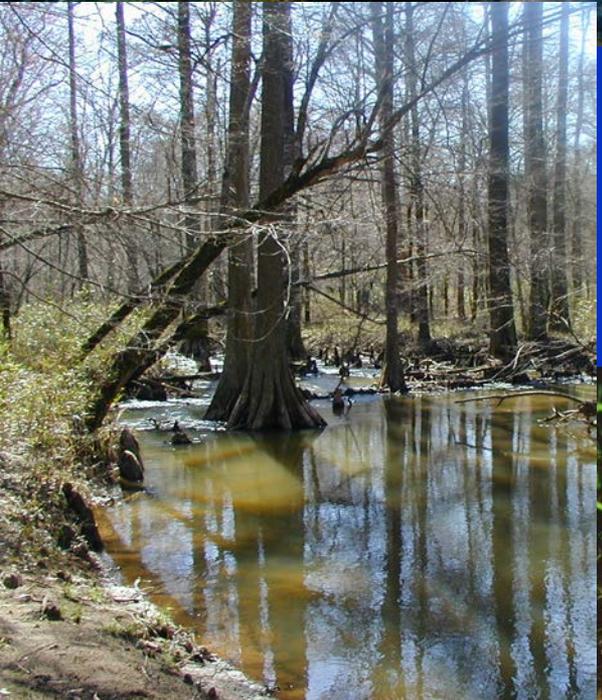
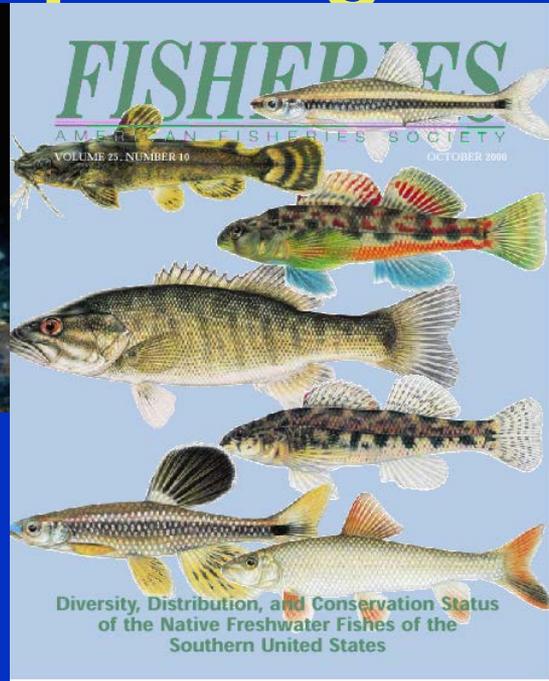


Forests and Southern United States Stream Fishes: Exploring the Links



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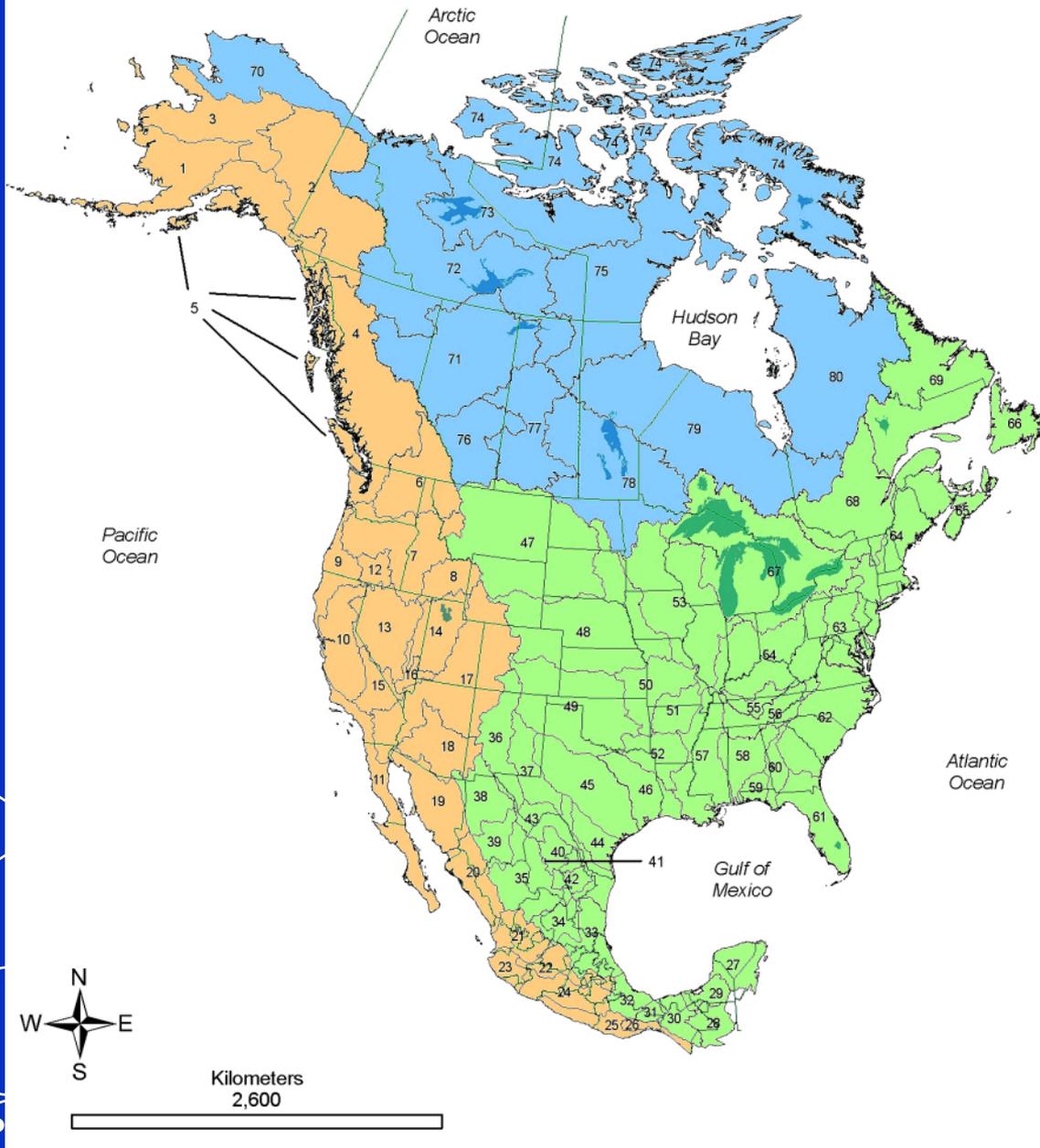




Objective: Explore potential links between fish biodiversity and forest landscape restoration with focus on southern United States

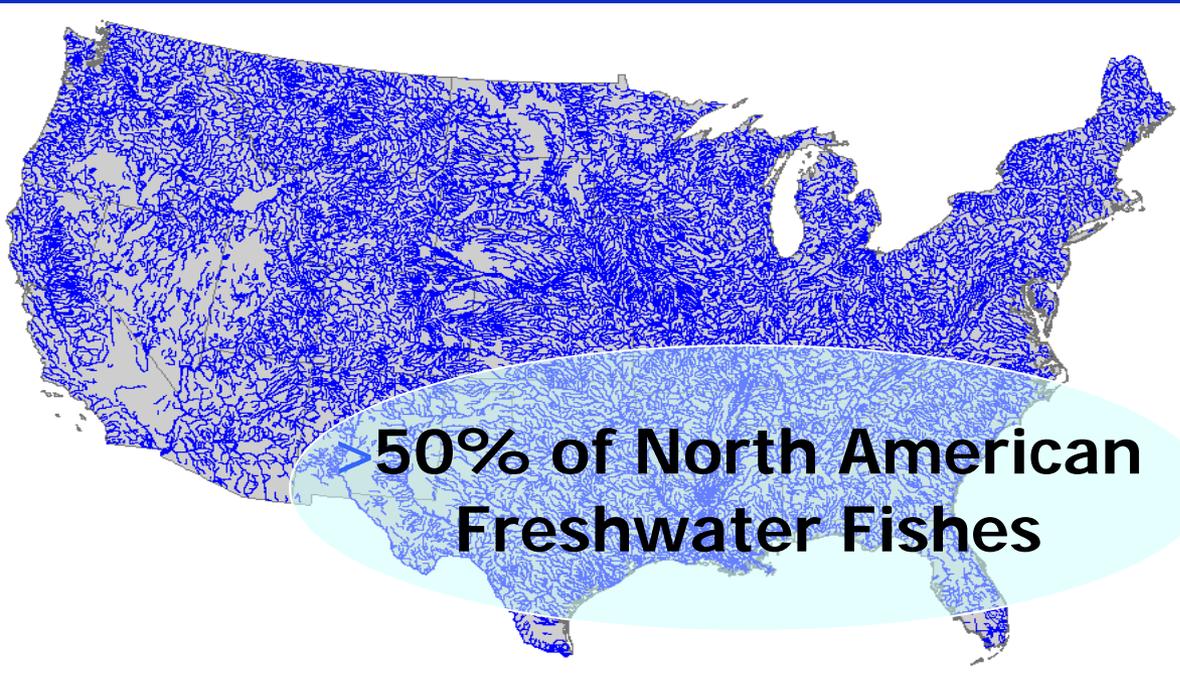
- **First, provide a perspective on the fish fauna**
 - **Second, explore fish-forest links through published examples of:**
 - **Riparian forests: sediment—water quality—temperature—fish assemblages**
 - **Instream wood as habitat and spawning substrate**
 - **Instream wood and fish food production**
 - **Floodplain forests and fish reproduction**
- 
- 
- 
- 

North America ~ 1200 native freshwater fishes

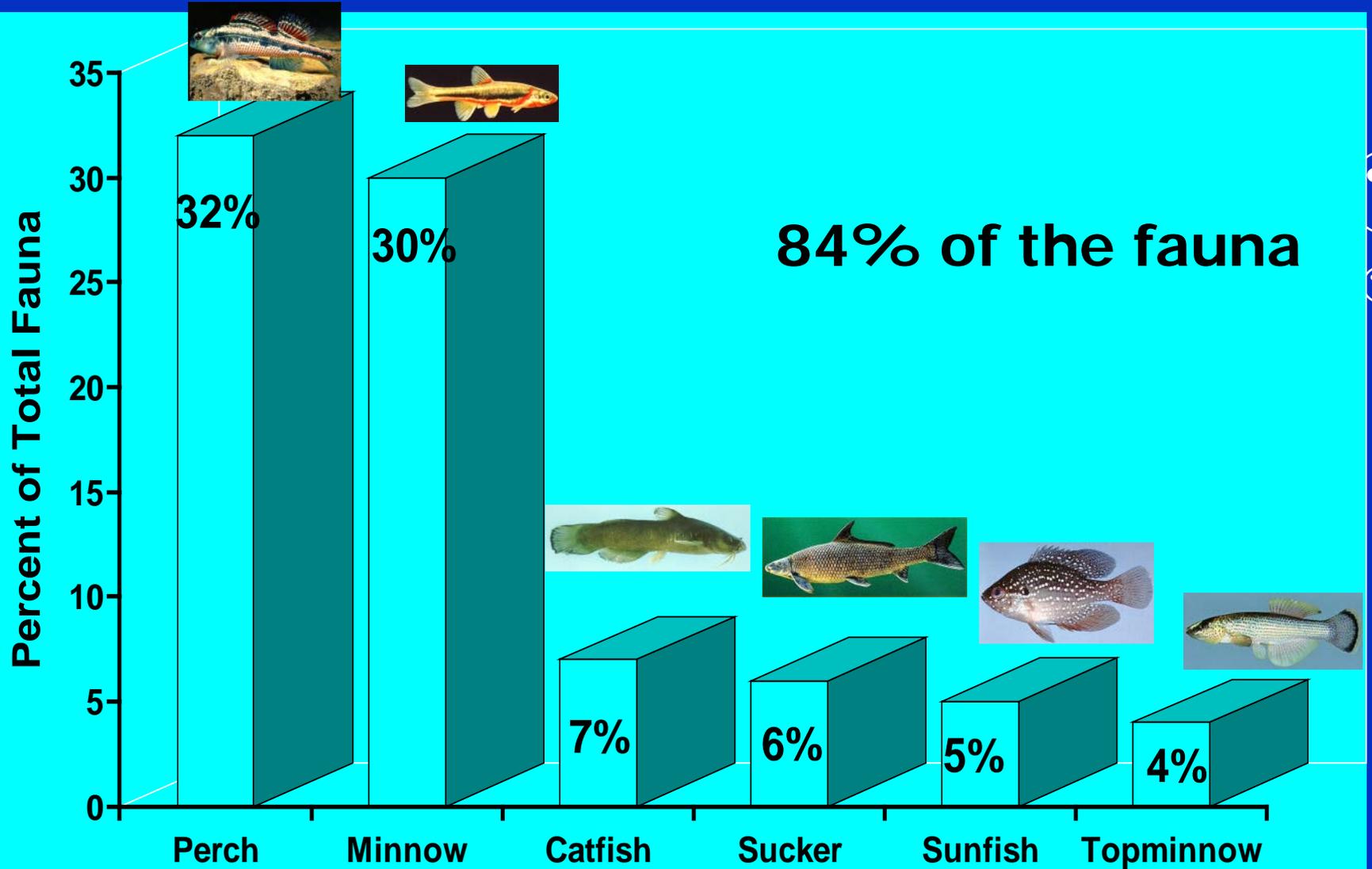


United States

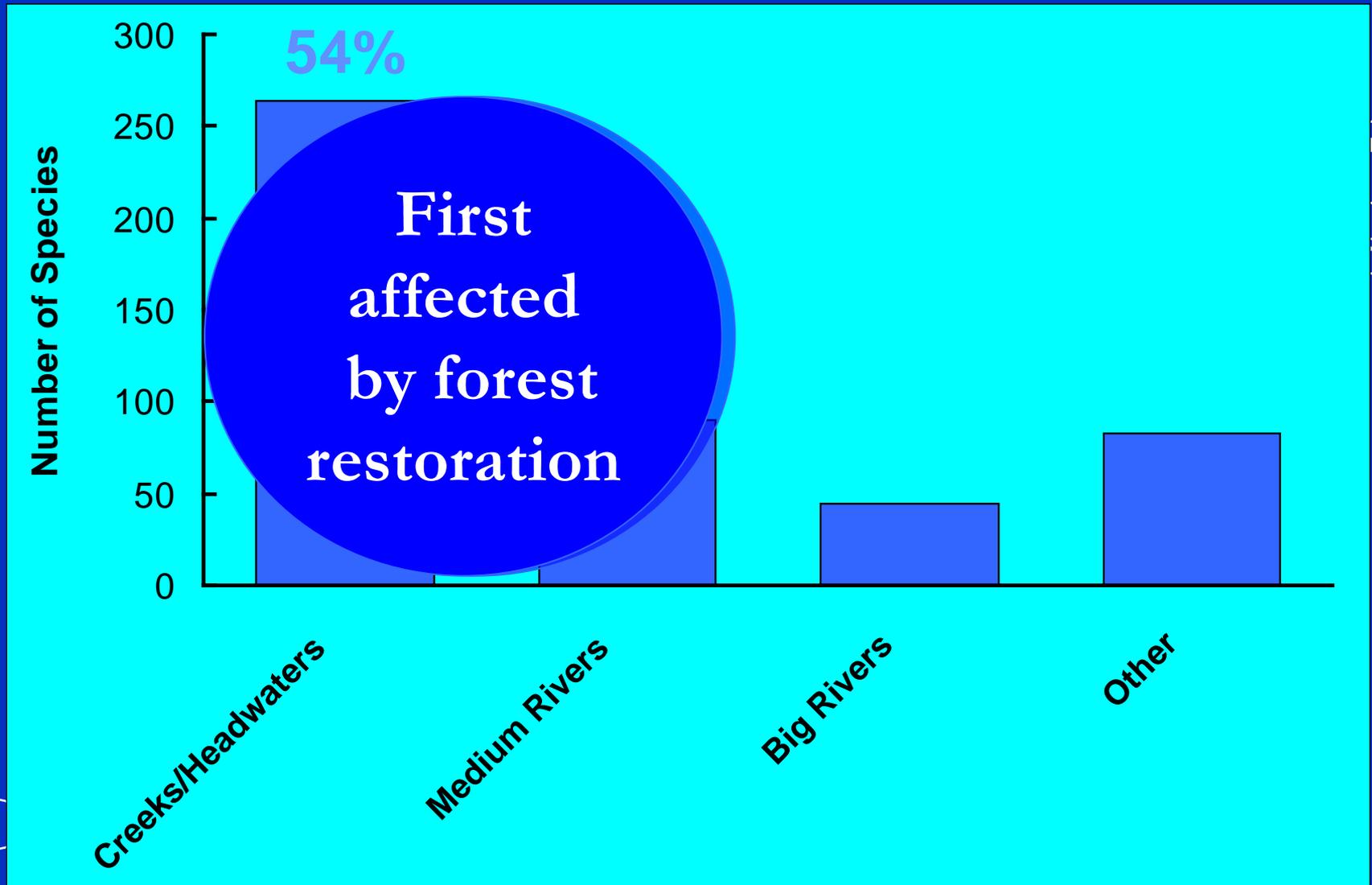
~ 800 freshwater fish species



Predominant Fish Families in Southern Waters



Where do southern fishes live? Stream-size and fish diversity

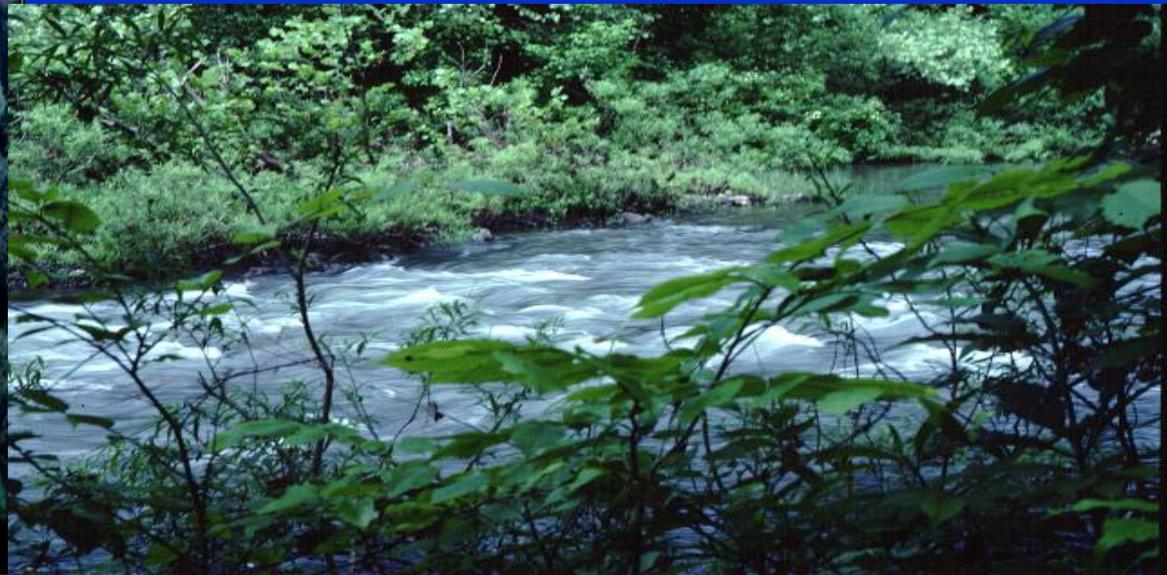


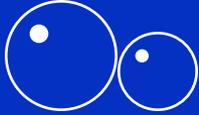
(Data from Etnier, 1997)



Forested Watersheds

- ✓ Best remaining fish habitats
- ✓ Best remaining native fish populations
- ✓ Increasing importance as biodiversity & conservation refugia





Three relatively well known links—riparian forests act to:

- **Reduce erosion**
 - Stabilize streambanks
 - Decrease sediment runoff
- **Moderate temperature extremes (provide shade)**
- **Improve water quality**
 - Reduce/filter nutrient loads in streams
 - Reduce/filter organic and other chemicals (e.g., pesticides and herbicides) runoff into streams



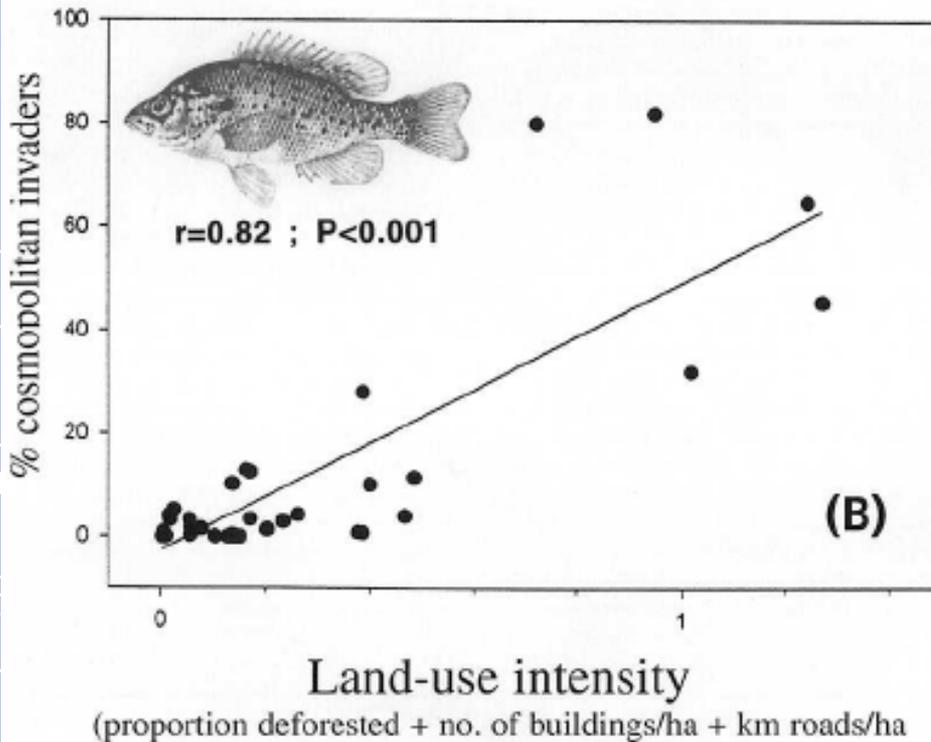
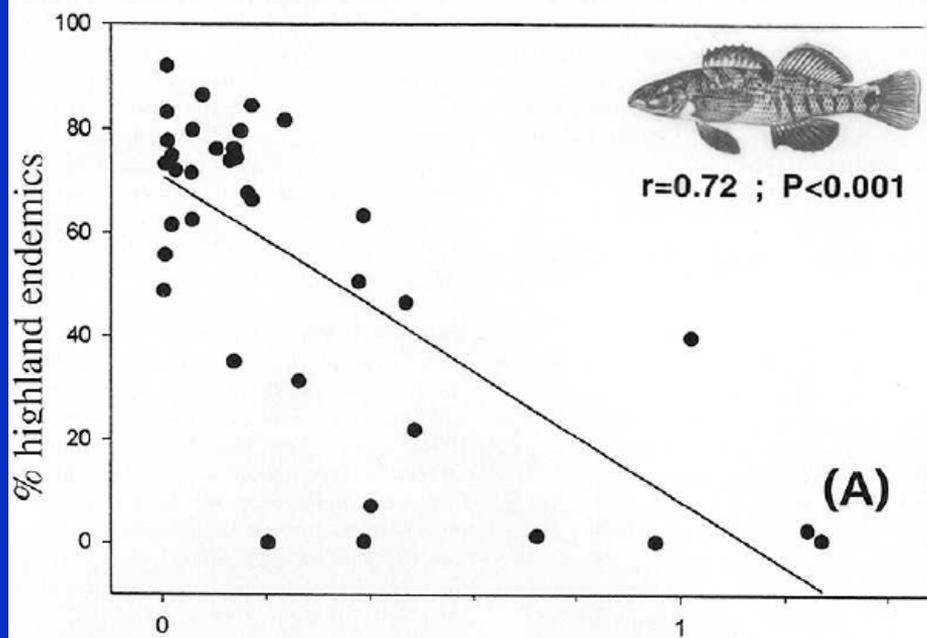
Land use & fishes

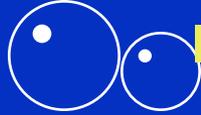
36 upland stream sites

Highland fishes: cool, clear
upland streams, sediment
intolerant
versus

Land-use intensity
(proportion deforested +
no. buildings/ha +
km roads/ha)

Cosmopolitan invaders: warmer
water, usually lower elevation
(sediment tolerant)
versus
Land-use intensity



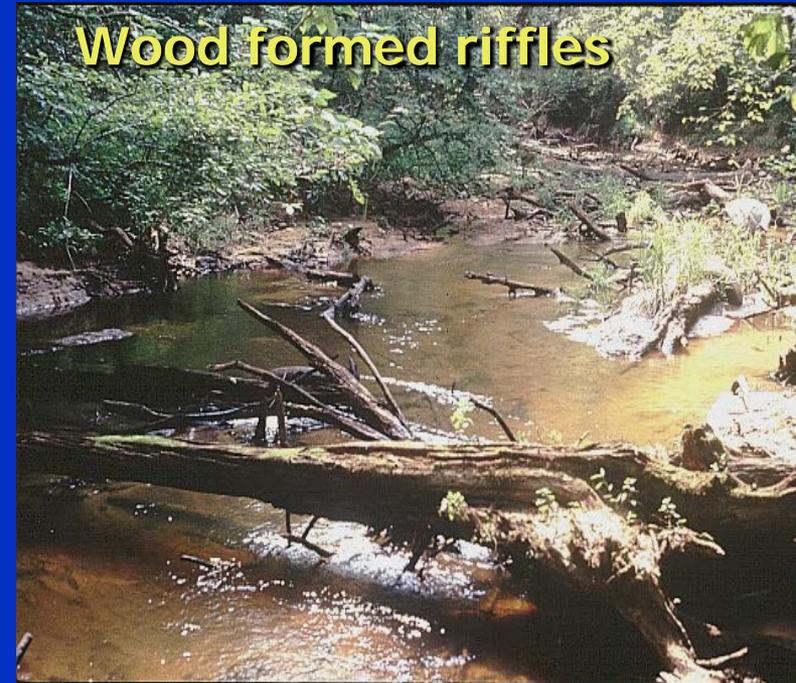


Instream Wood Forms Habitats

% drop caused by:

Stream Size	Stream Order	Organic Dams	Inorganic Dams
	1st	52	16
	2nd	46	29
	3rd	10	28

Bilby and Likens. 1980. Ecology



Instream Wood as Cover



	No Cover	Woody Cover
Fish > 120 mm (%)	7	93
Minnows (%)	35	65
Suckers (%)	10	90
Sunfishes (%)	11	89
Invertebrate Density (m ²)	92	3828

Source: Paul Angermeier

stream Wood as Physical Habitat: channelized, incised streams, upper Coastal Plain, Mississippi

Flowing Habitats



Darter abundance (%) 	+
Catfish abundance (%) 	+
Large Instream Wood (% coverage)	+
Current Velocity	+



Instream Wood as Physical Habitat: channelized, incised streams, upper Coastal Plain, Mississippi

Non-Flowing Habitats

Sunfish abundance (%)

+



Small wood (%
coverage)

+

Large Instream Wood
(% coverage)

+

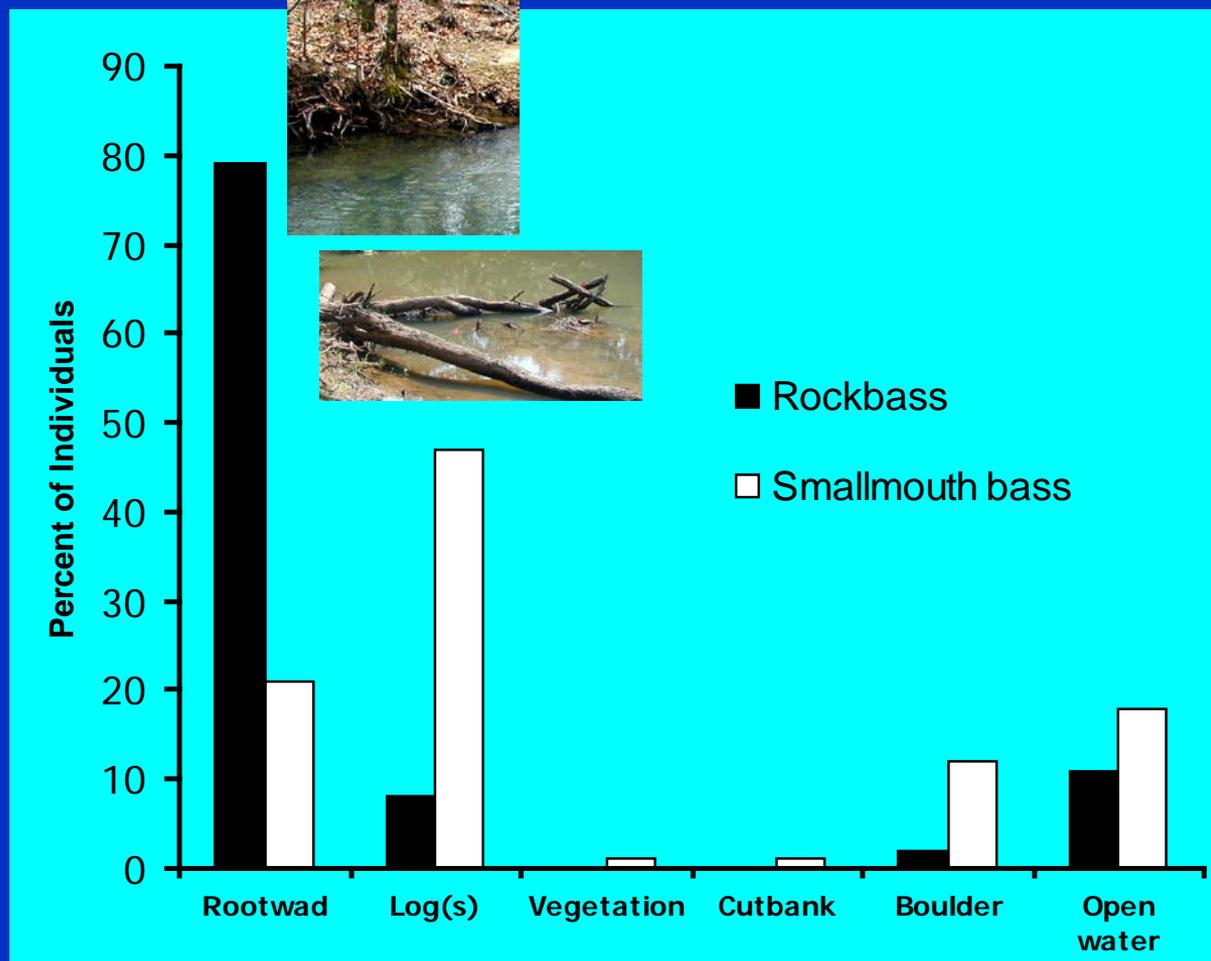
Organic debris piles
(% coverage)

+

Depth

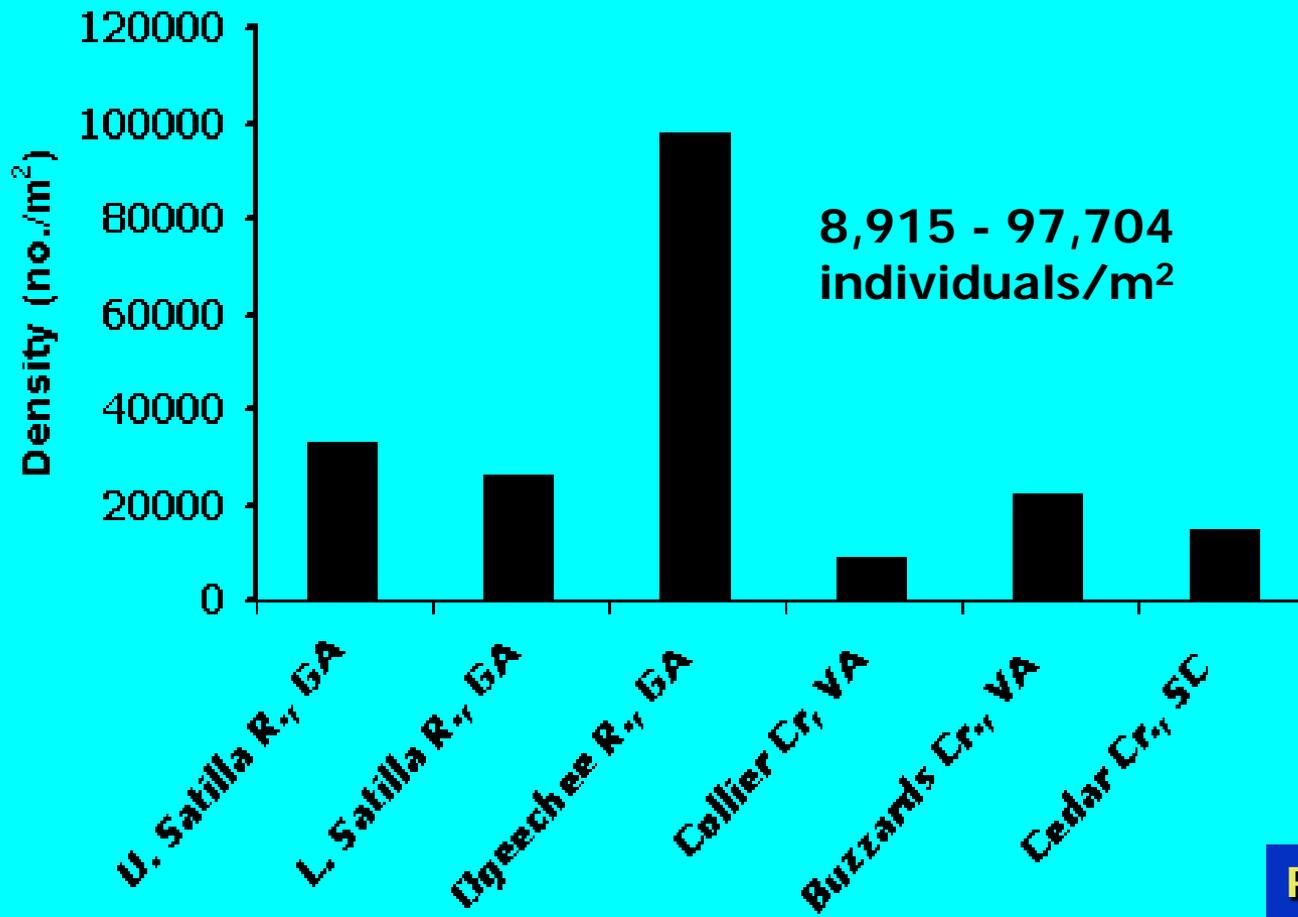
+

Instream Wood as Physical Habitat: habitat partitioning in co-occurring top predators in rocky upland streams



Instream wood and fish food production

Aquatic invertebrate density on instream wood in southern U.S. Coastal Plain streams



Snags



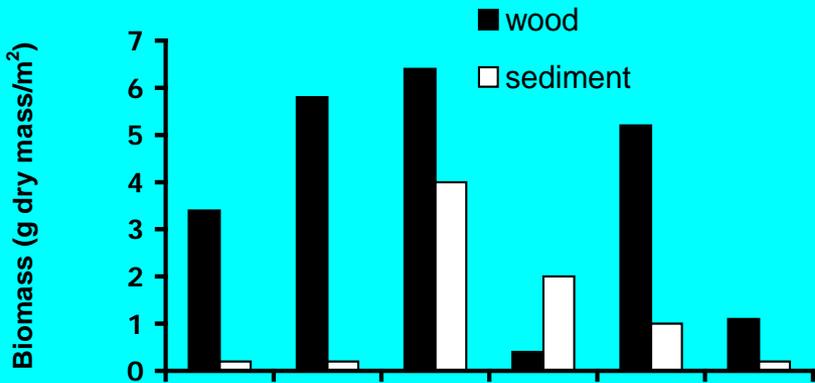
Debris dams



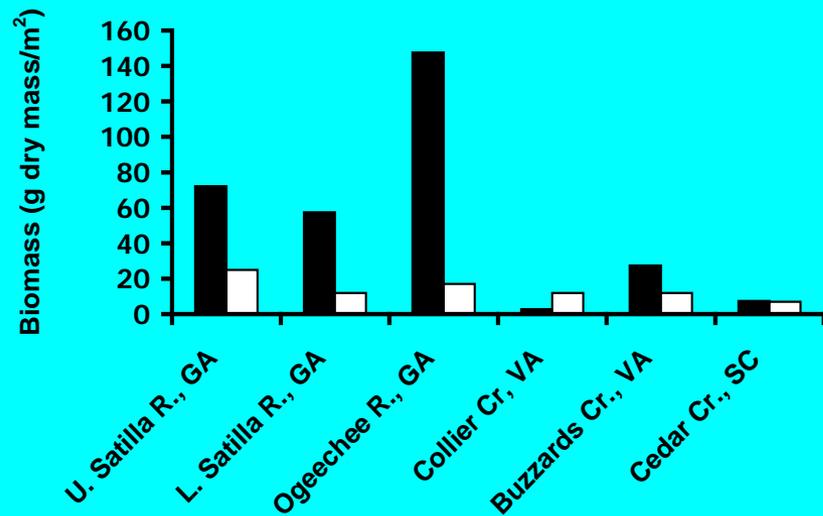
Review in :
Benke and Wallace. 2003.
Am. Fish. Soc. Symp. 37

Aquatic Invertebrate Biomass: instream wood vs sediment

Mean Annual Biomass



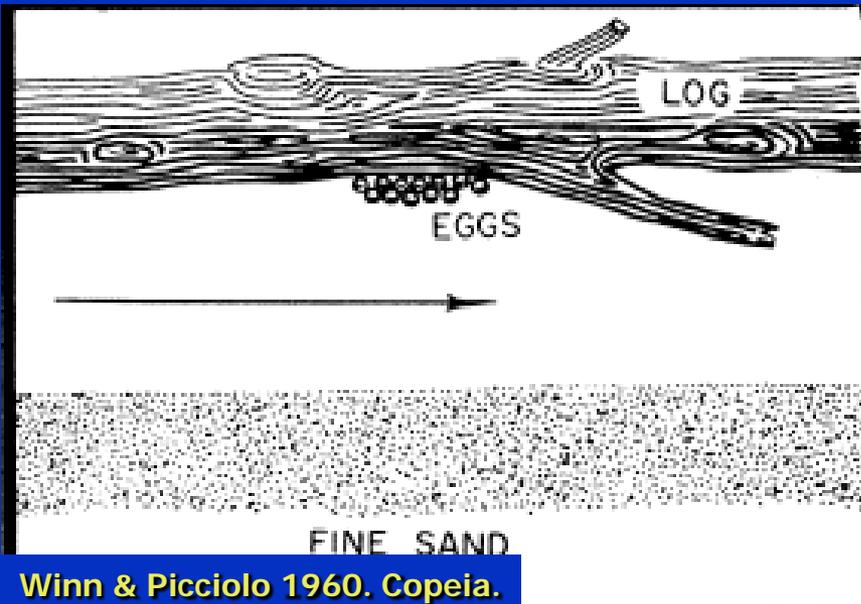
Annual Production



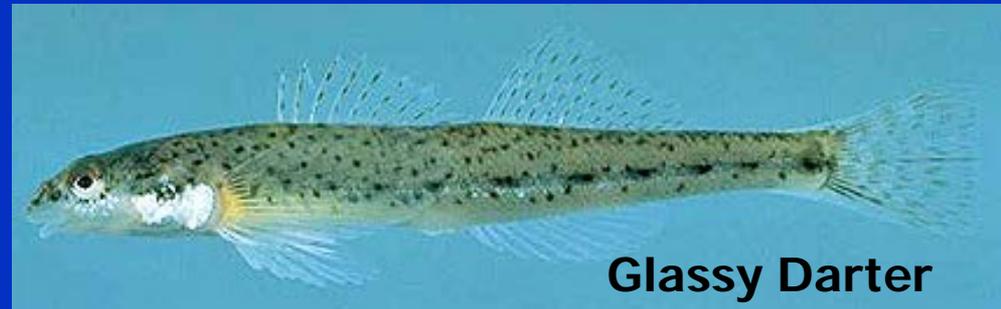
- higher density (10x) and biomass (5x) on wood than sediments
- inverts form base of fish food-web
- 99% of fishes feed on inverts at one or more life stages
- most fish are life-long invertivores
- up to 60% of fish diet biomass from inverts produced on wood

Instream Wood as Spawning Substrate

Egg attachers & clusterers
(high investment in parental care)



Relict Darter



Glassy Darter



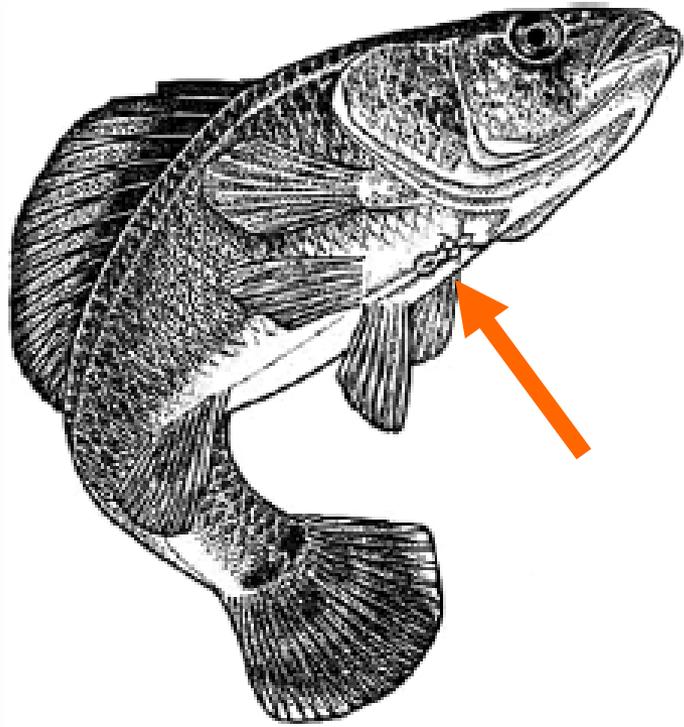
Piebald Madtom

Blacktail Shiner



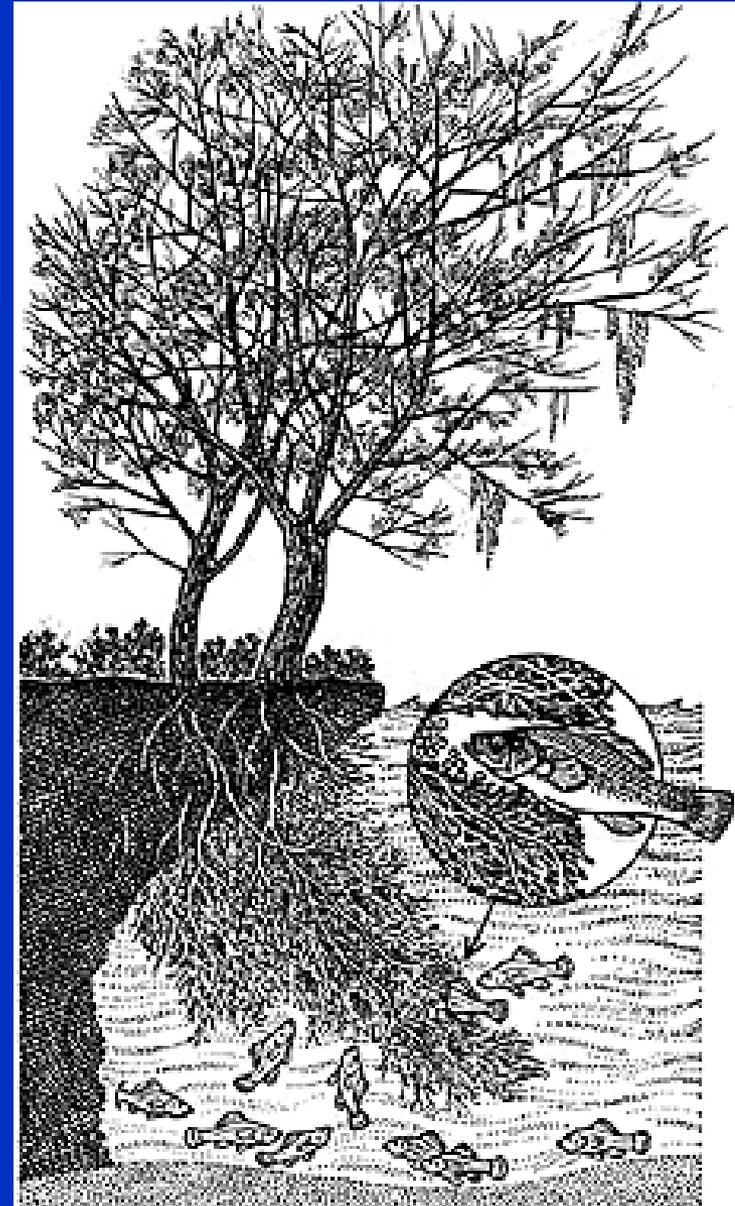
Crevise spawners

Instream Wood and Spawning

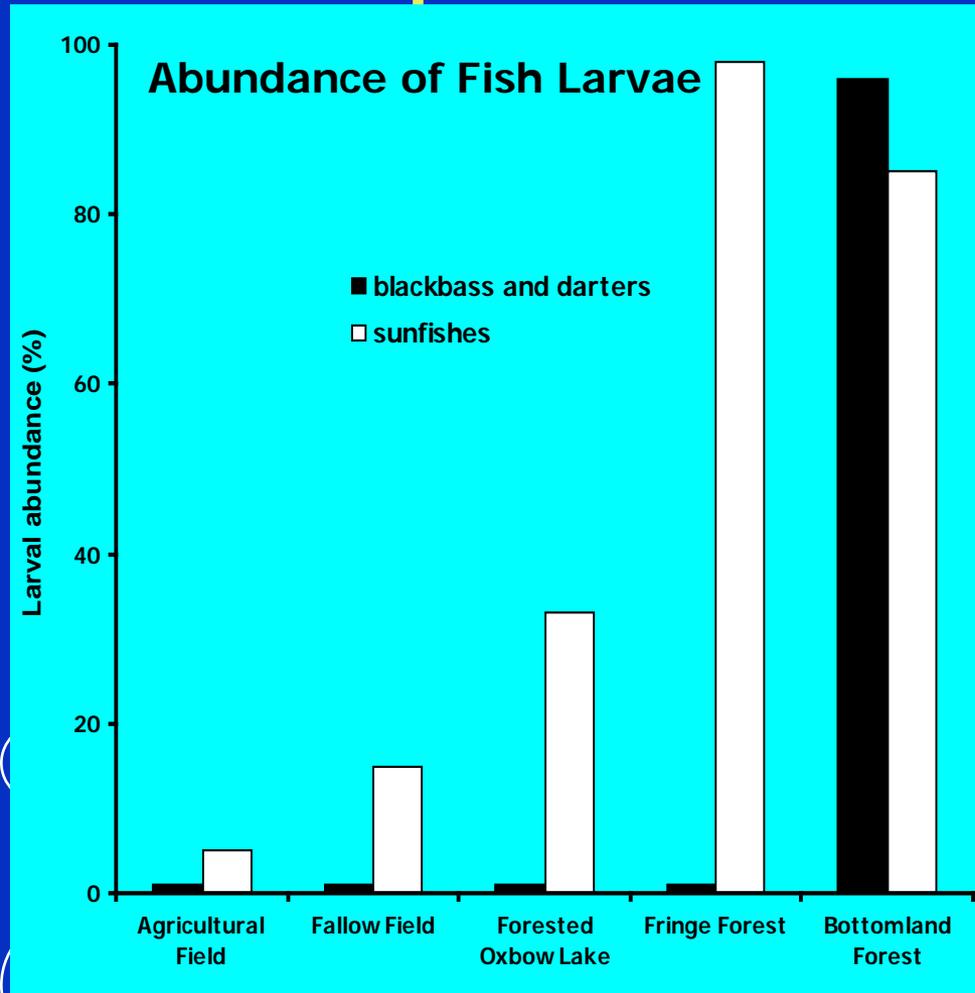


“Canal”
spawner

Pirate Perch



Flooded Forests and Fish Reproduction



- 65+ fish species characteristic of flooded bottomland hardwood forests

- BUT flooded forests provide spawning and nursery habitats for wetland fishes and fishes in adjacent streams

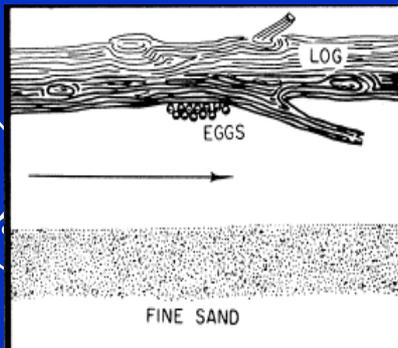
- Flooded forests are superior habitats for larvae for important sport fish and darters.

Hoover & Killgore. 1998. Fish Communities. In Messina and Conner, Southern Forested Wetlands

Summary

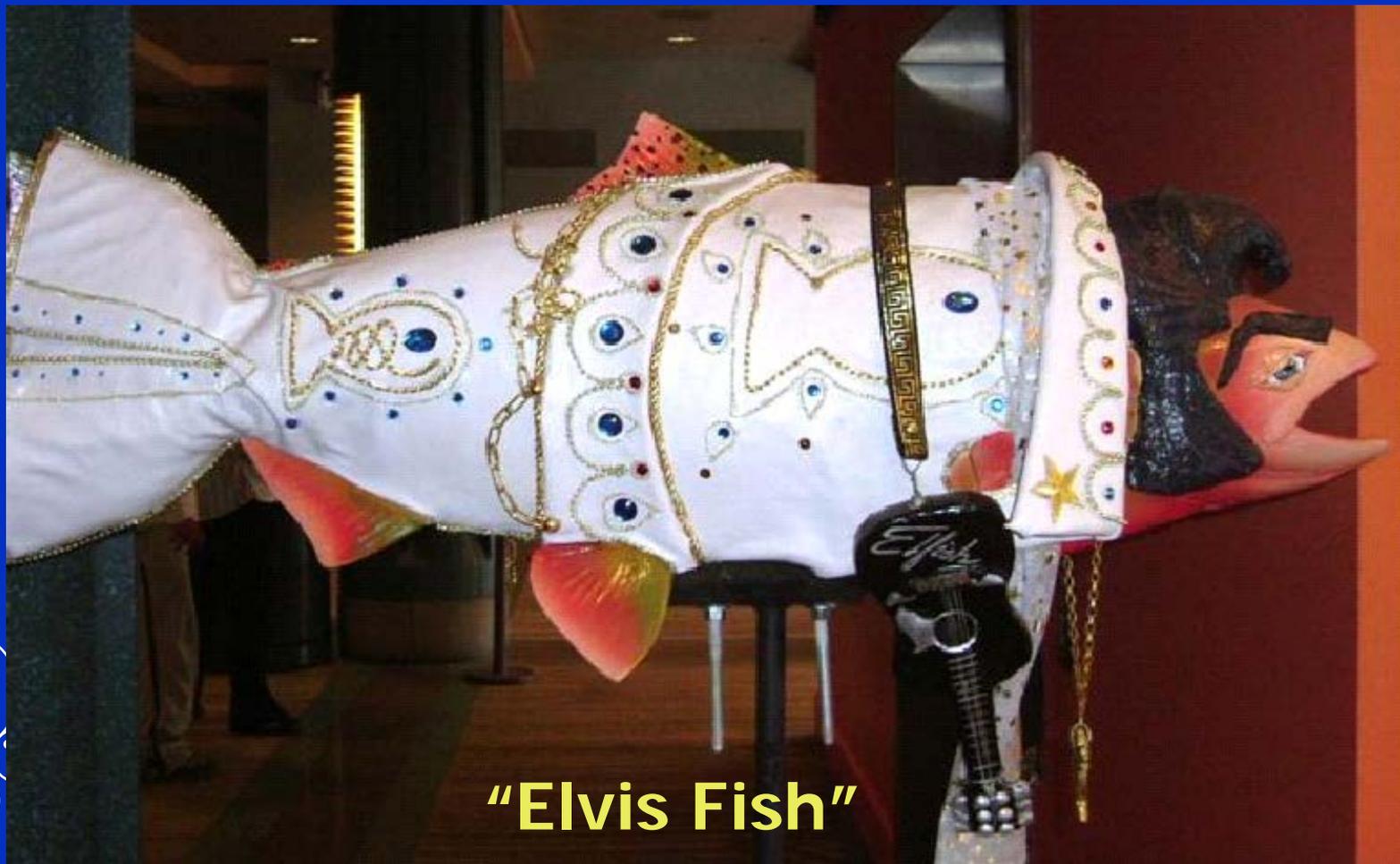
Fish-Forest Landscape Restoration Links

- Riparian forests: sediment—water quality—temperature—fish assemblages
- Instream wood as habitat
- Instream wood and food production



- Forests, instream wood, and reproduction

Thank you, thank you very
much!



"Elvis Fish"