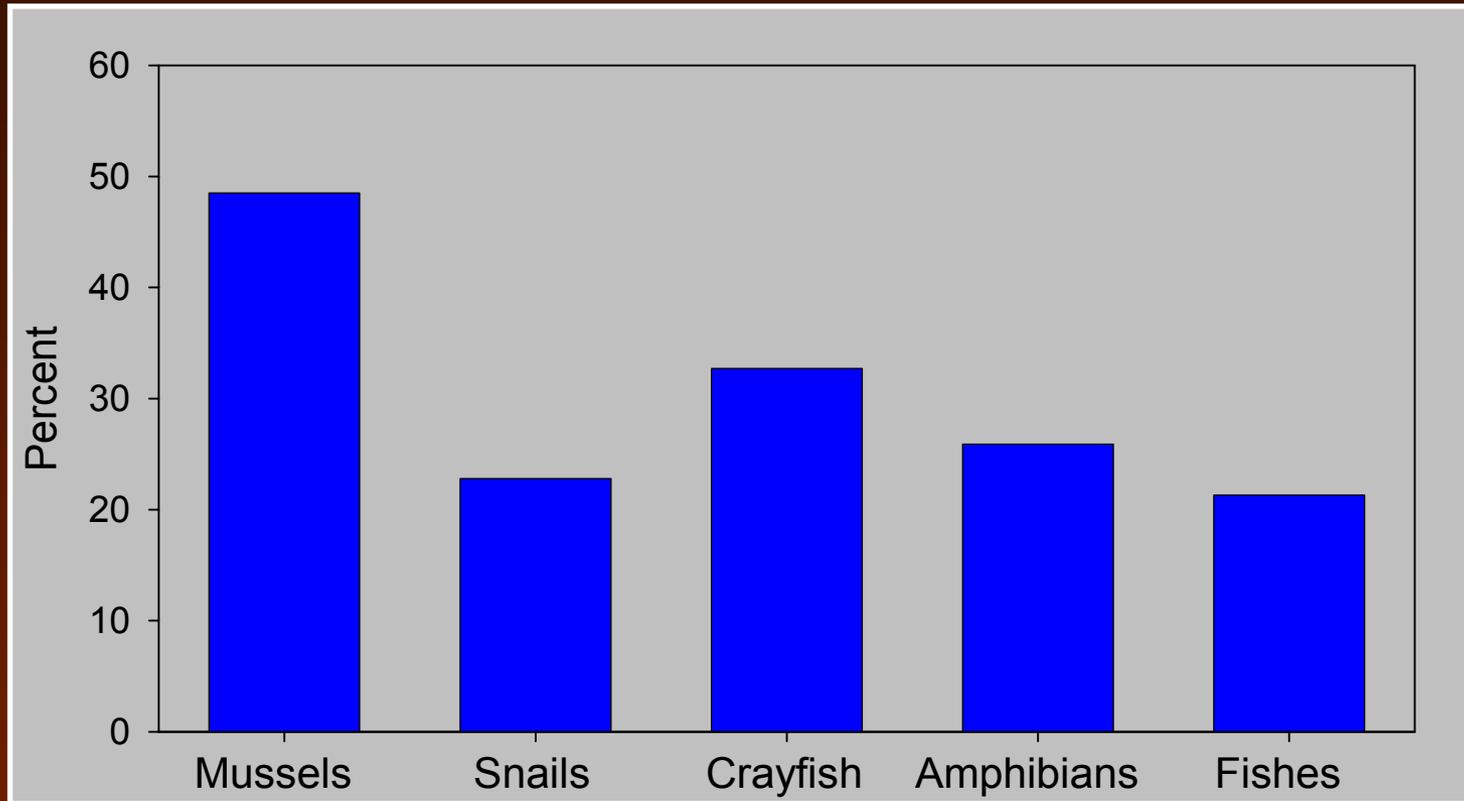
The Effects of Extended Low-Flows On Freshwater Mussels In the Lower Flint River Basin, Georgia

S.W. Golladay, P. Gagnon, M. Kearns, J. Battle, and
D.W. Hicks

J. W. Jones Ecological Research Center, Newton GA



Imperiled North American Freshwater Animal Species



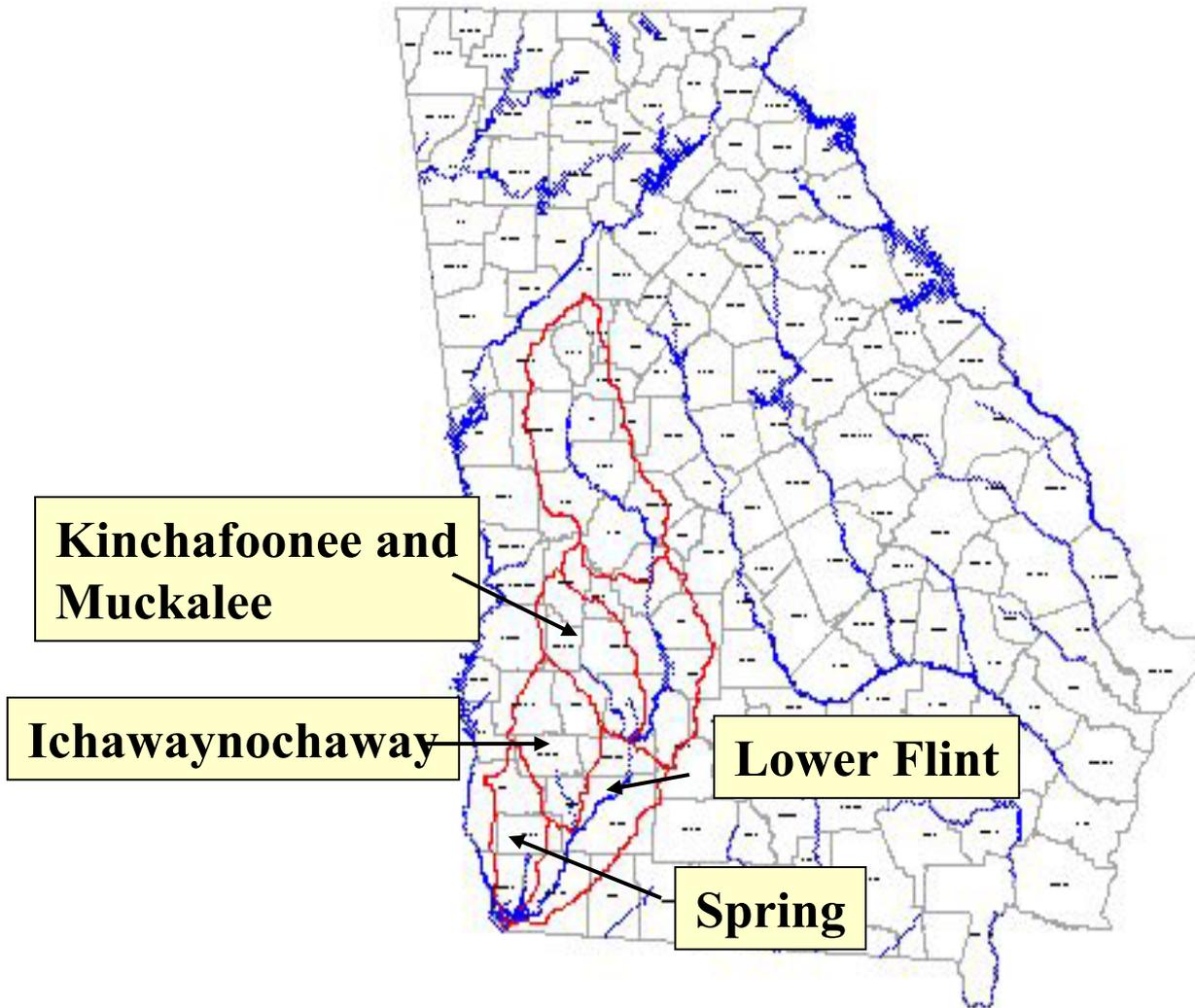
Imperiled = Threatened or endangered throughout their historical range. Ricciardi and Rasmussen. 1999. Conservation Biology 13: 1220-1222.

Southeastern Mussel Diversity

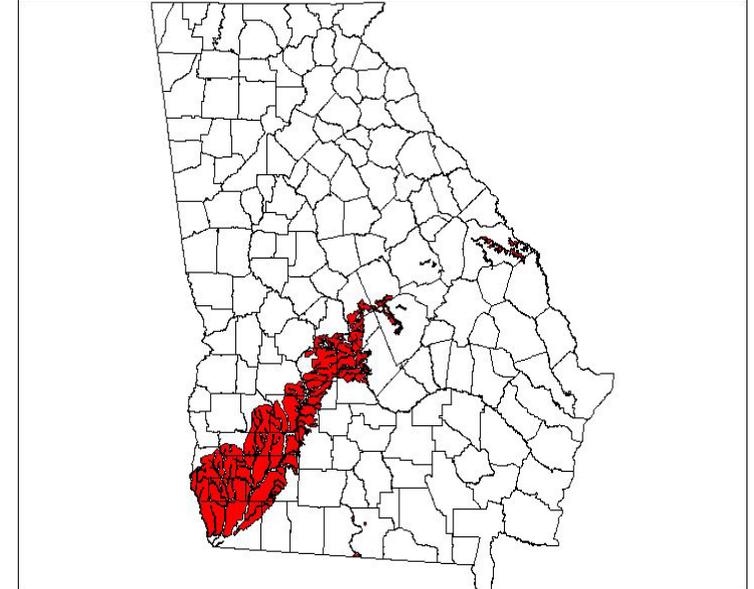
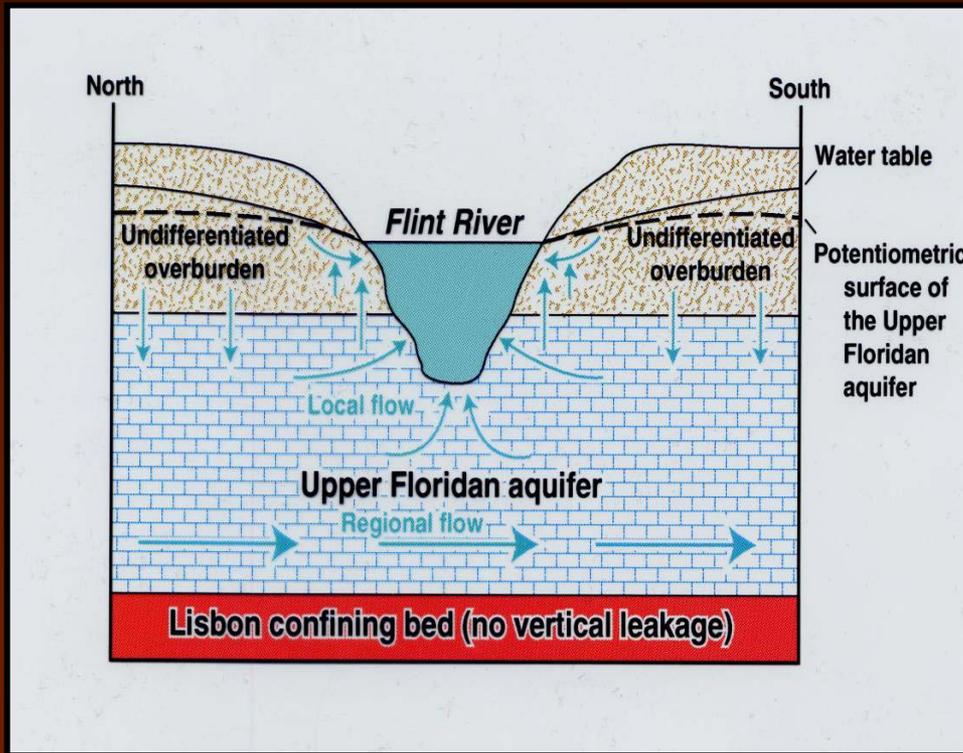


Neves et al. 1997. Status of aquatic mollusks in the southeastern US: a downward spiral of diversity. In George W. Benx and David E. Collins editors. Aquatic Fauna in Peril: the Southeastern Perspective. Lenz Design and Communications, Decatur, GA. 554 pp.

Mussel Studies in the Flint River Basin



Regional Geology

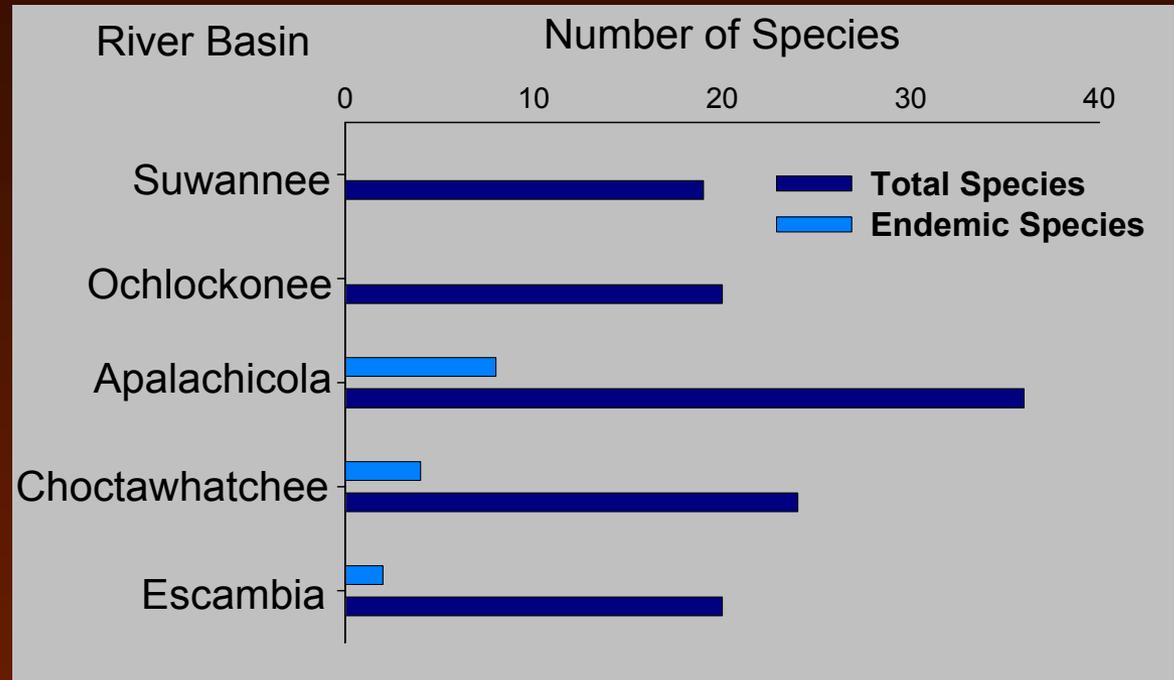
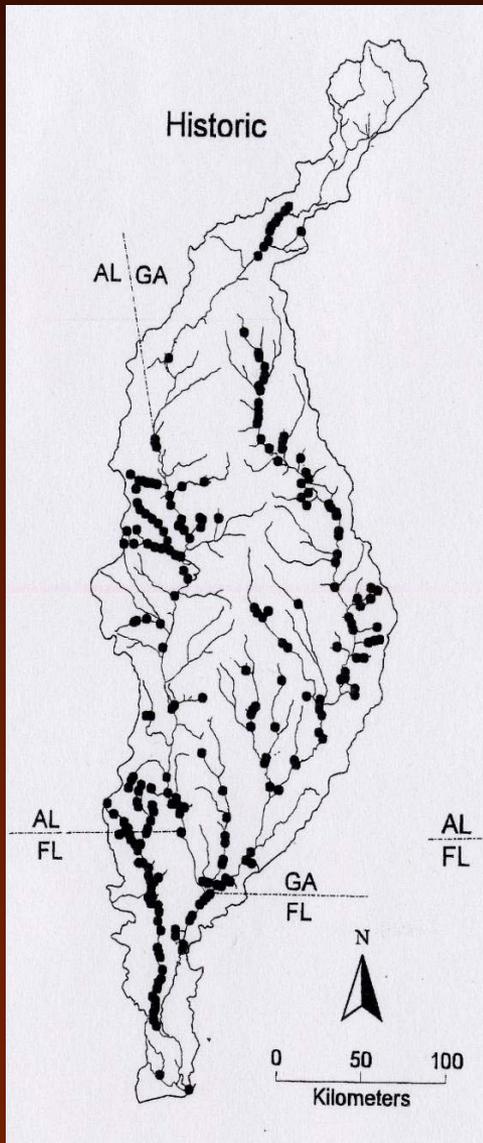


County
Floridan

Upper Floridan Aquifer

Flint River Mussel Studies 1950's

W.J. Clench and R.D. Turner



- Recognized high diversity of the Apalachicola River Basin
- Summarized localities of type specimens
- Noted declines in the Chattahoochee river

Flint River Mussel Studies 1991-1992

J. Brim Box and J.D. Williams

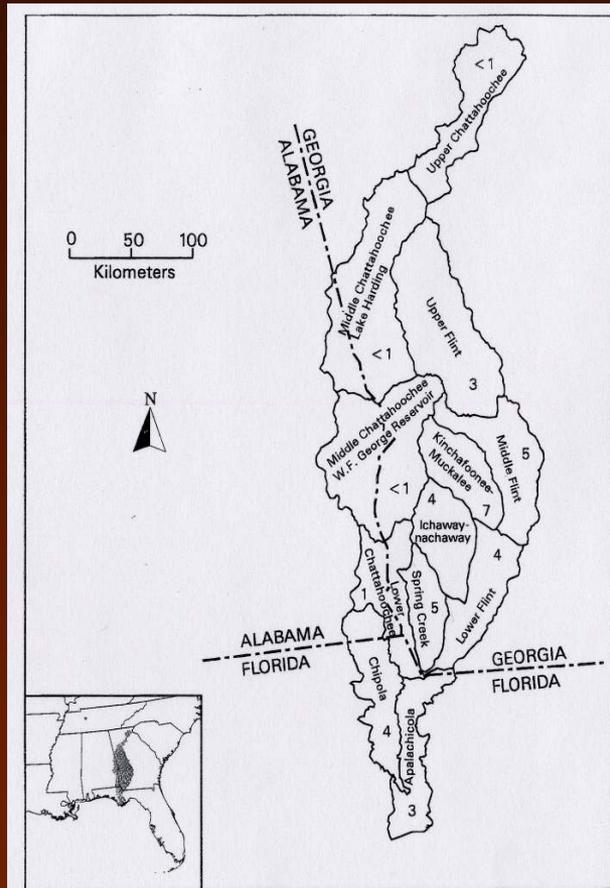
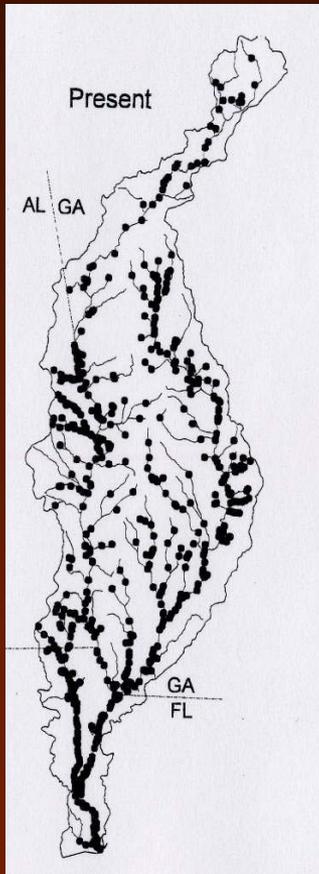
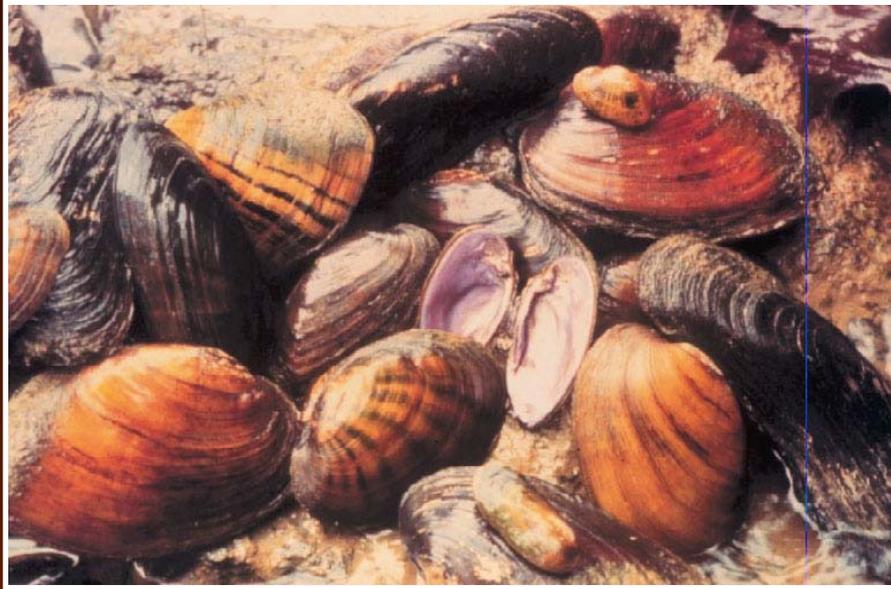


Fig. 6. Average species richness for each hydrologic unit based on the 1991-1992 survey data.

- 134 sites sampled
- 22 species observed
- Kinchafoonee, Muckalee, and Chickasawhatchee Creeks had very high mussel richness (9-16 species)
- Very few mussels observed in the Chattahoochee Basin

Flint River Mussel Studies

P. Johnson 1999-2000



- Surveying historic mussel populations
- Examining mussel responses to drought

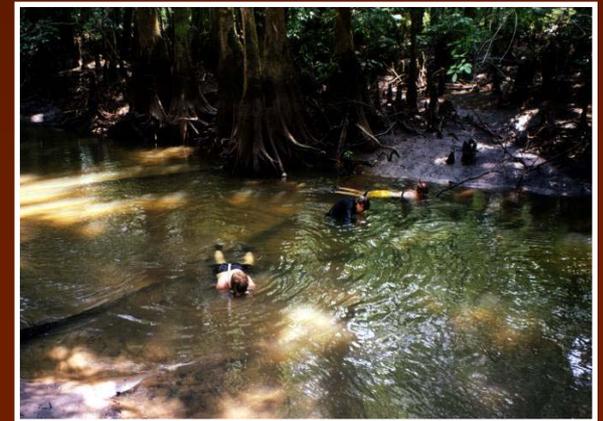
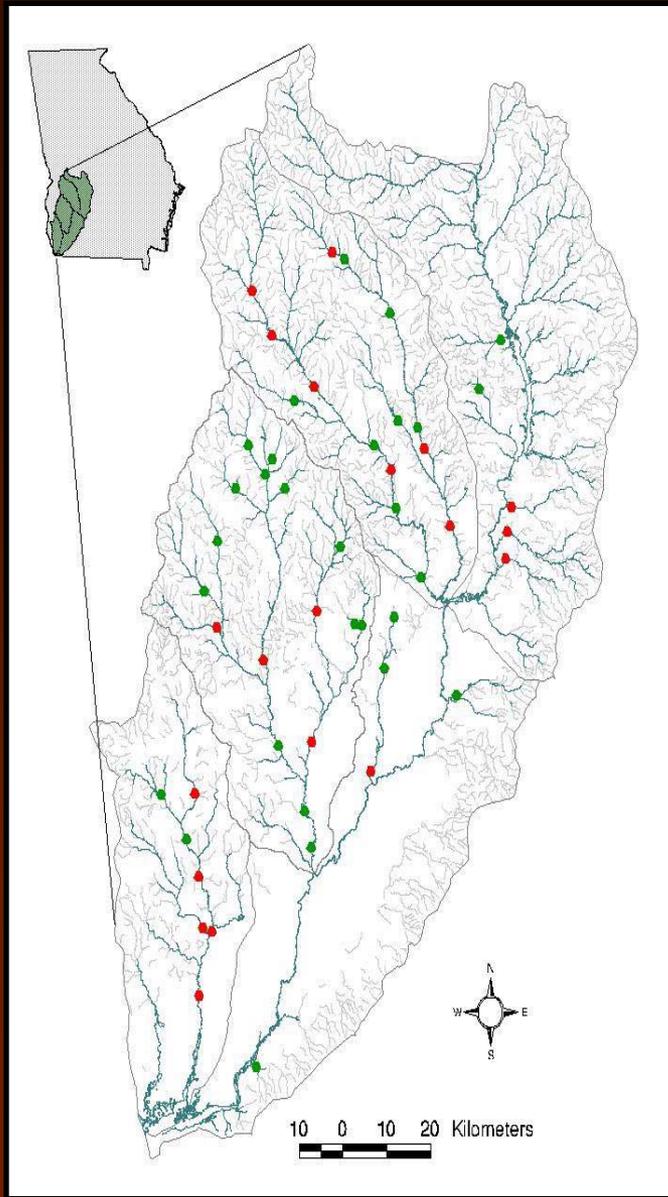


1999 Mussel Survey

- 46 sites on 12 tributaries

- Visual and tactile search for mussels

- 100 m sampling areas



1999 Mussel Survey Results

- 14,873 mussels
- 19 species
- 3 endangered species



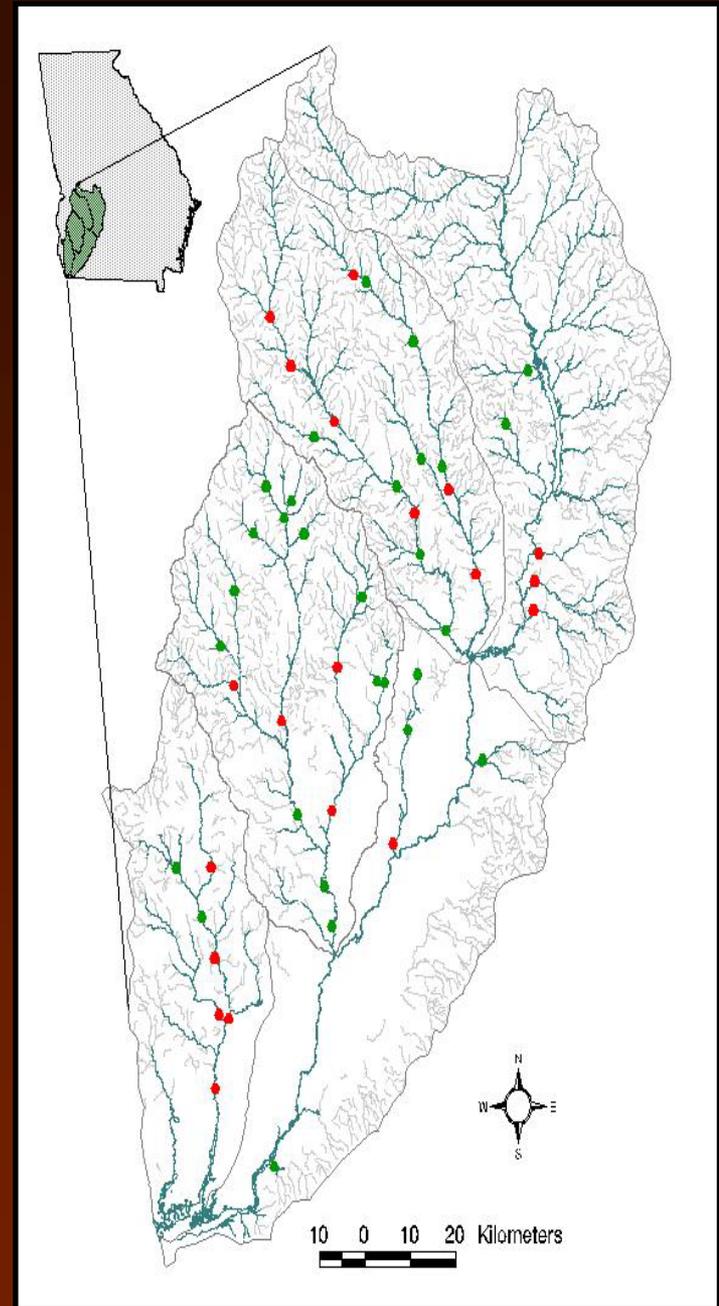
Gulf
Moccasinshell



Oval pigtoe

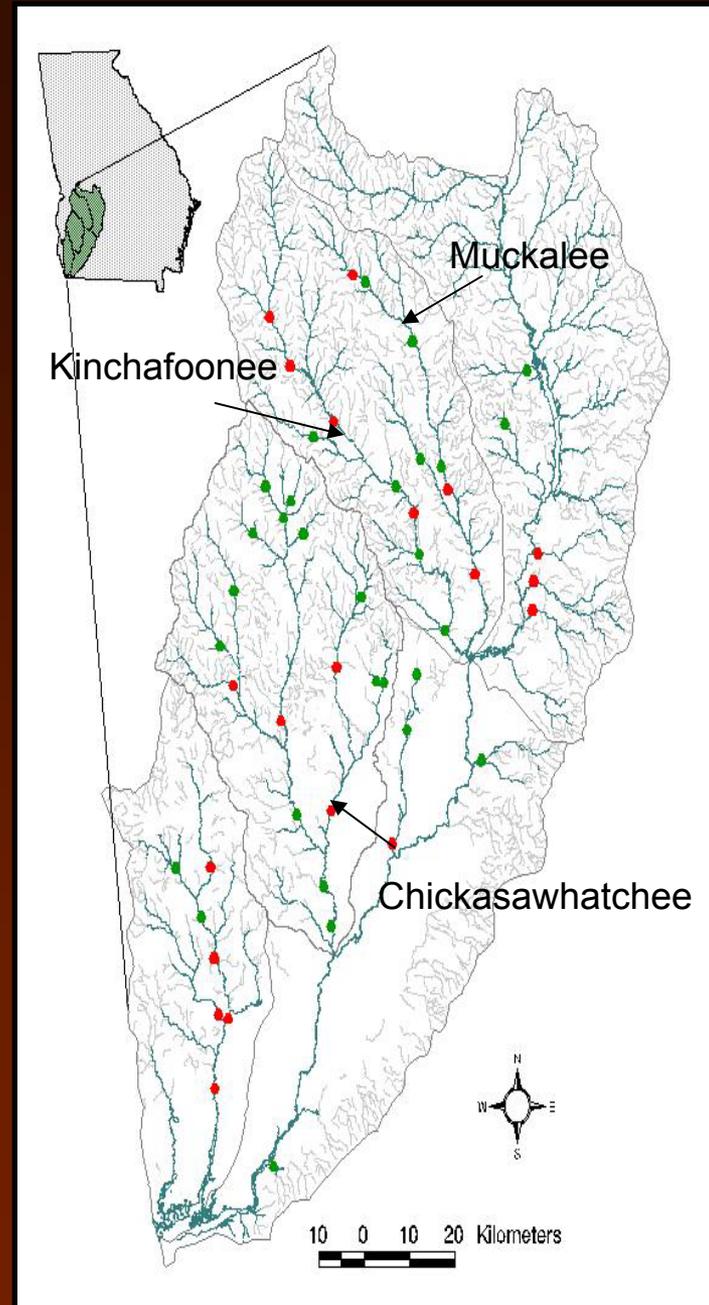


Shiny-rayed
Pocketbook

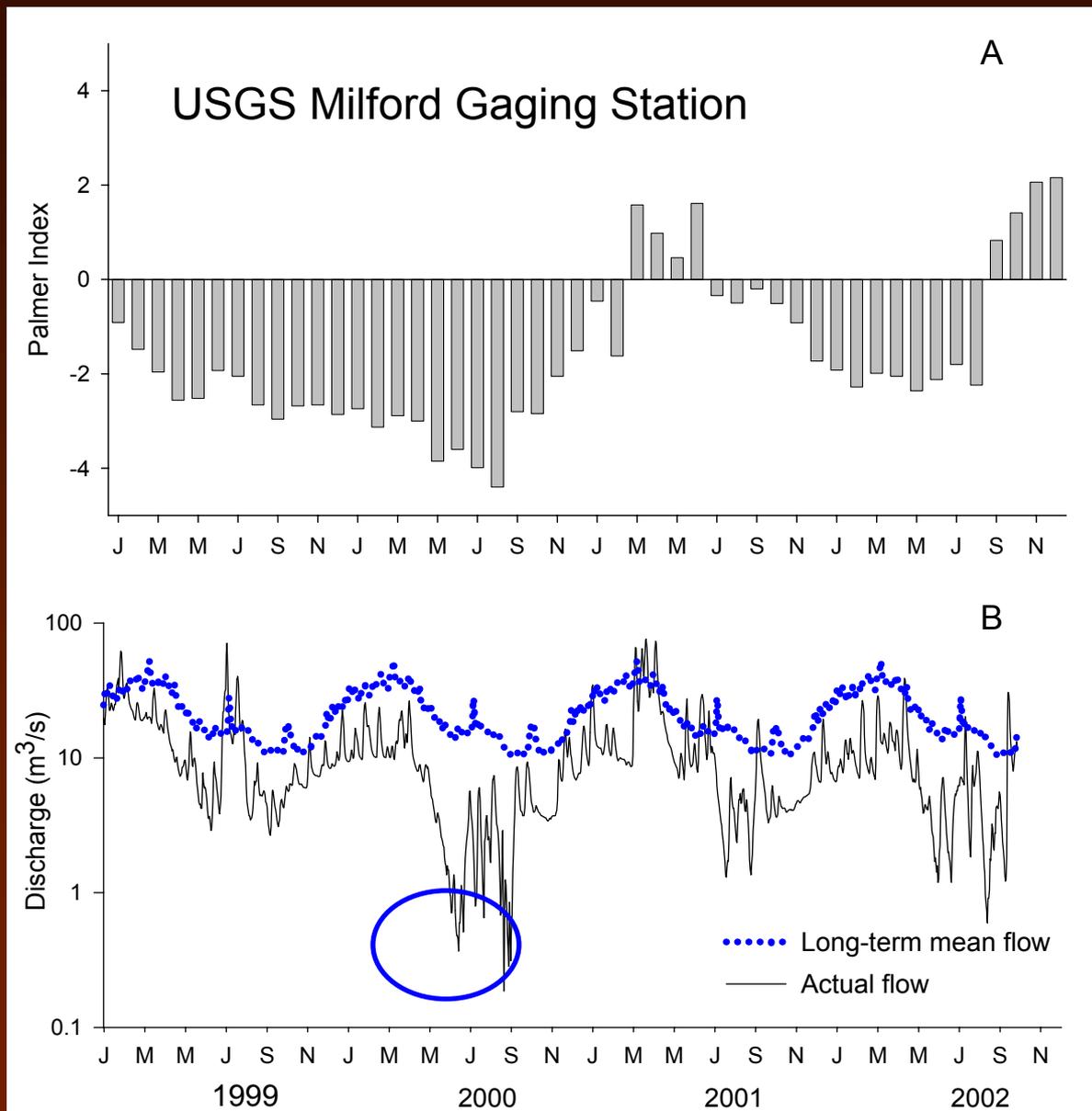


1999 Mussel Survey Conclusions

- Abundant mussel populations still occur in the basin
- Endangered species are generally not abundant
- Muckalee, Kinchafoonee and Chickasawhatchee Creeks continue to support the greatest richness and abundance



Southwest Georgia Hydrology – 1999-2002



Mussel Responses to Drought (2000)

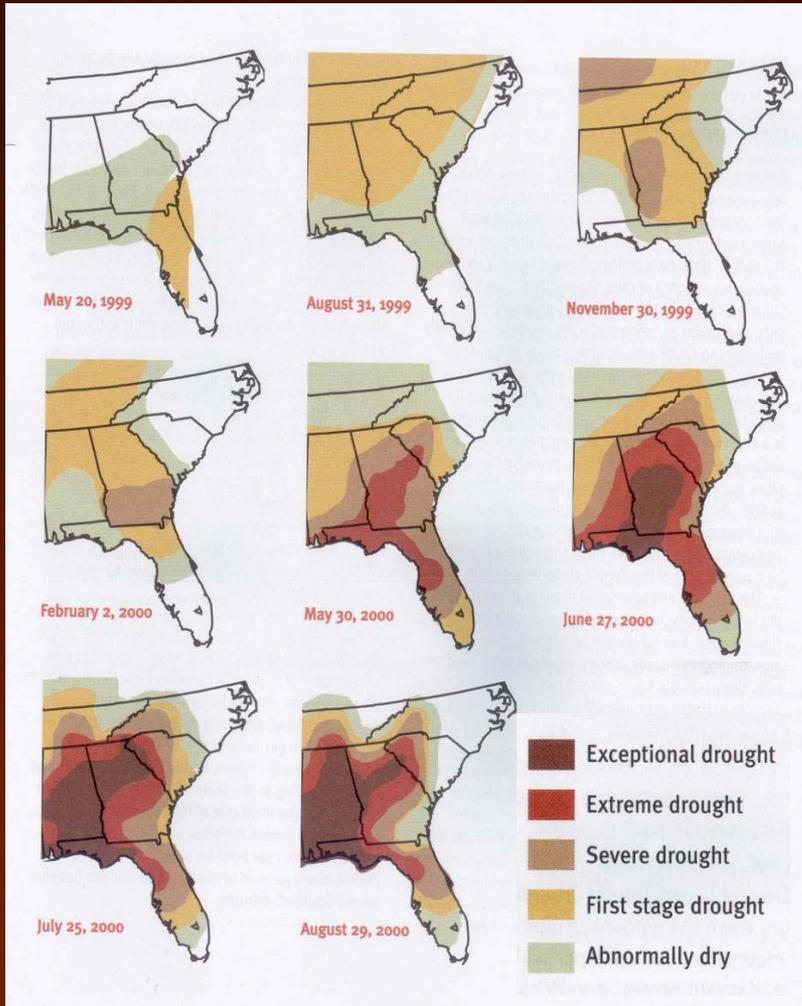


Prior drought studies:

- ?

- ?

Summer 2000 Drought Severity



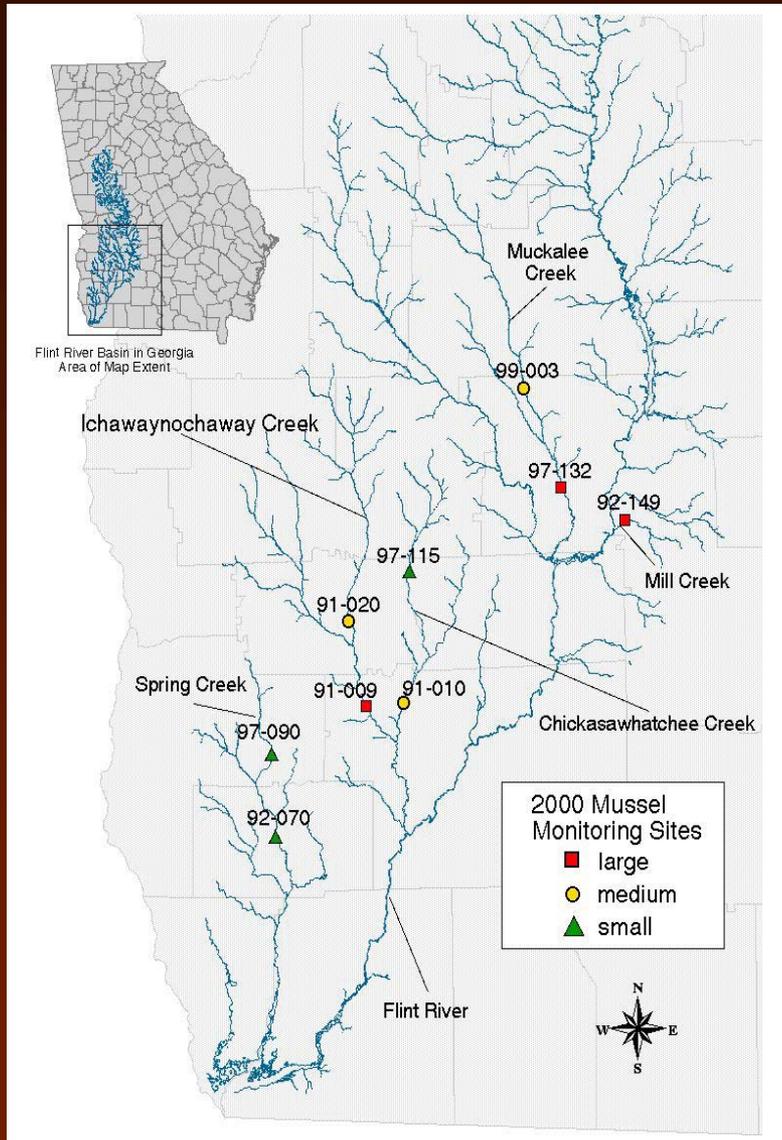
Dewatered stream



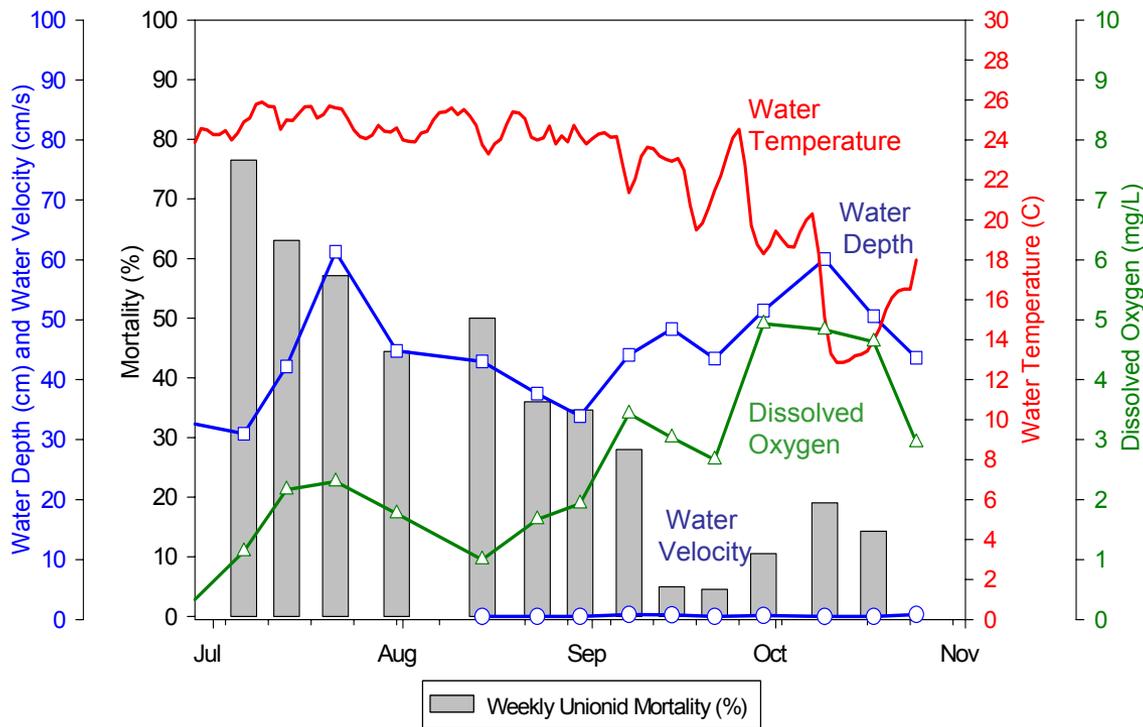
Anoxic stream

2000 Drought Monitoring Study

- 9 sites stratified by stream size
- 3-5 4 m² quadrats per site
- Weekly monitoring of
mussels
depth
bottom velocity
DO
- Continuous temperature
measurements

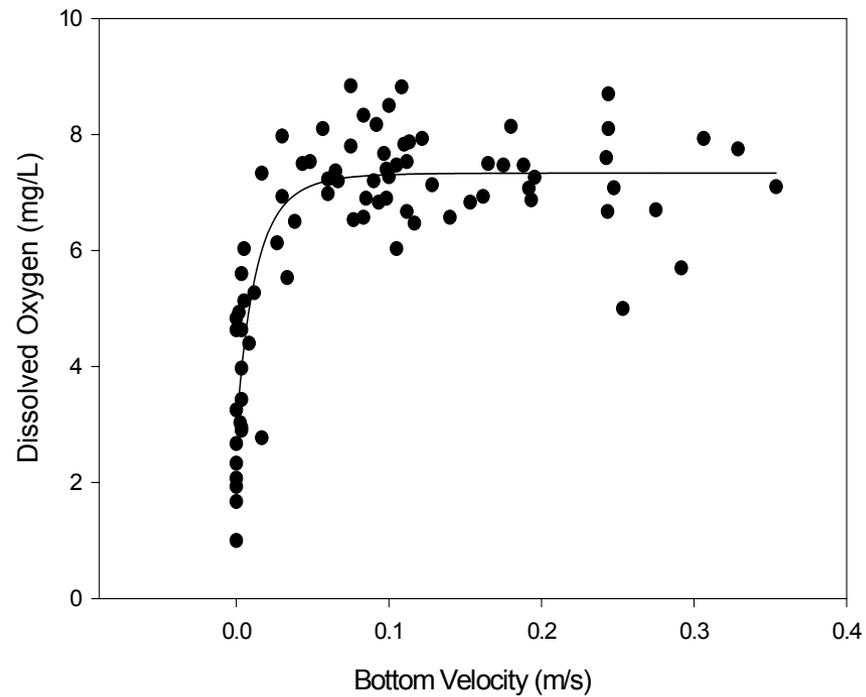


Trends in physicochemical conditions

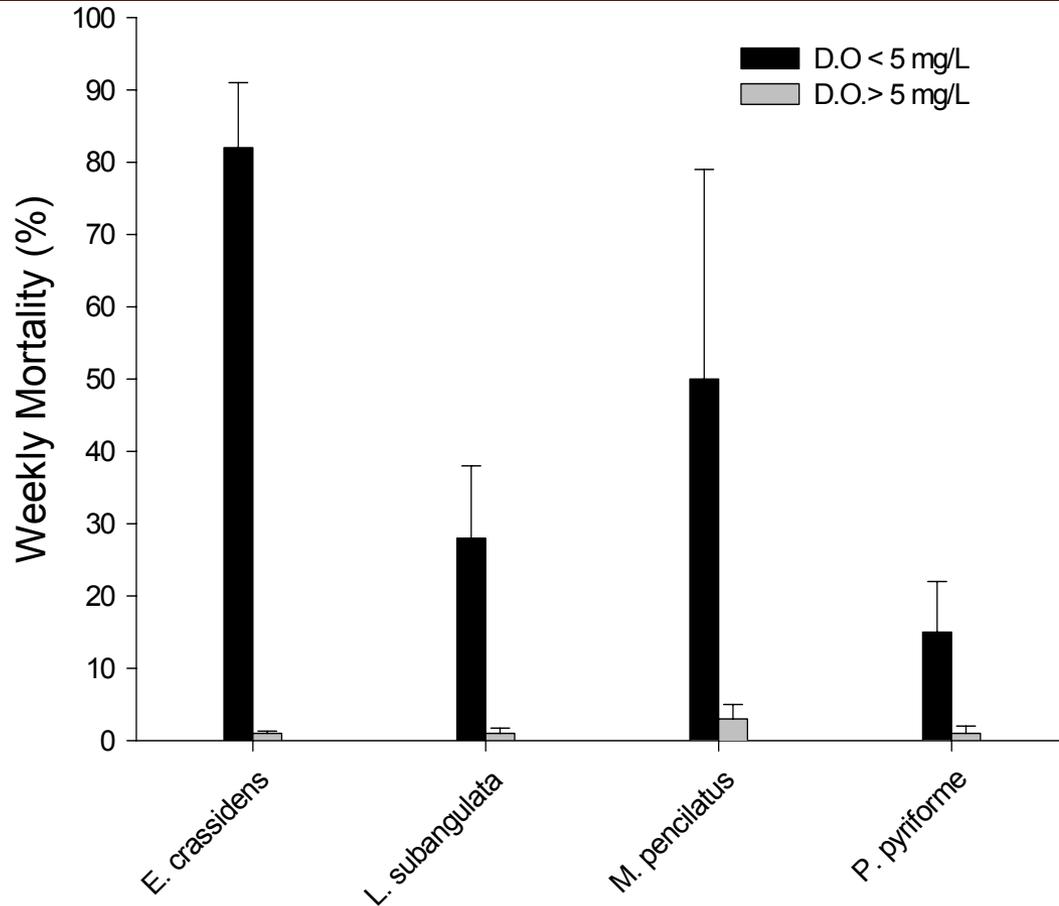


Mussel survey plot

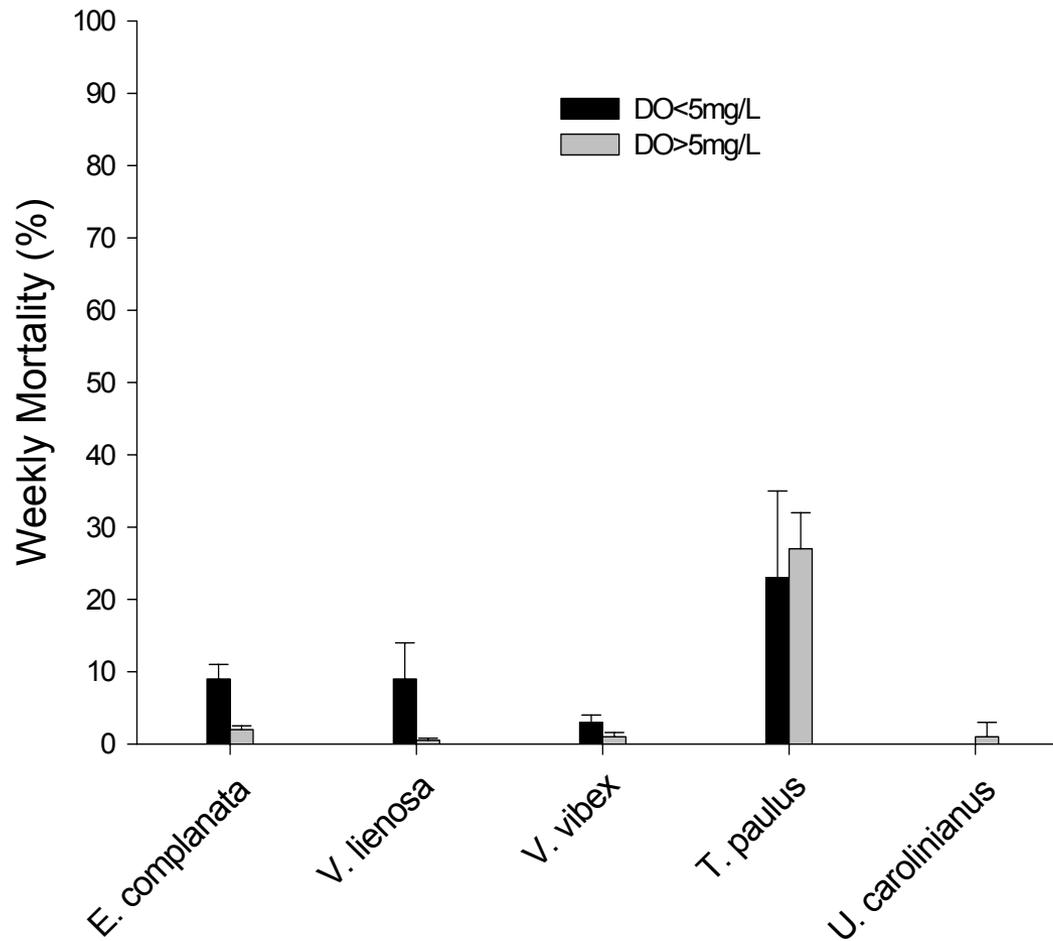
Relationship between water velocity and dissolved oxygen



Species Mortality at dissolved oxygen levels above and below 5 mg/L



Species Mortality at dissolved oxygen levels above and below 5 mg/L



Results of the 2000 Drought Study

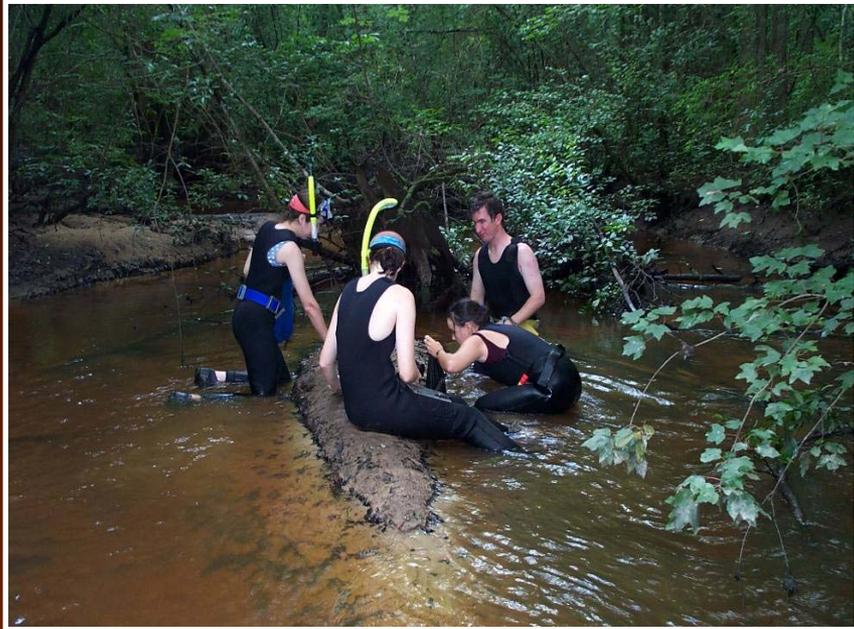


- stagnation accelerated mussel mortality
D.O. < 5 mg/L
velocity < 0.05 m/sec



- medium sized streams were most affected
- drought tolerance varies by species

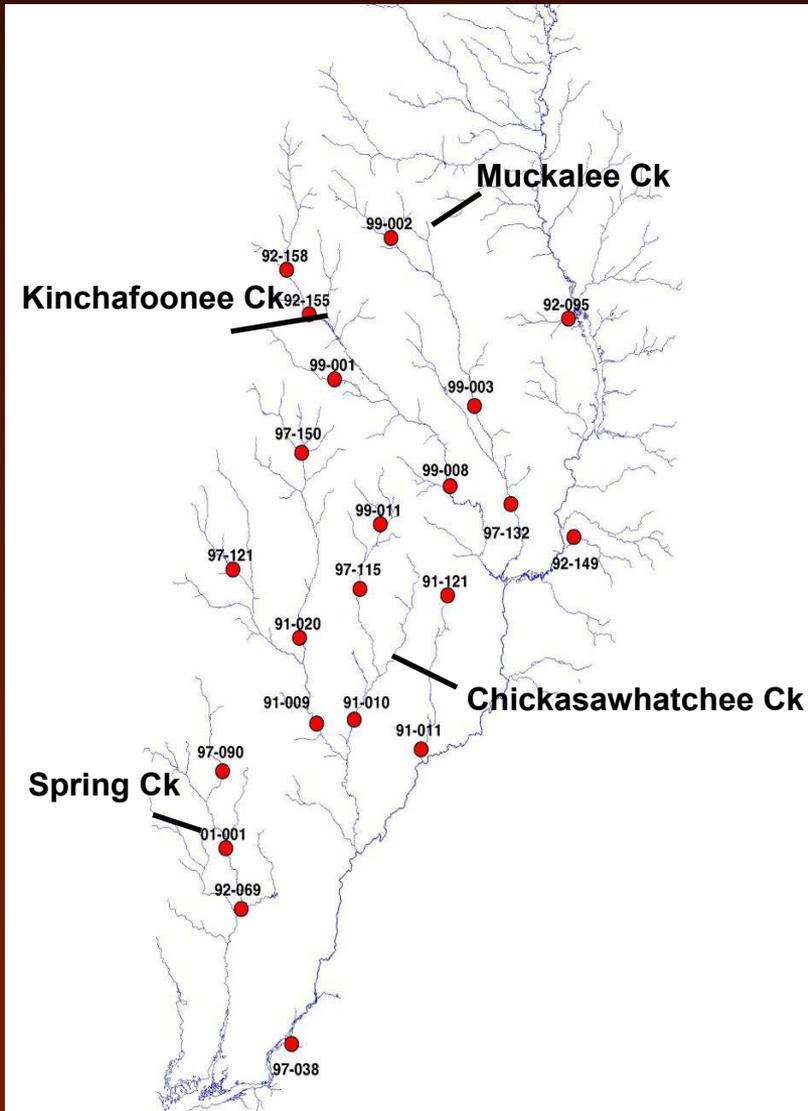
2001 Mussel Resurvey



Objectives:

- 1) Determine the extent of regional changes in mussel assemblages due to the drought
- 2) Determine stream reaches likely to be adversely affected by drought

Site Selection



Criteria for Selection

- 20 sites surveyed
- Previously surveyed in 1999
- Previously supported diverse or abundant mussel populations
- Represent a range of stream size

Methods

- 100 m reaches surveyed
- Small streams (< 12 m) entire stream bottom searched
- Large streams (> 12 m) 6 transects searched (2 m wide)
- Baseflow discharge measurement (USGS)
- Photo record of survey sites



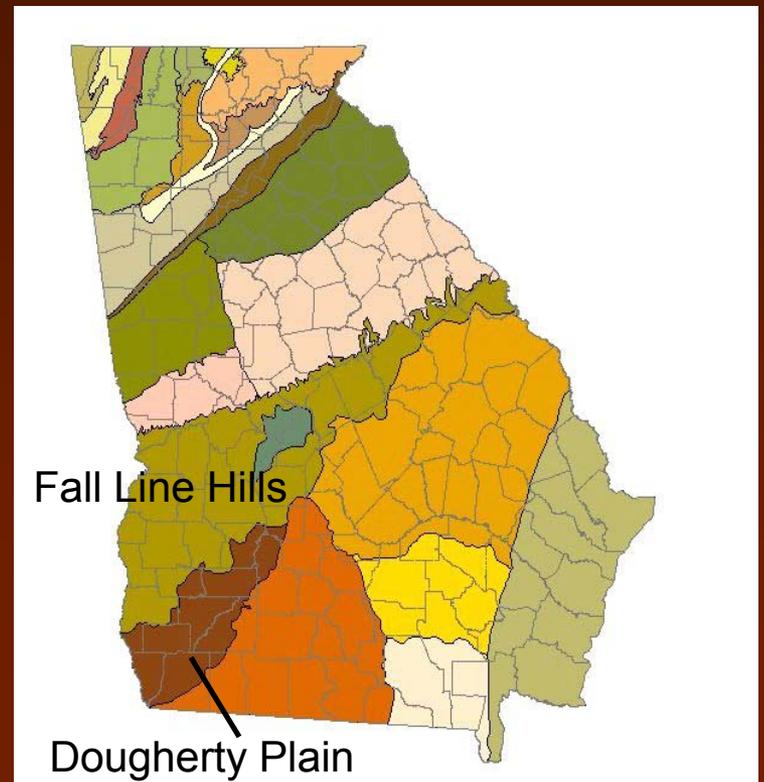
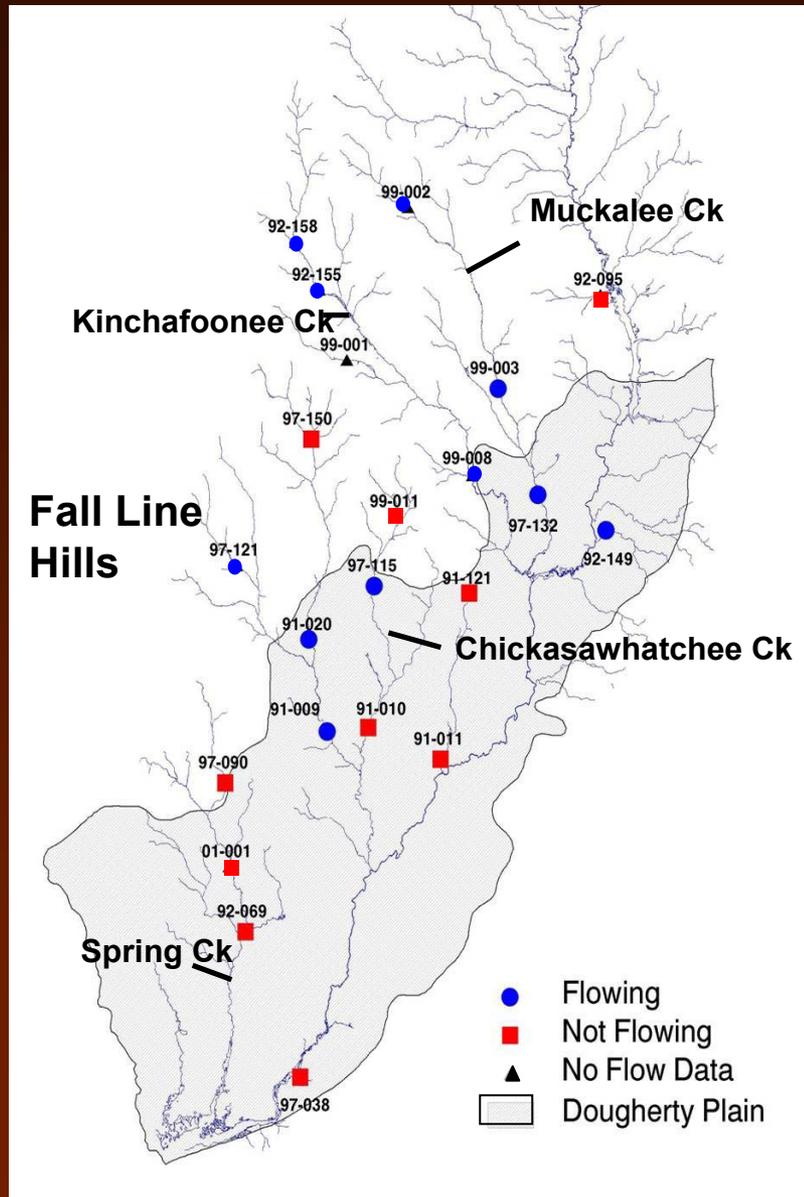
Searching



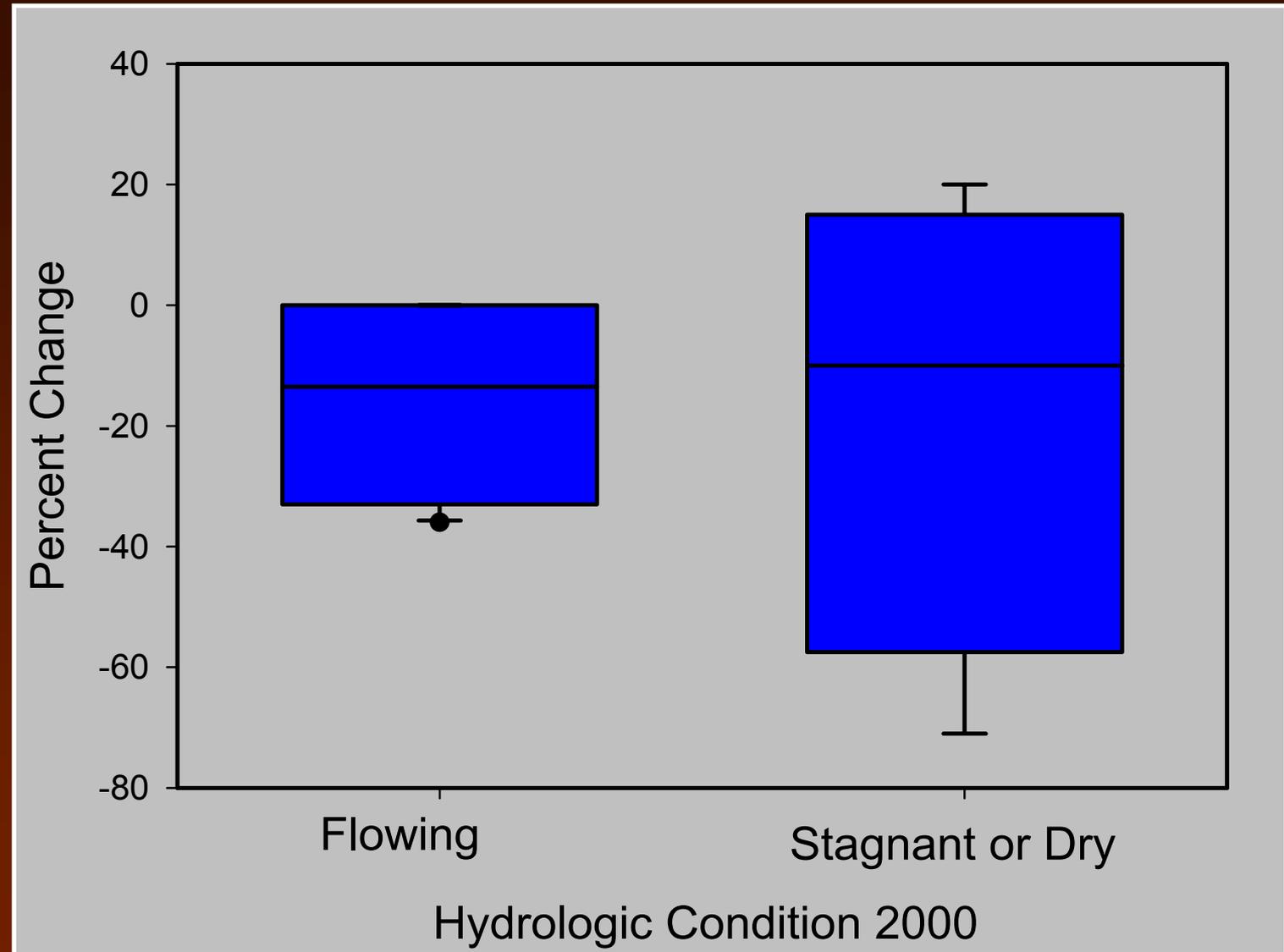
Physical measurements

Results

Hydrologic and Geologic Classification

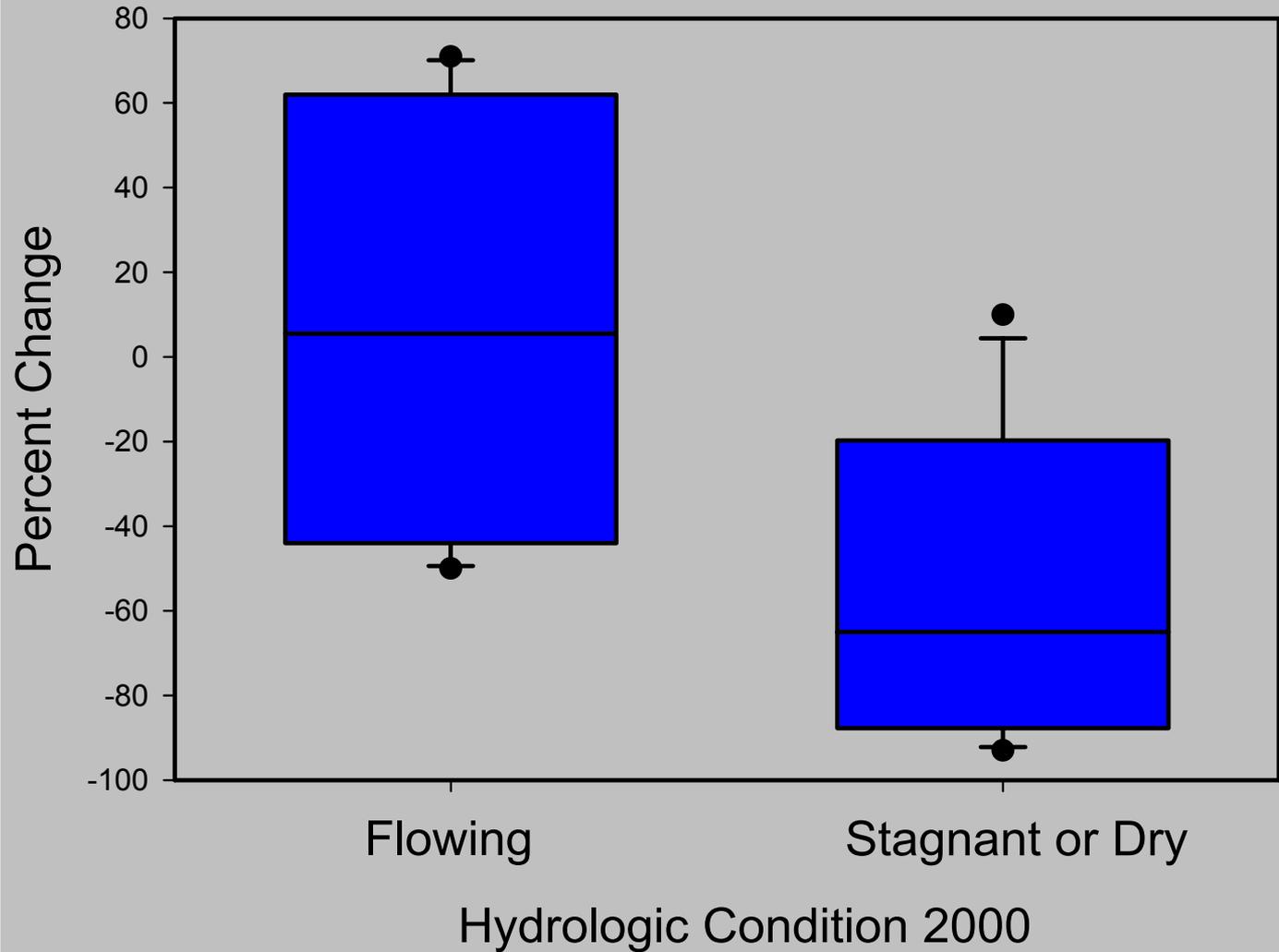


Box Plot of Taxa Richness



Mann-Whitney Rank Sum Test $p=0.8$

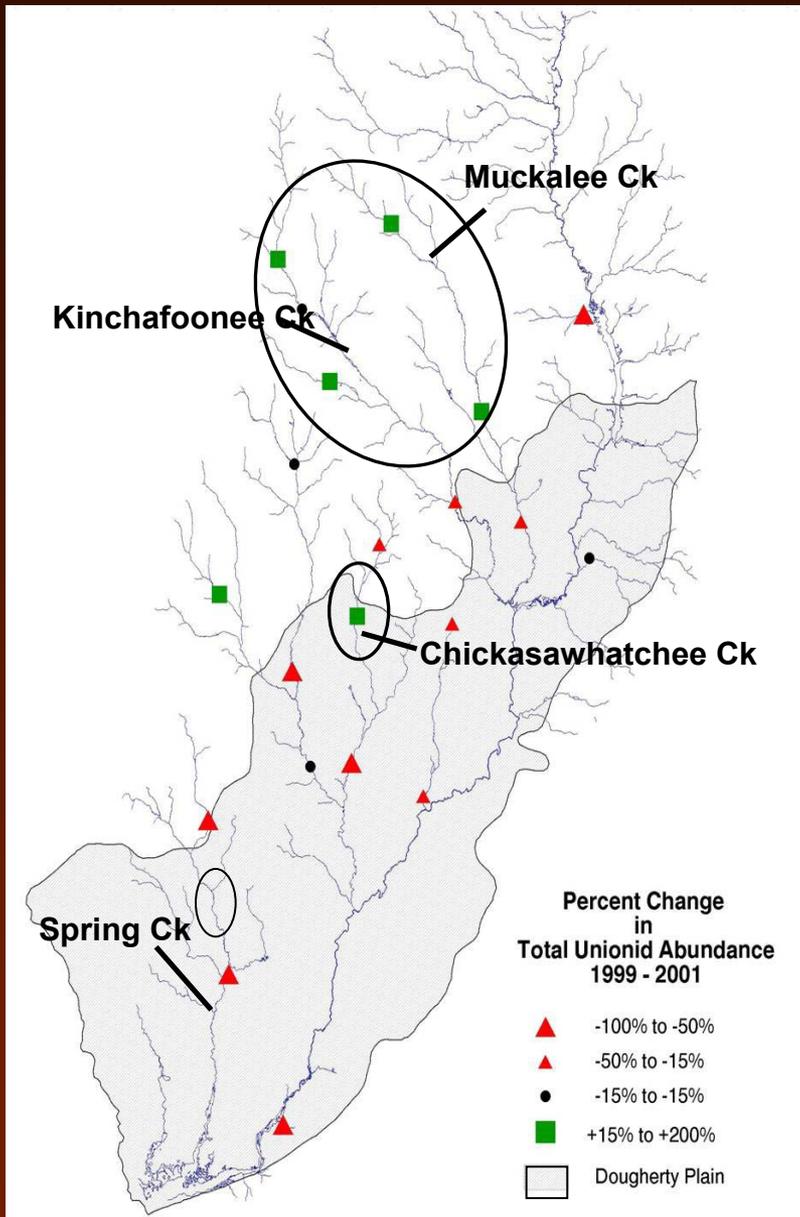
Box Plot of Mussel Abundance



Mann-Whitney Rank Sum Test $p=0.05$

Changes in Mussel Abundance

1999 to 2001



Status of Mussels 1999 to 2001

Common Species



Elliptio complanata



Elliptio crassidens



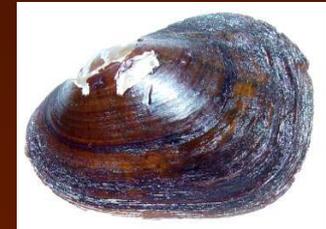
Villosa vibex



Toxolasma paulus



Uniomerus carolinianus



Villosa lienosa

	<u>1999 (#/site)</u>	<u>2001 (#/site)</u>	
Flowing	226	314	p=0.02
Non-Flowing	181	71	p=0.01

Status of Mussels 1999 to 2001

Endangered Species



Lampsilis subangulata
Sites 11/7



Medionidus pencillatus
Sites 2/1



Pleurobema pyriforme
Sites 5/6

	<u>1999 (#/site)</u>	<u>2001 (#/site)</u>	
Flowing	3	6	p=0.2
Non-Flowing	27	2	p=0.1

Status of Mussels 1999 to 2001

Special Concern Species



Elliptio purpurella



Lampsilis claibornensis



Villosa villosa



Quincuncina infucata



Strophitus subvexus

	<u>1999 (#/site)</u>	<u>2001 (#/site)</u>	
Flowing	20	22	p=0.6
Non-Flowing	3	1	p=0.7

Conclusions

- Streams of the Dougherty Plain were most sensitive to drying during 2000 drought
- Mussel mortality was related to drying
- Greatest declines in mussel abundance occurred in the Dougherty Plain
- Endangered and Special Concern species still occur but are not abundant
- The best populations of mussels occur in the upper reaches of Kinchafoonee, Muckalee, and Chickasawhatchee Creeks

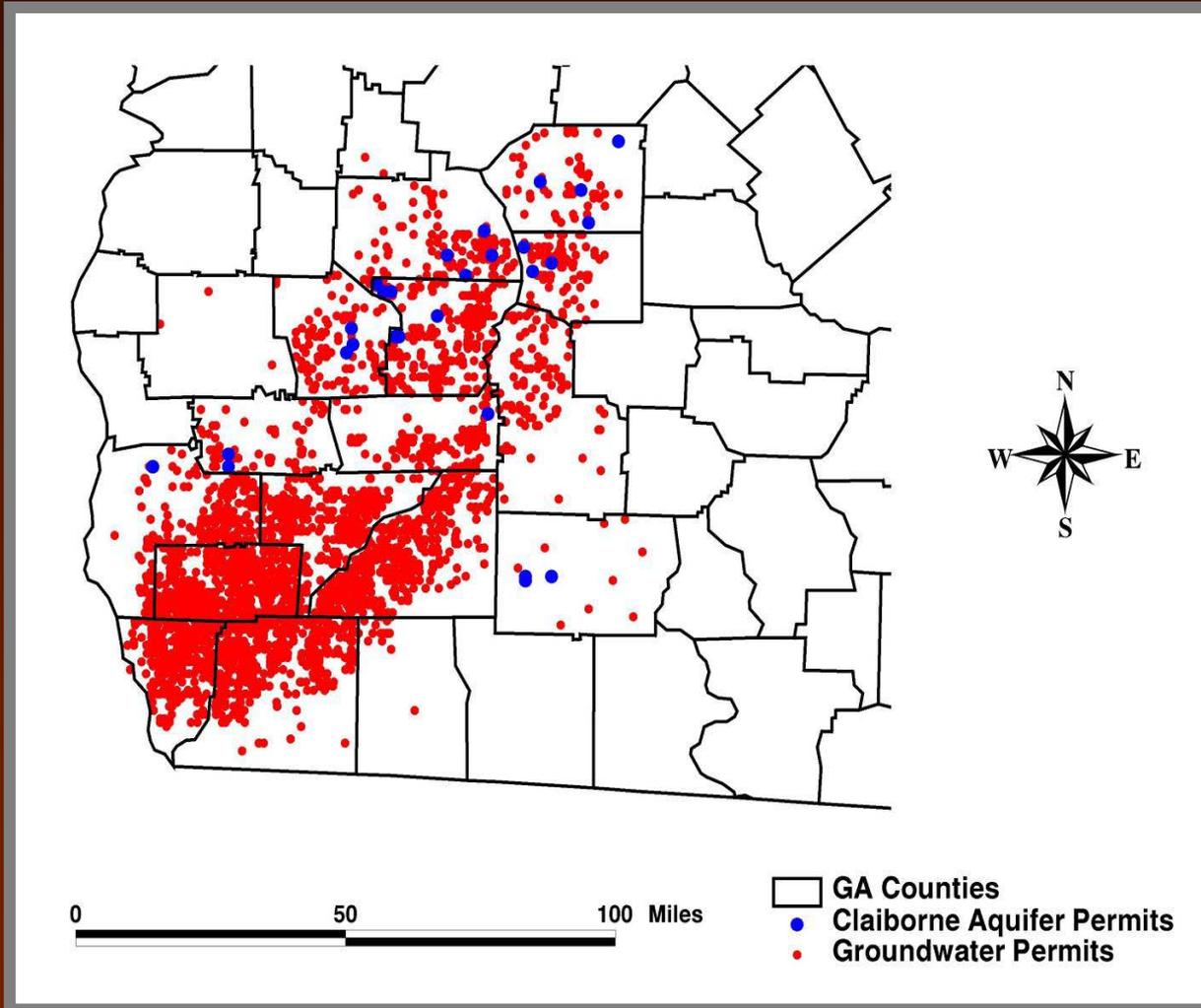
Potential Human Impacts



Regional land-use
50-60% agriculture



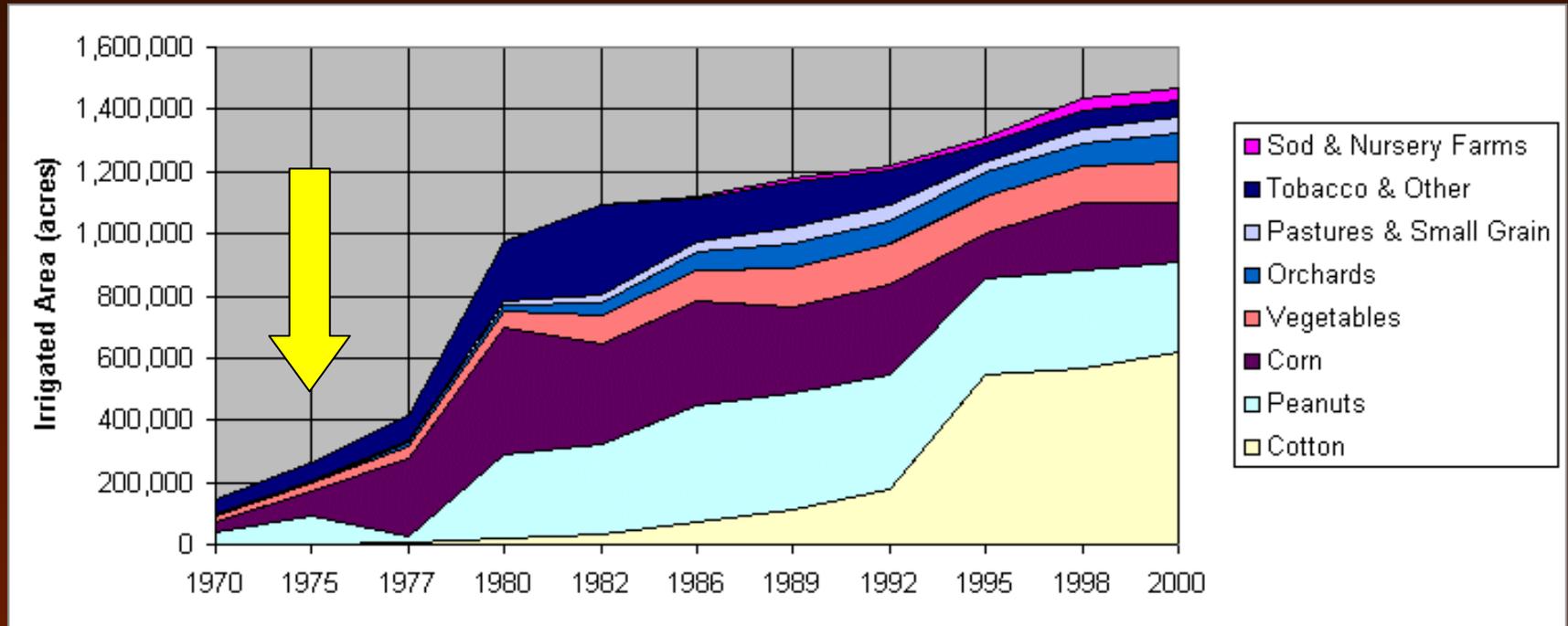
Groundwater Permits



Total permitted
9.3 bgd

Actual use
?????

Expansion of Irrigation



Data from: Harrison, K.A. and A.W. Tyson. 2001. Irrigation survey for Georgia. Proceedings of Georgia Water Resource Conference.

Changes in the lower Flint River Basin

- Declining minimum daily flows
- Altered seasonality of flows
- Increasing water use?
- Continuing losses of mussel diversity?



Epilogue



“If the biota, in the course of eons, have built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the sign of an intelligent tinkerer.”

Aldo Leopold.

Acknowledgements

Funding – R.W. Woodruff Foundation, J.W. Jones Center, Georgia DNR, and The Nature Conservancy

Field Assistance – R. Bambarger, M. Bell, B. Clayton, A. Liner

