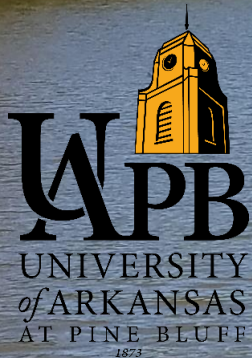# Effects of Bigheaded Carps on Native Fish Assemblages in Oxbow Lakes of the Lower White River
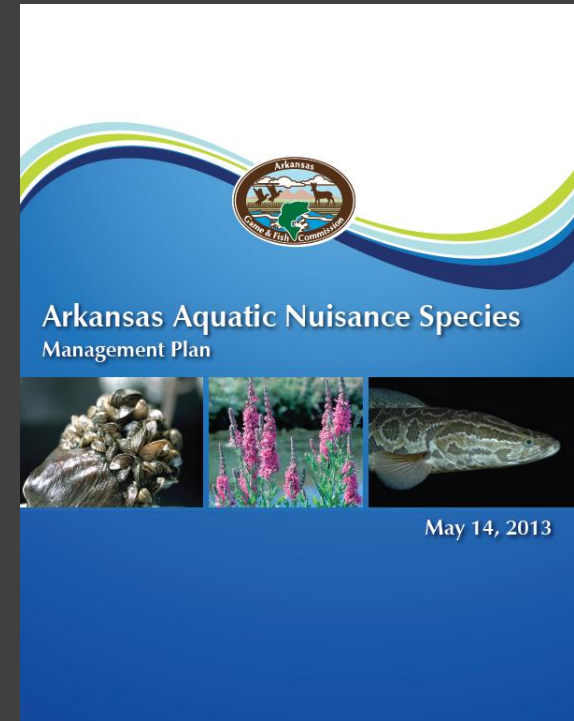
Cody Salzmann,
Joseph Kaiser, Shannon Smith,
and Michael Eggleton

University of Arkansas at Pine Bluff
Department of Aquaculture and Fisheries

Arkansas ANS Management Plan (2013)

1) The extent to which the species is invasive and becomes a nuisance

2) Economic damage

3) Ecological damage

4) Harm to human health

5) Feasibility of management or control

Bighead and Silver Carps

Invasive fishes whose population ranges have grown tremendously during the past 10-15 years

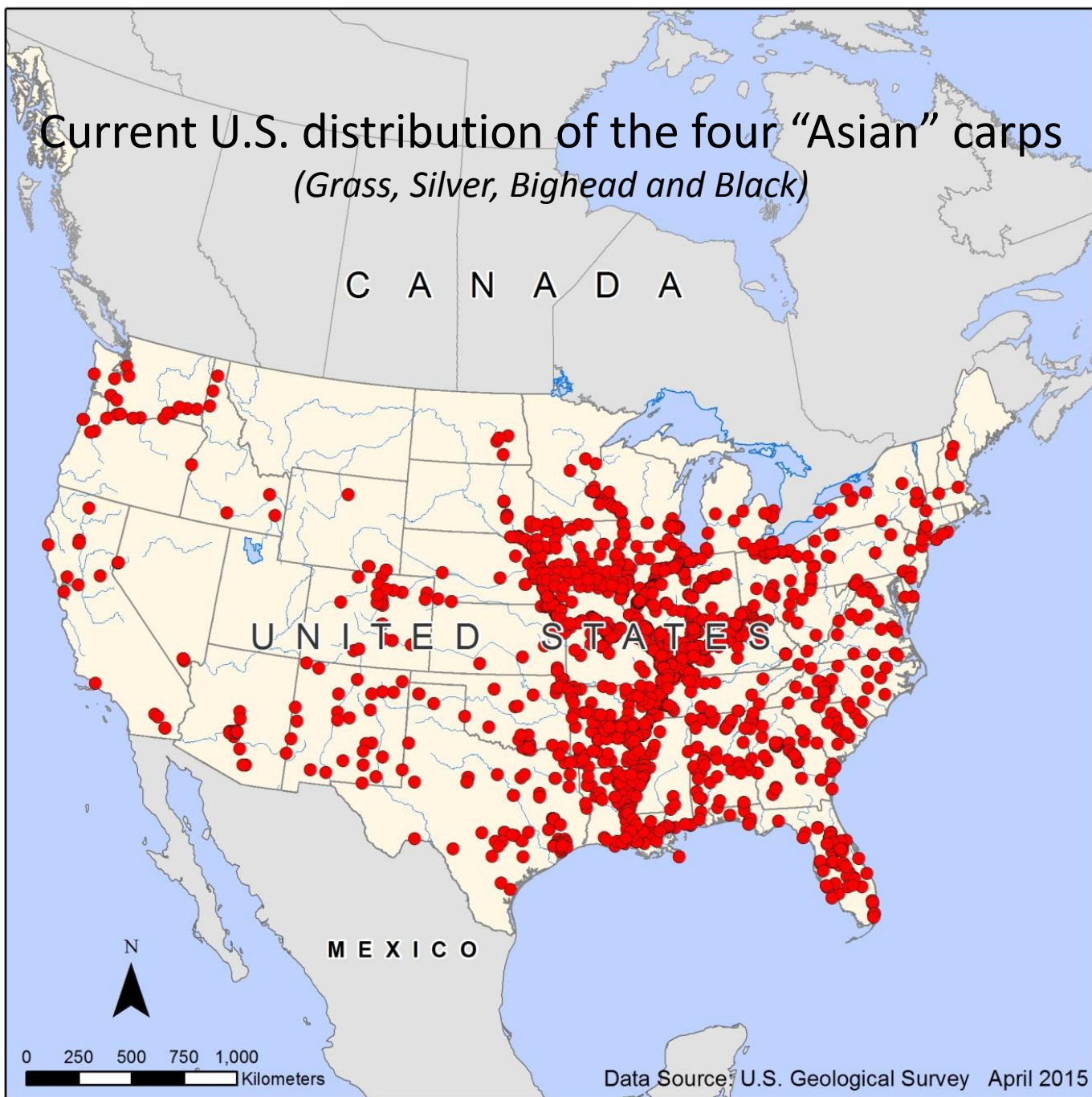Collectively referred to as "bigheaded carps"

Bighead Carp
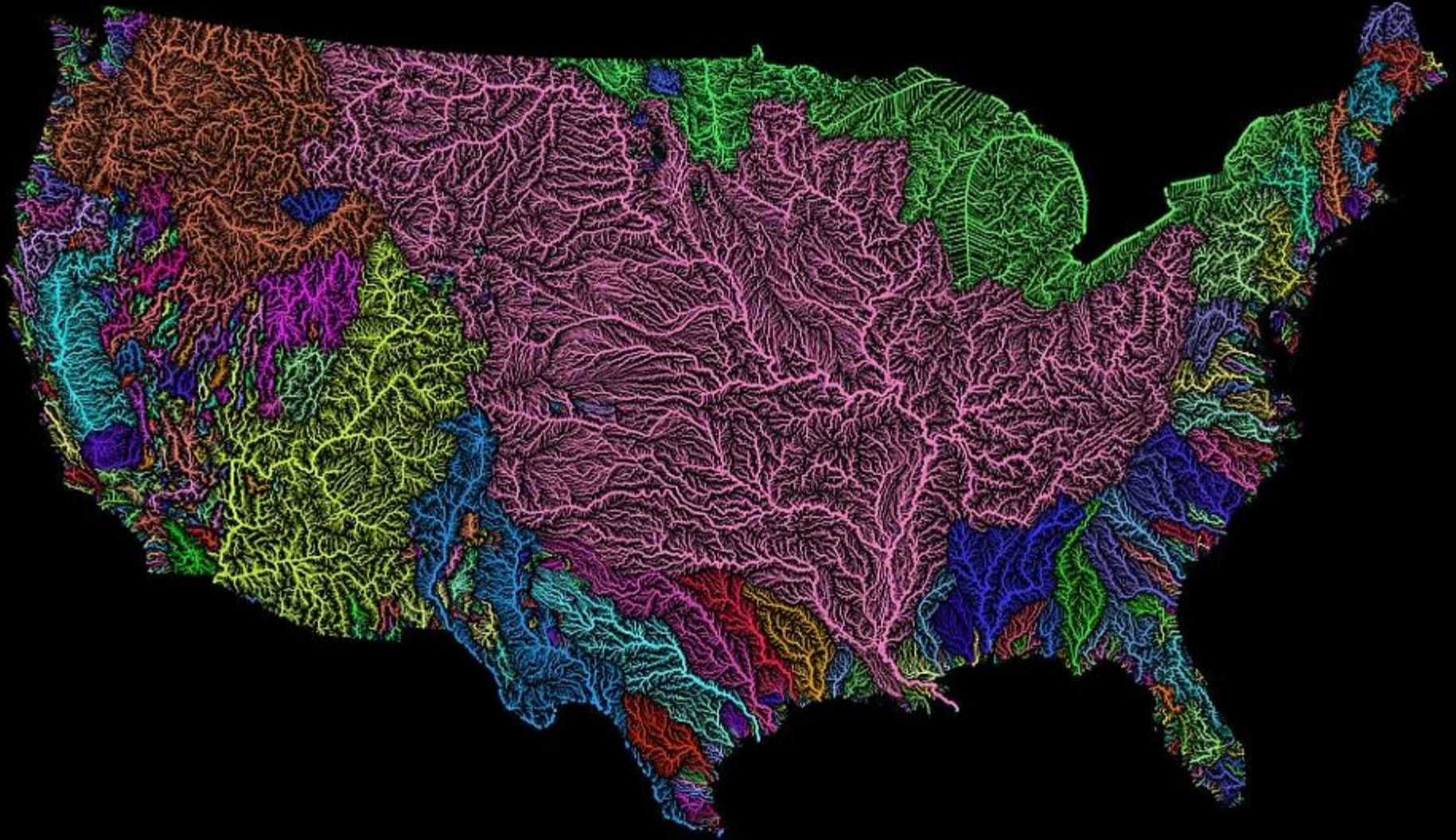*Hypophthalmichthys nobilis*

Silver Carp
Hypopthalmichthys molitrix

Current U.S. distribution of the four "Asian" carps
(Grass, Silver, Bighead and Black)

Data Source: U.S. Geological Survey   April 2015

U.S. River Basins

U.S. River Basins

Lower White River

- Bigheaded carps are established

- Less altered lowland river-floodplain ecosystem

- Invasion is relatively recent (since 2005)

- Unique habitats and high fish diversity

- Nearby Cache-White River confluence listed as RAMSAR "Wetlands of International Significance"

- Extensive historical datasets available
(Lubinski 2004; Clark 2006)
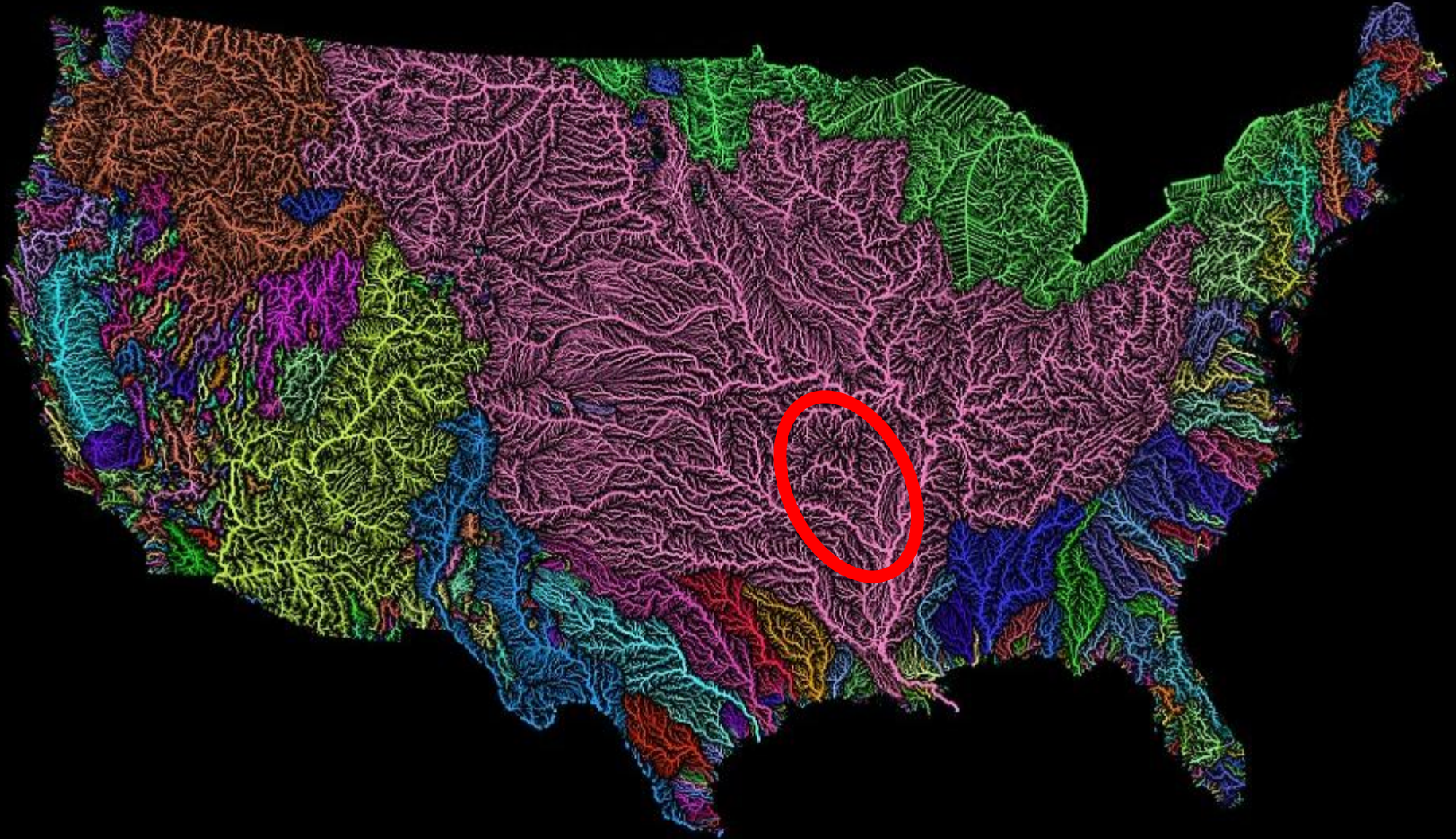
Lubinski (2004) and Clark (2006)

Data collection preceded widespread carp establishment in lower White River...

Relationships between Floodplain Lake Fish Communities and Environmental Variables in a Large River–Floodplain Ecosystem

BENJAMIN J. LUBINSKI[1]
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JOHN R. JACKSON
Department of Biological Sciences, Arkansas Tech University,
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MICHAEL A. EGGLETON*
Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff,
1200 North University, Box 4912, Pine Bluff, Arkansas 71601, USA

A Comparison of Shoreline Seines with Fyke Nets for Sampling Littoral Fish Communities in Floodplain Lakes

SANDRA J. CLARK[1] AND JOHN R. JACKSON*
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STEVE E. LOCHMANN
Department of Aquaculture and Fisheries, University of Arkansas at Pine Bluff,
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Fisheries Technical Articles

Potential for a Minimum-length Limit Regulation to Improve Floodplain Lake Crappie Fisheries in Arkansas

Michael A. Eggleton, Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff, 1200 N. University, Box 4912, Pine Bluff, AR 71601
John R. Jackson, Arkansas Tech University, Department of Biological Sciences, 1701 North Boulder, Russellville, AR 72801
Benjamin J. Lubinski, Illinois Natural History Survey, Great Rivers Field Station, 8450 Montclair Avenue, Brighton, IL 62012

Comparison of Gears for Sampling Littoral-Zone Fishes in Floodplain Lakes of the Lower White River, Arkansas

MICHAEL A. EGGLETON*
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JOHN R. JACKSON
Department of Biological Sciences, Arkansas Tech University,
1701 North Boulder, Russellville, Arkansas 72801, USA

BENJAMIN J. LUBINSKI
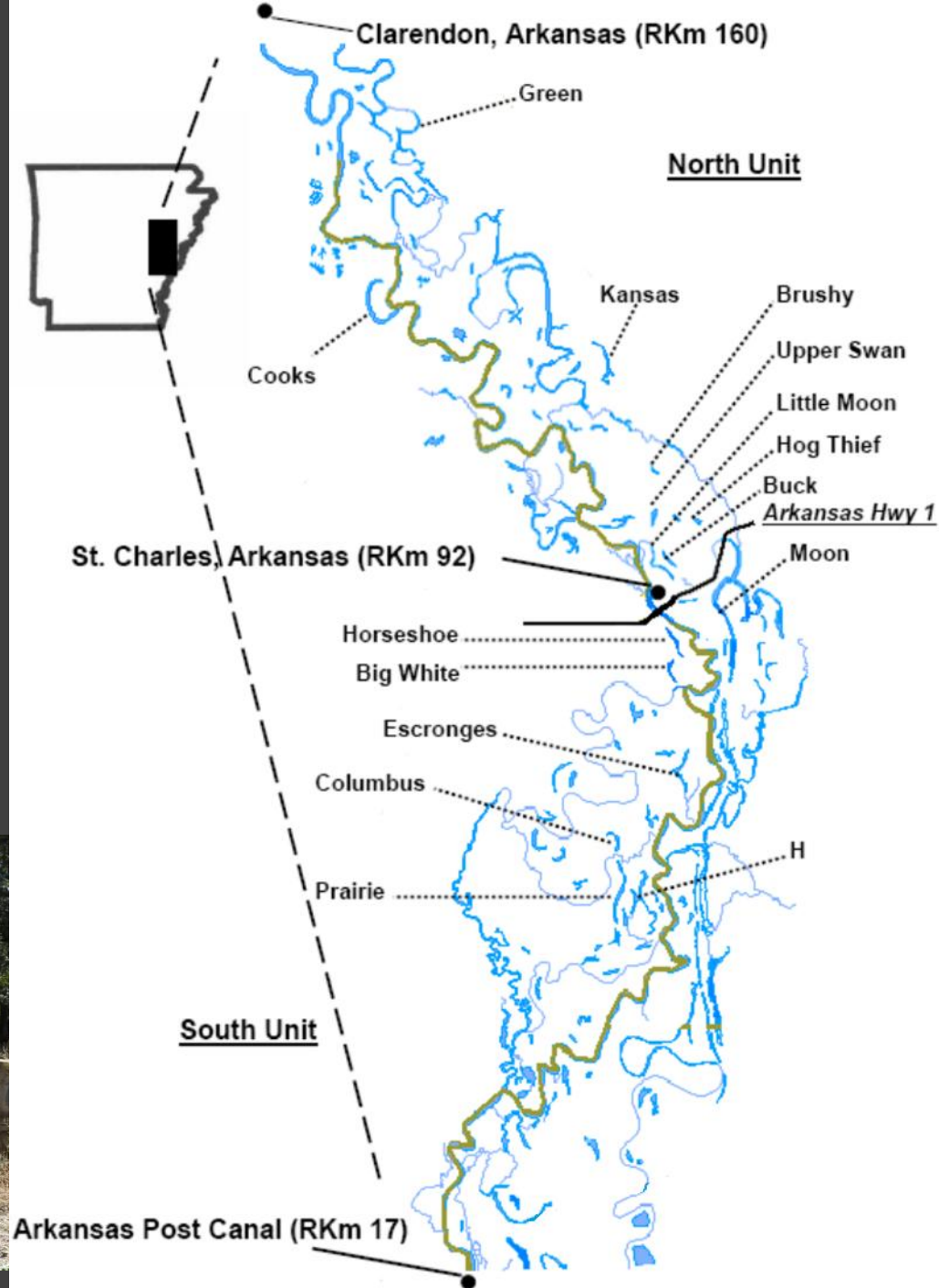Illinois Natural History Survey, Great Rivers Field Station,
8450 Montclair Avenue, Brighton, Illinois 62012, USA

Study Areas

Replicate oxbow lake sampling during "pre-carp" period

- 15 oxbow lakes total
- 7 lakes within North Unit
- 8 lakes within South Unit

Multi-Gear Fish Collections
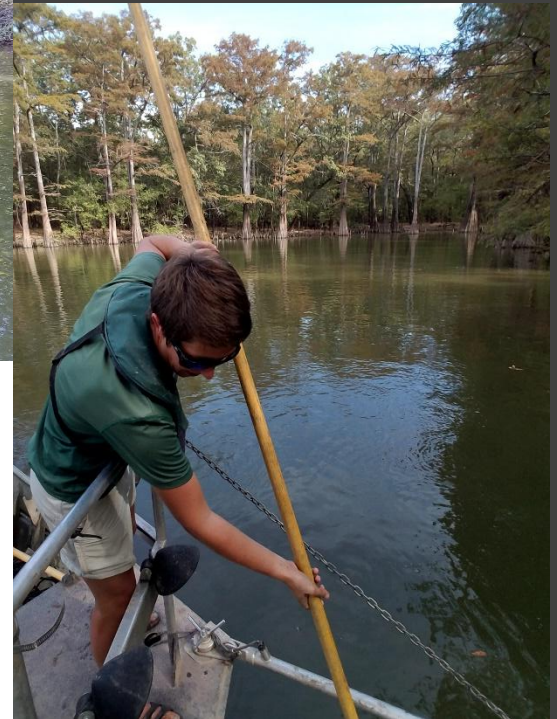
Done in replicate in all study lakes during July-August and October-November 2017 ("post-carp" period)

Objectives
a pre-carp/post-carp comparison…

Objective 1:   Compare present-day (i.e., post-carp) oxbow lake fish assemblage attributes* with historical datasets collected during 2002-2005 (i.e., pre-carp invasion)

*Attributes include abundance, richness, evenness, and diversity

Objective 2:   Examine relationships between present-day oxbow lake fish assemblage attributes and bigheaded carp densities in oxbow lakes

Objective 3:   Compare present-day empirical relationships between oxbow lake fish assemblages and selected environmental variables (that include bigheaded carp densities) to historical fish-environment relationships

In Progress

Objective 1: Fish Assemblage Variables

- Species-specific fish abundances – quantified by various measures of CPUE

  All CPUE measures will be ~~gear~~ specific

  Ex: catch/net-night, catch/net, or catch/hr

- Total fish abundance, relative abundances of selected groups

  Ex: particular trophic guilds, age-0, or fish ≥400-mm TL

$$D = 1 - \sum \left(\frac{n_i}{N}\right)^2$$

$$H' = -\sum_{i=1}^{s} \left(\frac{n_i}{N}\right) \ln \left(\frac{n_i}{N}\right)$$

$$D = \frac{S}{\sqrt{N}}$$

$$e = \frac{\bar{H}}{LogS}$$

In Progress

In Progress

Objective 1: Fish Assemblage Variables

- Species indices – including richness, richness index, evenness, and diversity

    All measures pooled across gears and seasons

- Use of mean ranks – will average rank abundances across gear types and generate one composite measure of species abundance for the assemblage (per Lubinski et al. 2008)

In Progress

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Preliminary Information (2017)
using all datasets combined

Salzmann & Kaiser	Electrofishing* (60-Hz and 15-Hz)	Gillnetting	Mini-Fyke*	Total*
Fishes collected	21,499	1,446	12,090	35,035
Number of species	*56*	*34*	*43*	*65*

*identification of unidentified specimens pending
(4,470+ from mini-fykes, 876+ from electrofishing)

Preliminary Information (2017)
using only summer netting & fall electrofishing

Salzmann & Kaiser	Electrofishing* (60-Hz and 15-Hz)	Gillnetting	Mini-Fyke*	Total*
Fishes collected	9,661	488	9,747	19,896
Number of species	*48*	*30*	*39*	*61*

Historical Information (2002)
using only summer netting & fall electrofishing

Lubinski	Electrofishing (60-Hz and 15-Hz)	Gillnetting	Mini-Fyke	Total
Fishes collected	7,643	529	33,893	42,065
Number of species	*47*	*24*	*44*	*64*

*identification of unidentified specimens pending
(3,935 from mini-fykes, 583+ from electrofishing)

Shannon-Weiner Diversity
current vs. historical

Metric	Salzmann & Kaiser (2017)	Lubinski (2002)	Salzmann & Kaiser (2017)*
S	65	64	61
H'	2.618	2.351	2.357
H'_{max}	4.174	4.159	4.111
E	0.627	.565	0.573
SRI	0.347	0.312	0.432

*identification of unidentified specimens pending
(3,935 from mini-fykes, 583+ from electrofishing)

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Assemblage Differences

	Lubinski (2002)	Salzmann & Kaiser (2017)	
Count	Species	Species	Count
1	CNLP	AGGR	2
257	CYMW	BHCP	1
57	DLSF	BHMW	21
1	GDTM	BKCARP	1
1	GSPK	BNMW	3
1	HFCS	CYDR	12
4	LKCS	FLIR	1
1,322	MMSN	GDYE	5
5	NSTM	GSCP	6
27	PDSN	QLBK	1
7	SGER	RVDR	2
14,928	SVMW	SRBS	6
		SRML	1

Assemblage Differences

Missing species

Lubinski (2002)		Salzmann & Kaiser (2017)	
Count	Species	Species	Count
1	CNLP	AGGR	2
257	CYMW	BHCP	1
57	DLSF	BHMW	21
1	GDTM	BKCARP	1
1	GSPK	BNMW	3
1	HFCS	CYDR	12
4	LKCS	FLIR	1
1,322	MMSN	GDYE	5
5	NSTM	GSCP	6
27	PDSN	QLBK	1
7	SGER	RVDR	2
14,928	SVMW	SRBS	6
		SRML	1

Assemblage Differences

New species

Lubinski (2002)		Salzmann & Kaiser (2017)	
Count	Species	Species	Count
1	CNLP	AGGR	2
257	CYMW	BHCP	1
57	DLSF	BHMW	21
1	GDTM	BKCARP	1
1	GSPK	BNMW	3
1	HFCS	CYDR	12
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27	PDSN	QLBK	1
7	SGER	RVDR	2
14,928	SVMW	SRBS	6
		SRML	1

Silver Carp

Silver Carp *Hypopthalmichthys molitrix*

Objective 2: Establishment of an Silver Carp Density Gradient

- Pop-Shocking
    - 30 sec at 60-Hz/500-V
    - Visual observations of all carp "jumps" from three observers
- Electrofishing
    - Six 10-minute transects with GoPro cameras mounted and running
- Gill nets
    - Two net types, with experimental meshes ranging from 2.54-cm to 20-cm (1-8")
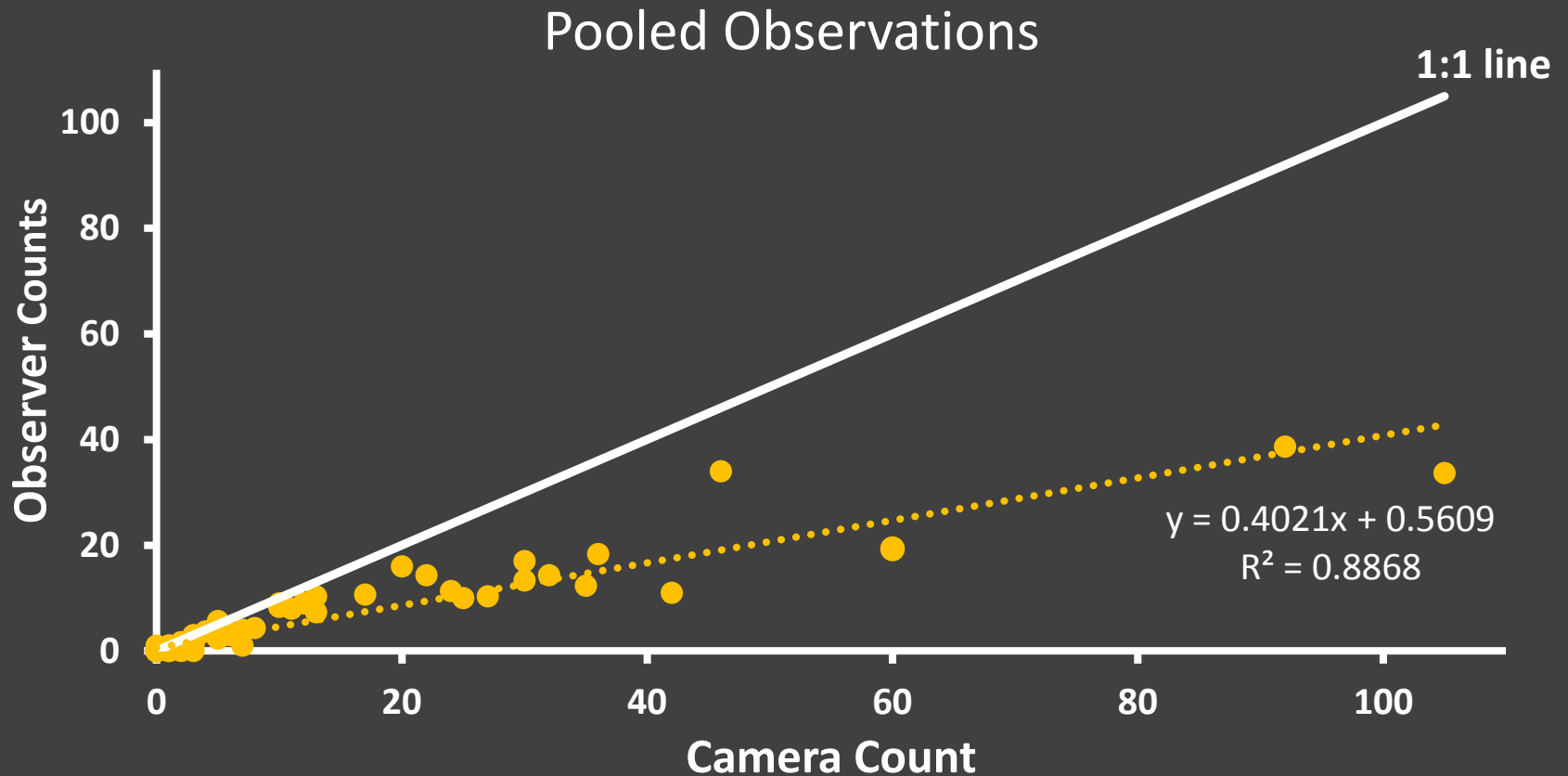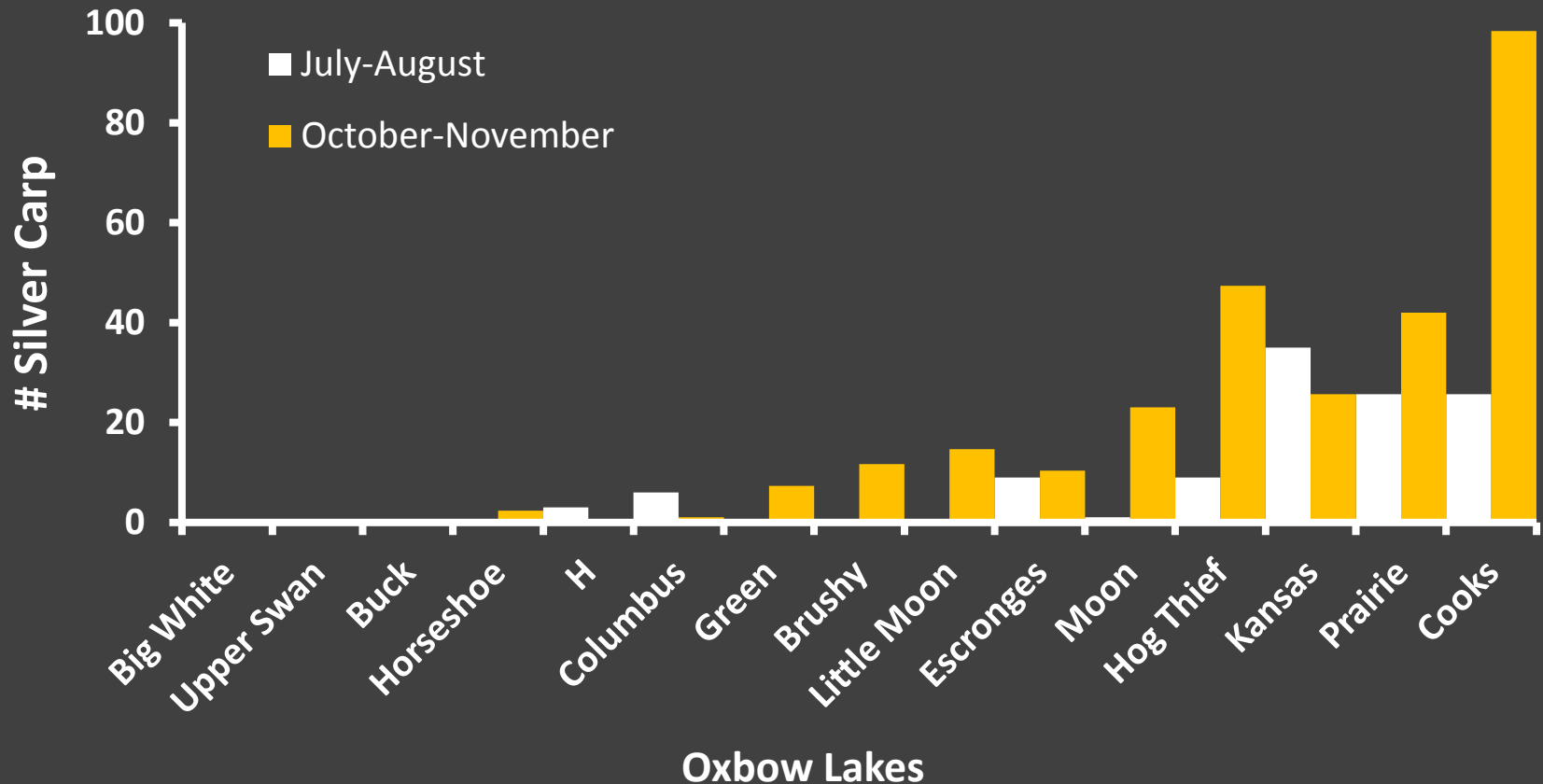
CARPOCALYPSE!!!

Visual Observations
comparing observed carp "jumps" vs. camera counts

Pooled Observations

1:1 line

$y = 0.4021x + 0.5609$
$R^2 = 0.8868$

Observer Counts

Camera Count

*P = 1.14 E-57

Camera Counts from Pop-Shocking
seasonal variation within lakes

Legend:
- ■ July-August (white)
- ■ October-November (yellow)

Y-axis: # Silver Carp (0, 20, 40, 60, 80, 100)

X-axis (Oxbow Lakes): Big White, Upper Swan, Buck, Horseshoe, H, Columbus, Green, Brushy, Little Moon, Escronges, Moon, Hog Thief, Kansas, Prairie, Cooks

Silver Carp abundances
ranks averaged across gears & seasons

Lake	Summer	Fall	Mean Rank*
Cooks	4.1	1.3	**2.7**
Prairie	4.1	2.8	**3.4**
Kansas	5.4	3.4	**4.4**
Escronges	3.3	7.9	**5.6**
Columbus	4.5	9.1	**6.8**
Little Moon	8.0	7.0	**7.5**
Hog Thief	8.4	6.9	**7.6**
H	8.0	9.6	**8.8**
Moon	10.1	8.1	**9.1**
Green	11.1	8.0	**9.6**
Buck	8.5	11.6	**10.1**
Brushy	12.3	9.4	**10.8**
Big White	10.4	11.5	**10.9**
Horseshoe	11.1	10.8	**10.9**
Upper Swan	10.8	12.8	**11.8**

*averaged across all gears and both seasons

Silver Carp abundances
## ranks averaged across gears & seasons

Lake	Summer	Fall	Mean Rank*
Cooks	4.1	1.3	**2.7**
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Green	11.1	8.0	**9.6**
Buck	8.5	11.6	**10.1**
Brushy	12.3	9.4	**10.8**
Big White	10.4	11.5	**10.9**
Horseshoe	11.1	10.8	**10.9**
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Increasing carp abundances

*averaged across all gears and both seasons

Richness Indices vs. Carp Abundance
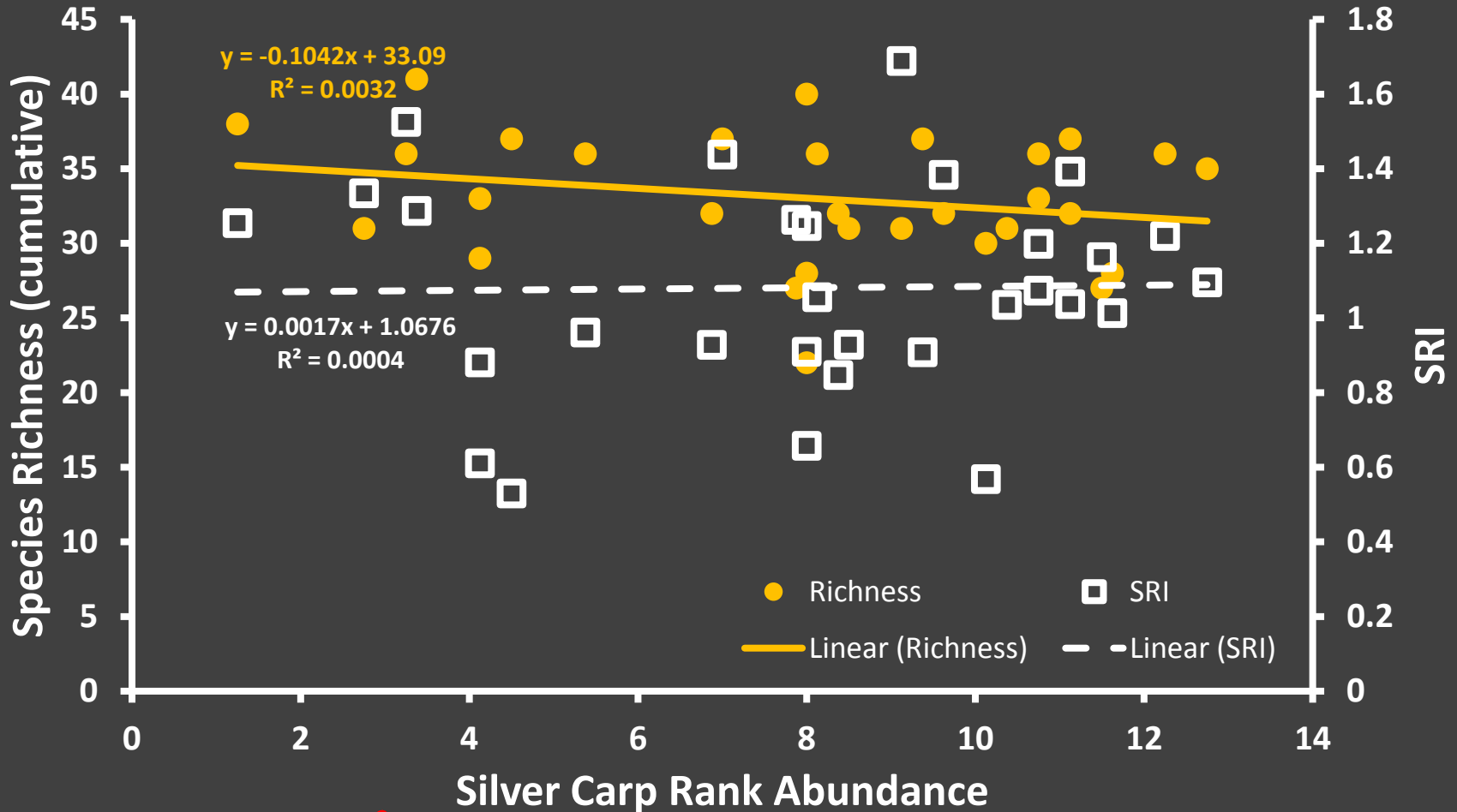
Summary

- Effects and/or impacts of bigheaded carp invasions on native fishes and fisheries is vital to fisheries management on a [nearly] national scale...

- Richness, SRI, diversity, and evenness only part of the story
  - shifts in fish assemblage structure not apparent

- At present, 12 species not found compared to historical datasets, but 13 new species have been collected
  - most species lost or gained were historically rare
  - possibly due to gear and/or seasonal differences

- Future work will focus on multivariate analyses of fish assemblage structure in comparison to historical datasets

Acknowledgements

- University of Arkansas at Pine Bluff

  Funding, equipment & facilities

  Jeremiah Salinger, Susie Frawley & Kyler Hecke

- U.S. Fish and Wildlife Service

  Funding & facilities

  Jay Hitchcock & WRNWR staff

- Arkansas Game and Fish Commission

  Jimmy Barnett

- USGS

  Billy Justus
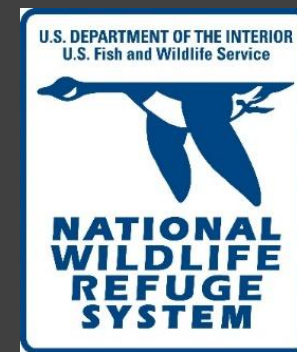
Questions

None found in entire study...

Two captured with one swimming away in good shape...

And we found one of these...

UAPB
UNIVERSITY
of ARKANSAS
AT PINE BLUFF
1873