Response of Fishes to Constructed, Woody Microhabitats in Sand-bed Streams of the Upper Coastal Plain, Mississippi, USA

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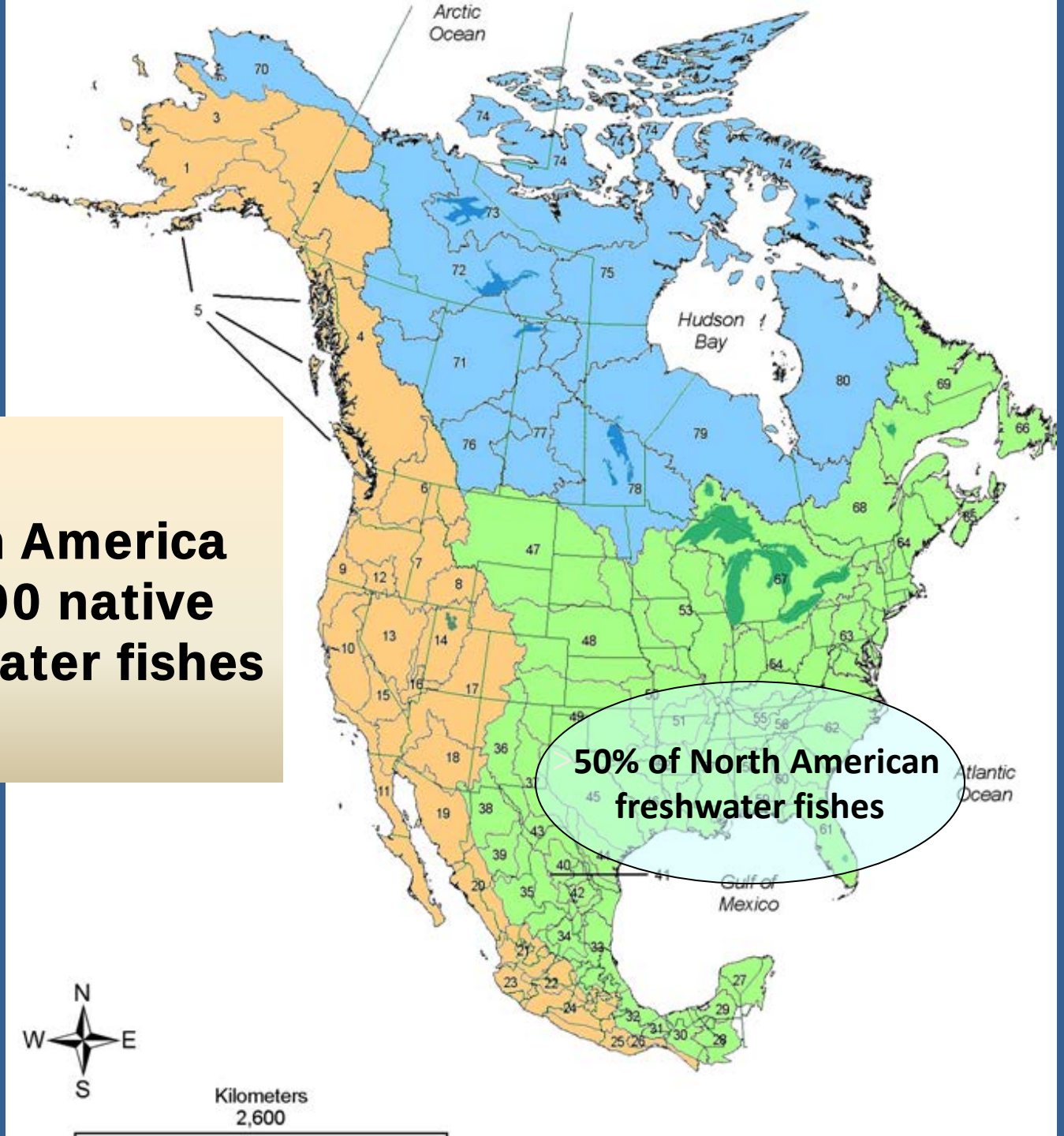
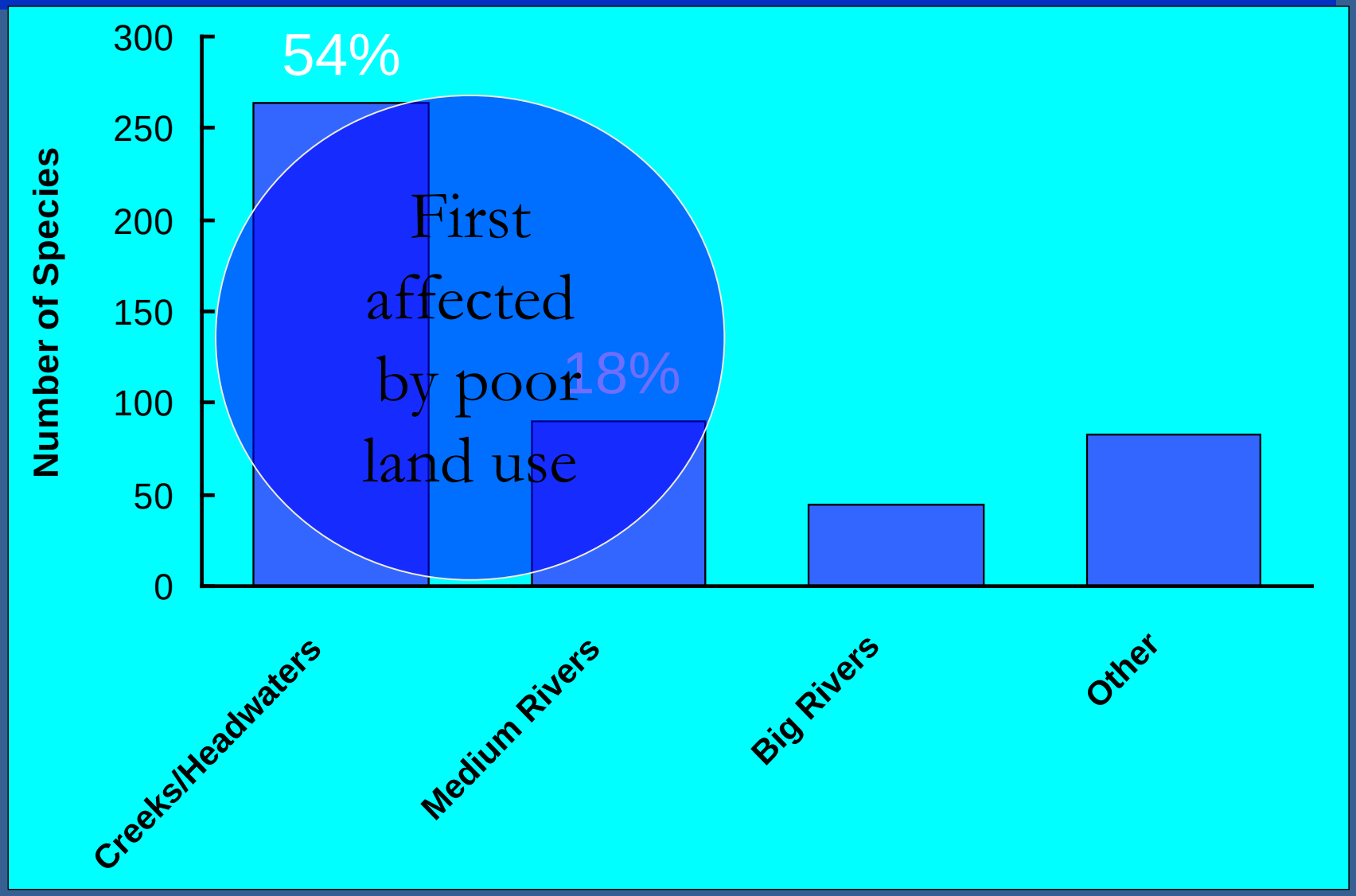
North America ~1100 native freshwater fishes



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



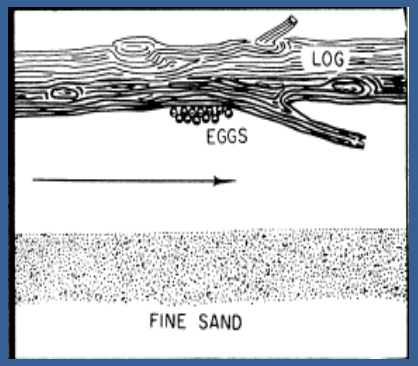
(Data from Etnier, 1997)

Fish-Forest Links

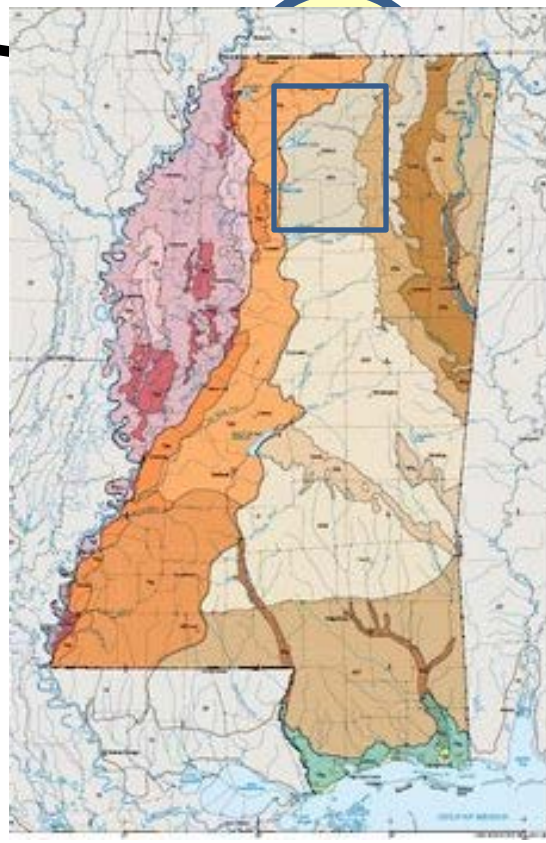
Riparian forests: sediment—water quality—temperature—fish assemblages

Instream wood provides habitat

Instream wood and food production

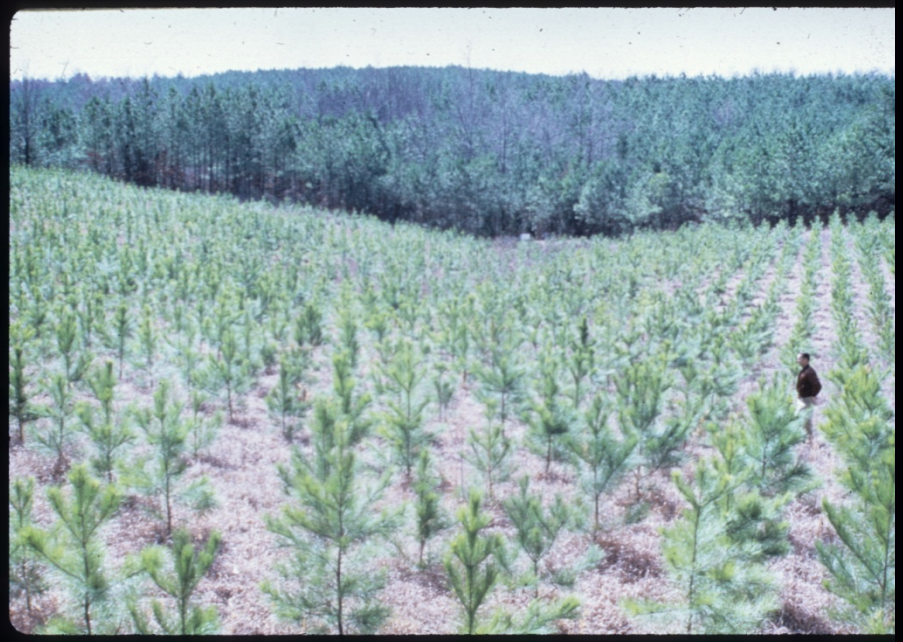


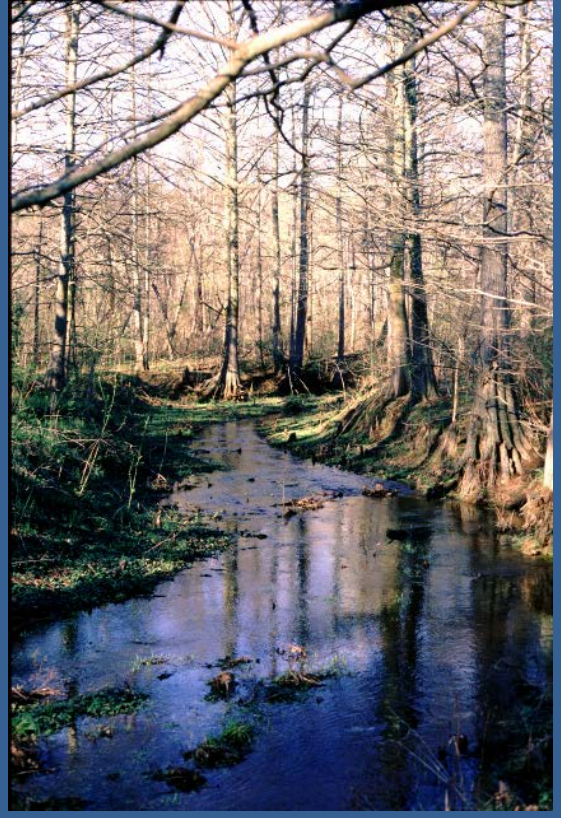
- Instream wood and reproduction



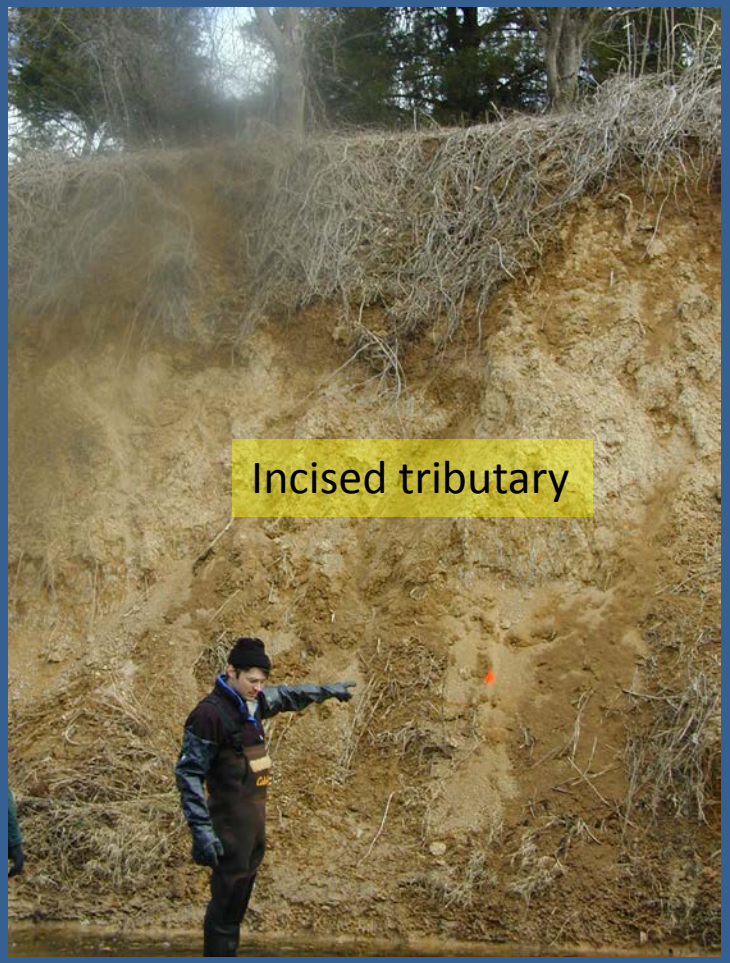
- Holly Springs National Forest
- Little Tallahatchie River system (Yazoo R-Miss. R.)
- Southeastern Plains
  - Northern Hilly Gulf Coastal Plain
- Irregular hills (30-91 m), clay-sand soils
- Mixed Hardwood-Pine Forests, 1000-1500 mm ppt/
- Most perennial streams, spring or groundwater fec
- Minimally disturbed small, perennial streams supp

Legacy of Historic Land Use





Channelization effects upstream tributaries via stream channel degradation or "STREAM INCISION"



~5 m

How important to fishes are accumulations of small wood in shallow, sand-bed streams in the upper Coastal Plain?

Cane bundles
(Asian bamboo *Phyllostachys* spp.)

- Installed by driving rebar in substrate
- Enclosed bundle with seine to capture fishes
- Identified , measured, and released fishes
- Recorded depth and current at point of capture

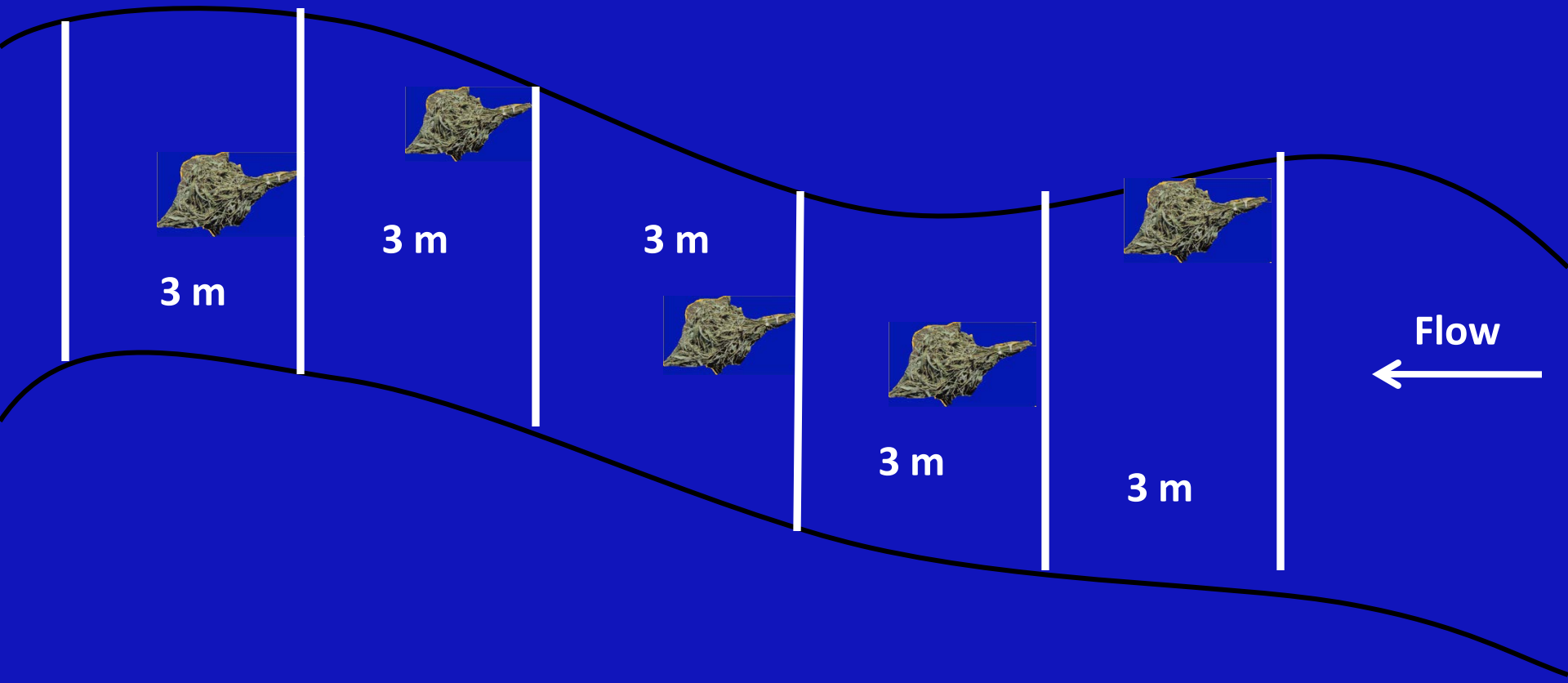
Objectives

- Examine fish use of standardized, constructed woody microhabitats (cane bundles) in streams with varying disturbance histories and amounts of naturally derived instream woody material

- Focus on four responses of fishes-
  - Occupancy
  - Abundance
  - Assemblage composition
  - Assemblage structure

90-m study reach

At 3-m intervals placed 30 bundles/stream (bank, mid-channel)



Disturbance Gradient

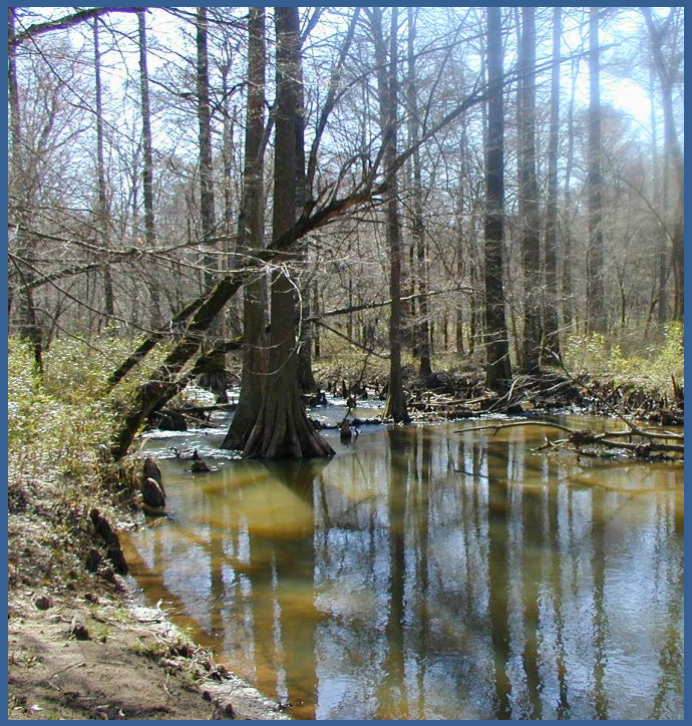
- Lee Creek- deeply incised, least depth and instream wood

Disturbance Gradient

- Cypress Creek-channelized, low depth and instream wood

Disturbance Gradient

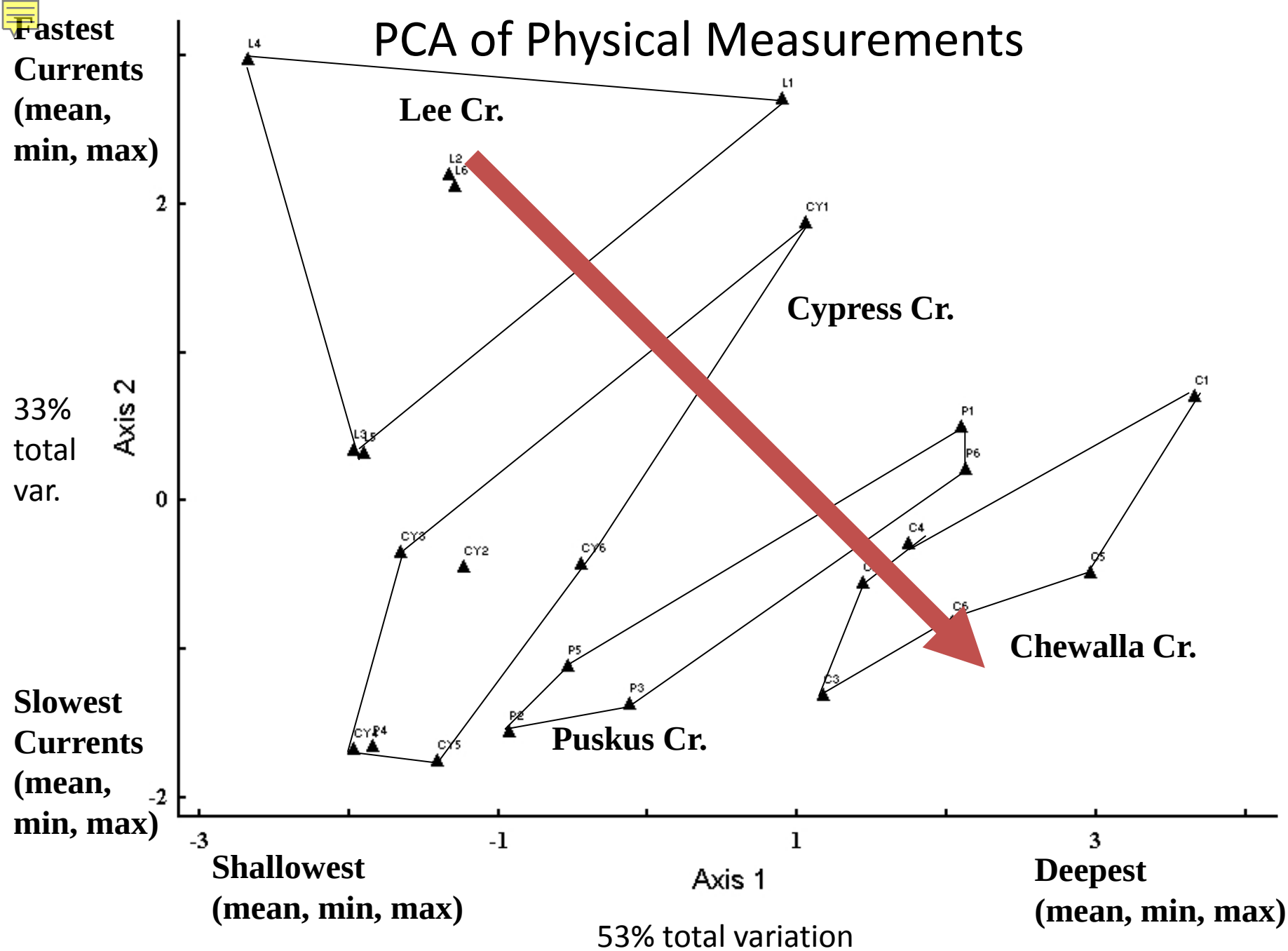
- Puskus Creek-natural channel, moderate depth and instream wood
- Chewalla Creek-natural channel, deepest, highest wood



Study Design

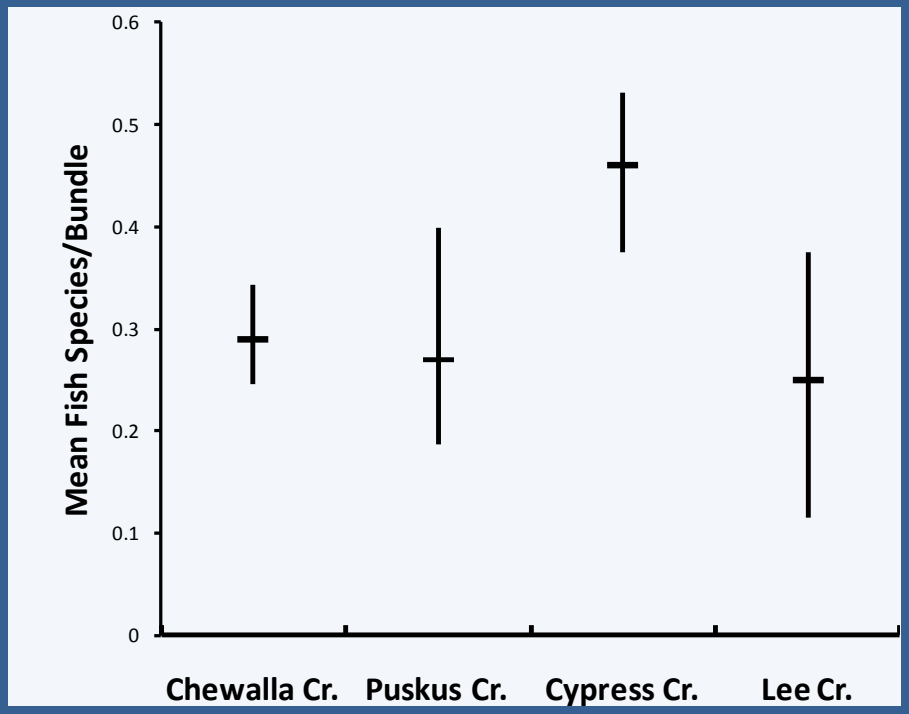
- **4 study streams**
- **Sampled after 14-day exposure**
- **6 exposures (March, May, June, October, September, February)**
- **Analysis**
  - **Habitat, PCA (Principal Components Analysis)**
  - **Abundance, bootstrap 95% CI (10^4 resamples)**
  - **Assemblage composition, MRPP (Multiresponse Permutation Procedure)**
  - **Assemblage structure, PCA**

PCA of Physical Measurements



Fish Use of Bundles Across Streams

- Diversity
  - 30 fish species
  - 9 fish families
  - 699 individuals
  - 0.25-0.46 spp./bundle



- Size
  - Mean 45 mm standard length
  - Range : 20-140 mm standard length

Topminnows (2)

Lampreys (1)

Sunfishes (6)

Pirate Perches (1)

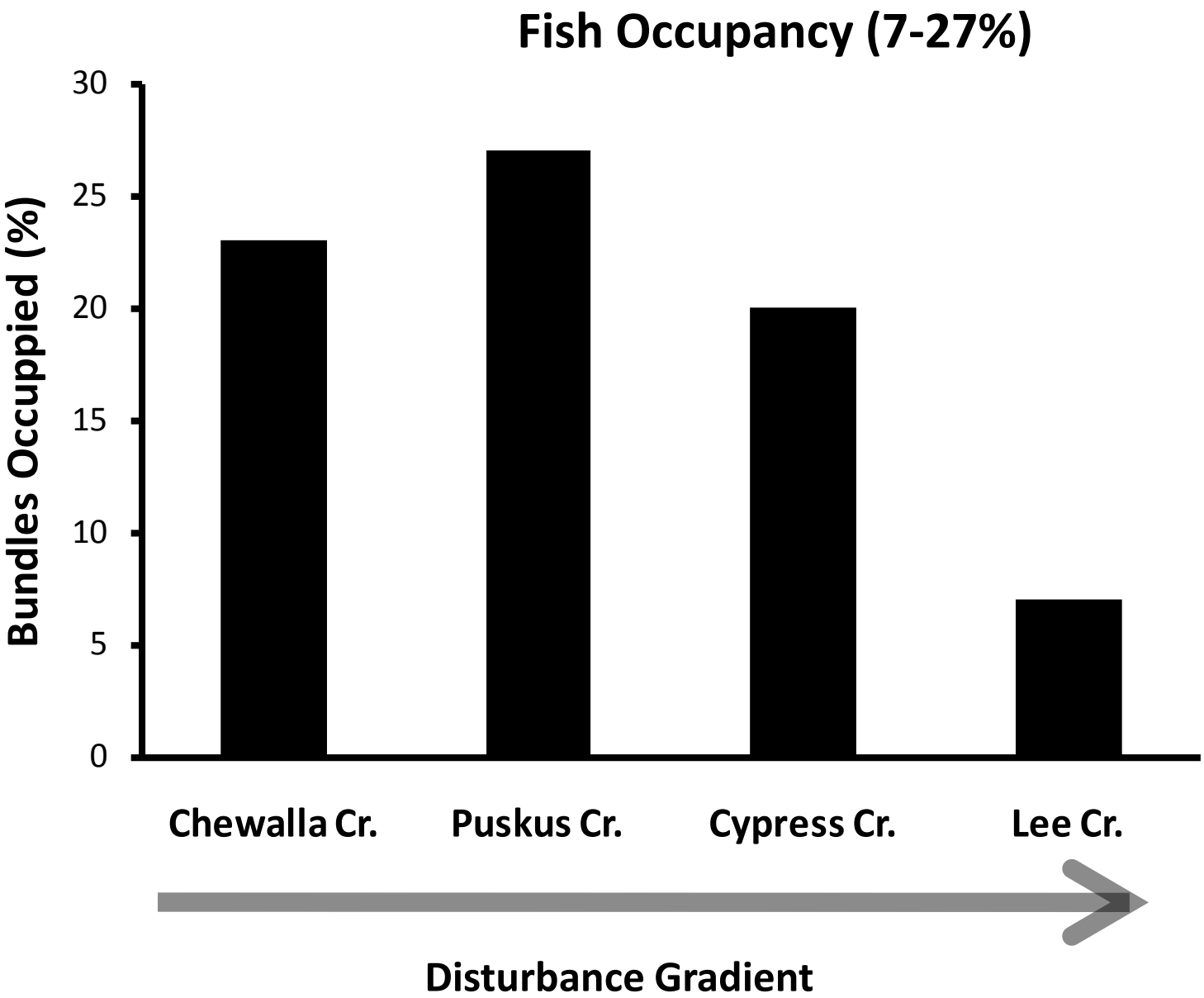
Minnows (8)

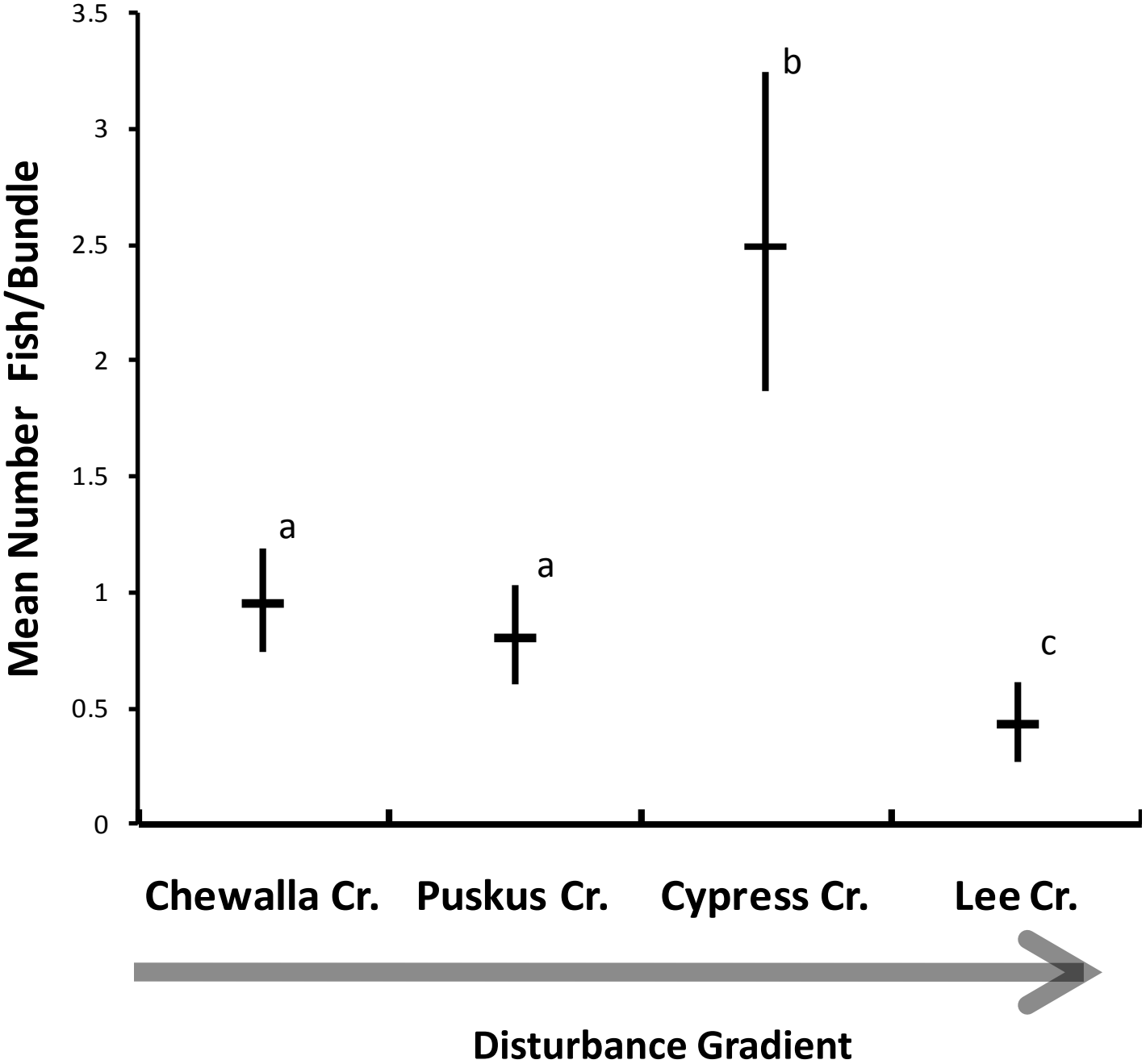
Perches (5)

Mosquitofishes (1)

Suckers (1)

North American Catfishes (5)


Fish Occupancy (7-27%)
Bundles Occuppied (%)
30
25
20
15
10
5
0
Chewalla Cr.
Puskus Cr.
Cypress Cr.
Lee Cr.
Disturbance Gradient


Mean Number Fish/Bundle
3.5
3
2.5
2
1.5
1
0.5
0
a
a
b
c
Chewalla Cr.
Puskus Cr.
Cypress Cr.
Lee Cr.
Disturbance Gradient

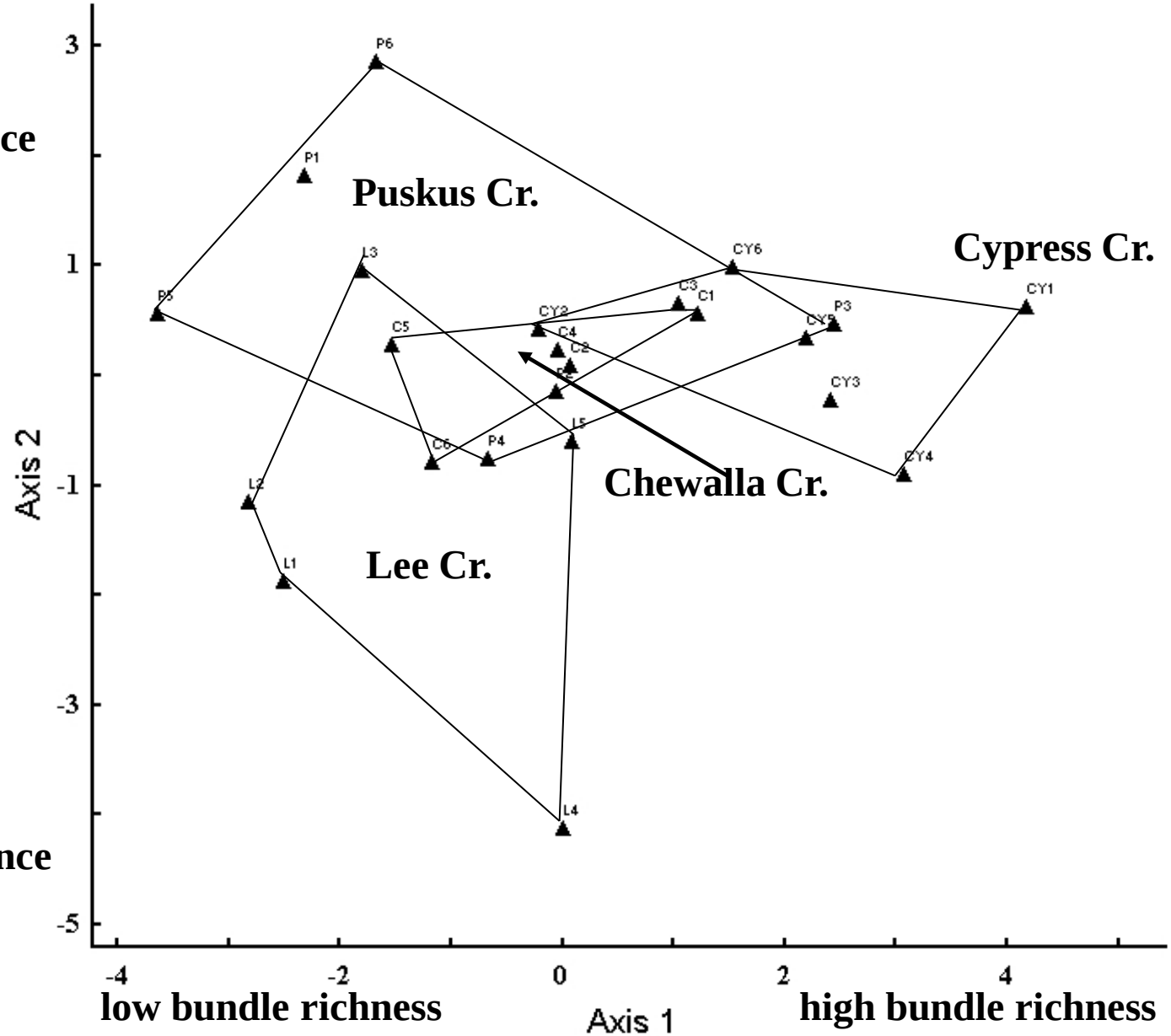
Differences in Fish Assemblage Composition in Bundles Among Streams (MRPP)

	Puskus Creek effect size (P-value)	Cypress Creek effect size (P-value)	Lee Creek effect size (P-value)
Chewalla Creek	0.053 (0.03814)*	0.063 (0.00757)*	0.094 (0.00439)*
Puskus Creek		0.078 (0.01065)*	0.083 (0.00058)*
Cypress Creek			0.109 (0.00381)*

large fish
high dominance
low CV abundance
low CV length

22% total variation

small fish
low dominance
high CV abundance
high CV length



low bundle richness
low site richness
low abundance

50% total variation

high bundle richness
high site richness
high abundance

Conclusions

- High numbers and kinds of fishes used the bundles the constructed cane bundles in most study streams.
- Use was least in the most disturbed stream but similar in the others.
- Abundance in bundles differed greatly between the two most disturbed streams but was intermediate and similar in the least disturbed streams.
- Assemblages in bundles were distinct among streams.
- Assemblage composition was most different in the two disturbed streams and least different in the two undisturbed streams.
- Assemblage structure across time and streams was complex and did not follow a simple linear disturbance gradient but again contrasted the two most disturbed streams with the two least disturbed systems showing intermediacy.

Three relatively well known links—riparian forests act to:

Reduce erosion
- Stabilize streambanks
- Decrease sediment runoff

Moderate temperature extemes (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

Disturbance Gradient

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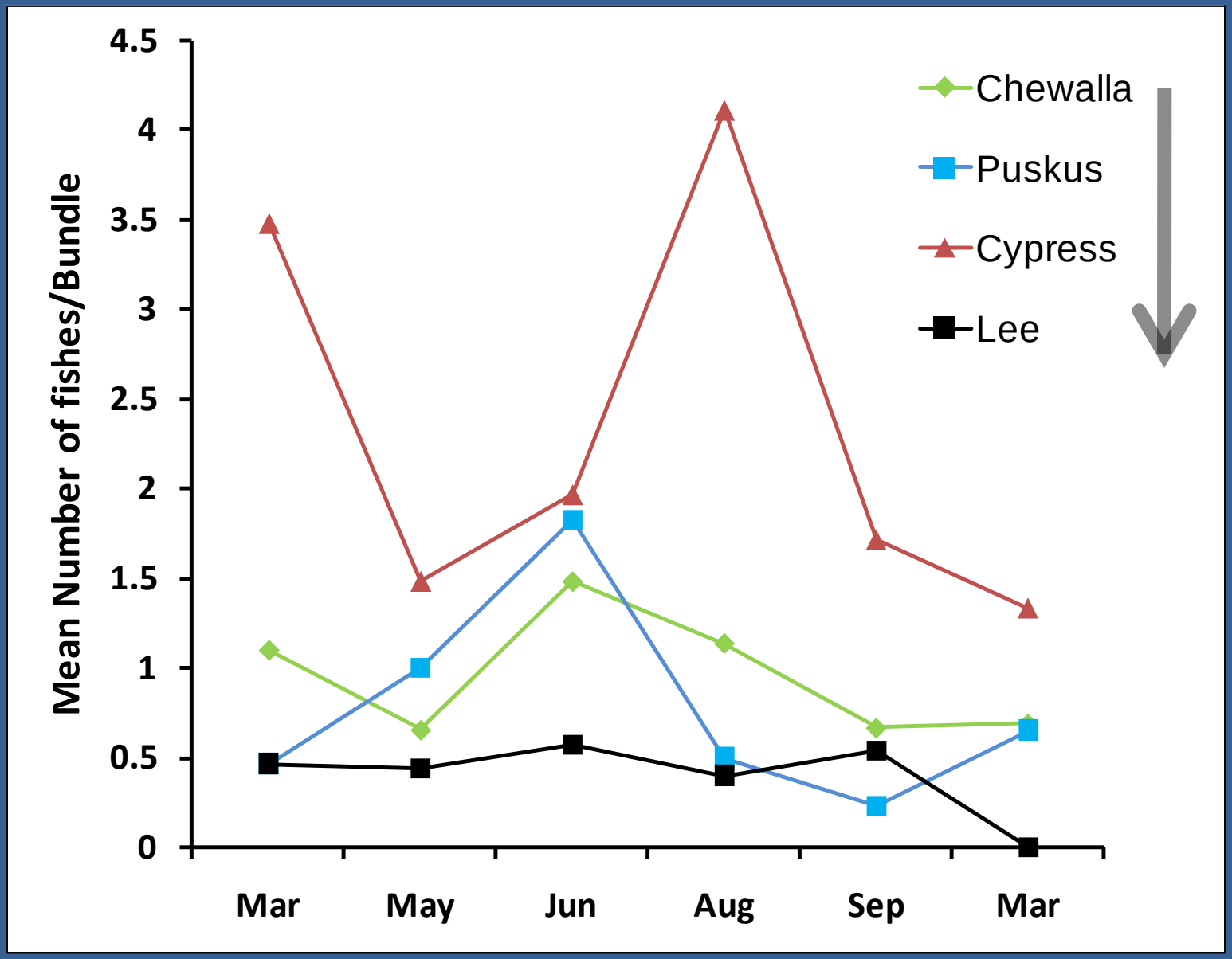
Mean Number of fishes/Bundle
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Mar
May
Jun
Aug
Sep
Mar
Chewalla
Puskus
Cypress
Lee