

## 2016 Proposal to AGFC SWG Program – Eggleton et al.

**Project Title:** Effects of Asian Carps on Native Fish Assemblages in White River Oxbow Lakes

**Project Summary:** The silver carp *Hypophthalmichthys molitrix* has become highly abundant, particularly in large river systems such as the Mississippi and lower White rivers. Both silver carp and bighead carp *Hypophthalmichthys nobilis* are listed as an injurious species under the Lacey Act ([www.fws.gov/injuriouswildlife/pdf\\_files/Current\\_Listed\\_IW.pdf](http://www.fws.gov/injuriouswildlife/pdf_files/Current_Listed_IW.pdf)); thus, their importation from another country and their transport across state lines is prohibited. In areas where silver carp have become established, some losses of recreational fishing and boating opportunities have occurred due to their jumping tendencies (Garvey et al. 2006). The ecological consequences of high abundances of these carps are presumed to be negative, but they have been thoroughly investigated, and are, thus, essentially unknown (Conover et al. 2007; AGFC 2013). In light of growing carp populations in some Arkansas waters and the potential for continued range extensions, their effects on native fish assemblages needs further investigation.

### **Project Co-Leaders:**

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**Project Budget:** The total project cost is **\$75,246**; this project requests **\$38,842** from the SWG program over a 2-year (fiscal year) period. Non-federal matching funds totaling **\$36,404** (48% of total project cost) are being provided from AGFC biologist time, AGFC equipment use, and UAPB nonresident graduate student tuition waiver. UAPB also is funding a 2.5-year M.S. assistantship to support this project (valued at **\$60,260** including fringe). In addition, \$11,000 in research support is provided over the next 2 years. (*University reporting guidelines prohibit the assistantship and related support from being shown as “match” for SWG grants*)

## Project Statement

**Project Need:** Successful introduction and expansion of non-native fishes has increased exponentially in North America, with the “Asian carps” being one of the more conspicuous examples (Williams and Garvey 2005). The silver carp (SC) has become highly abundant in large-river systems such as the Mississippi, Arkansas, and White rivers where they were previously rare or absent. In the lower White River, recent (2002-2005) multiple-gear fish surveys encompassing 41 oxbow lakes collected very few SC or bighead carp (BC) (Clark 2006; Lubinski et al. 2008). In 1980, both carps were considered uncommon in Arkansas, with only a few isolated reports of catches by commercial fishermen (Freeze and Henderson 1982). However, recent communications with state and federal biologists working in the lower White River verify that SC, and to a lesser extent BC, have successfully invaded and are dominating fish samples in many oxbow lakes. In light of the SC and BC invasions into many Arkansas waters and the potential for continued range extensions, their effects on native fish assemblages needs further investigation. In addition, given the recent appearance of juvenile northern snakehead *Channa argus* in the lower White River floodplain (B. Justus, personal communication), studies assessing the effects of invasive species on Arkansas’ native fish fauna are expected to become increasingly important over the next decade. This area of research is consistent with Arkansas State Wildlife Grants (SWG) priorities established for the period 2009-2014 concerning invasive species effects, and coincides with the recent creation of a new Aquatic Nuisance Species Coordinator within the Arkansas Game and Fish Commission (AGFC). The proposed project also is consistent with the Arkansas Aquatic Nuisance Species Management Plan, which acknowledges that the economic and ecological damage potential of these carps are unknown (pg. 49, AGFC 2013). Recent historical datasets compiled by the UAPB and ATU are ideally suited to serve as a baseline for this proposed study.

Silver and bighead carps have great potential to affect aquatic ecosystems throughout Arkansas. Both species feed largely on phytoplankton and zooplankton with some detritus (Garvey et al. 2006; Pongruktham et al. 2010). High abundances of these carps could potentially alter aquatic food webs (Williamson and Garvey 2005), and negatively impact other aquatic species (Garvey et al. 2006). Adults of some planktivorous species (e.g., gizzard shad *Dorosoma cepedianum*) also may compete directly with SC and BC. Similar concerns exist for paddlefish *Polyodon spathula* (Schrank et al. 2003), which is an AGFC species of concern. Given the continued increases in population abundances and likely range expansions of SC and BC in Arkansas waters, present research needs to be focused on better understanding and quantifying their effects on aquatic ecosystems.

**Purpose and Objectives:** UAPB working in concert with the U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (USFWS), and AGFC proposes to conduct comprehensive assessments of SC and BC populations and all other native fishes from ten (10) representative oxbow lakes in the White River basin. This proposed study will complement a future study already scheduled by UAPB for 2017 using identical methodology and historical fisheries data that exists for these systems. If this proposed study is funded, UAPB’s planned efforts are much enhanced in that SC and BC populations and native fish assemblages will be quantified from up to **twenty-five (25)** different oxbow lakes (i.e., 10 from this study in addition to 15 others by UAPB). Preliminary sampling for SC and BC will be conducted in lower White River oxbow lakes for which historical datasets exist. The range of densities is expected to include lakes with established SC and BC populations to lakes with zero or near-zero SC and BC abundances.

Quantification of carp densities across so many oxbow lakes allows comparison of native fish assemblage characteristics along a “density gradient” composed of high, moderate, low, and zero carp abundances. We also will be able to compare current fish assemblages in these lakes with historical fisheries datasets (2002-2005) that preceded the SC and BC invasions. We feel this type of approach represents a critical first step towards development of future hypothesis-driven studies to clarify relationships with respect to SC and BC effects on native fish assemblages.

The specific objectives of this project are:

1. Characterize SC and BC populations and native fish assemblages in ten (10) oxbow lakes in the White River basin using a multiple-gear sampling approach, and
2. Assess relationships between native fish assemblage structure and SC and BC population densities and other oxbow lake characteristics.

**Location:** The proposed study area includes the White River basin in eastern Arkansas, with the majority of oxbows selected anticipated to be located within the Dale Bumpers White River National Wildlife Refuge (WRNWR) (see map in Lubinski et al. 2008). The refuge represents an ideal study area due to the substantial historical fisheries database – all compiled prior to the detection of SC and BC. However, oxbow lakes in the nearby lower Cache, Black, or adjacent river basins will be considered if needed to characterize lakes where SC and BC are not present or exist at low abundances. Additionally, lakes in AGFC-managed wildlife management areas (e.g., Trusten Holder or Wattensaw) will be considered as feasible for the same reasons.

**Objective 1. Characterize silver and bighead carp populations and native fish assemblages in ten (10) oxbow lakes in the lower White River basin using a multiple-gear sampling approach.**

Basic fish assemblage structural measures will be determined for each oxbow lake. These measures will include species richness, diversity, and evenness. SC and BC abundances will be expressed using appropriate measures of catch-per-unit-effort (CPUE). SC and BC mean CPUE and descriptive statistics will be computed for individual oxbow lakes, and used as a general index of carp density. These densities will be the primary measure used to establish the carp density gradient, and serve as the independent variable during subsequent modeling of fish assemblage metrics. Concurrently with all fish sampling, basic water quality, lake morphometrics, and river-floodplain connectivity variables will be recorded following Clark (2006), Lubinski et al. (2008), and Eggleton et al. (2010). In addition, abundance, condition, and weight-length relations for selected sport fishes, and abundance and richness of sensitive species (e.g., selected minnows and darters) also will be assessed in relation to carp densities.

**Objective 2. Assess relationships between native fish assemblage structure, and silver and bighead carp population densities and other oxbow lake characteristics.**

Following the compilation of all datasets outlined above, statistical relationships will be assessed using SC and BC density as the independent variable (SC and BC will be analyzed both separately and combined). In particular, we will focus on two lines of analysis. First, we will examine whether fish assemblage structure (e.g., richness, diversity, evenness, abundance of sensitive species, etc.) in oxbow lakes is related to SC and BC densities. This will be done largely through examination of scatterplots and correlation/regression analyses. Second, canonical correspondence analysis (CCA; ter Braak 1986) or comparable analysis will be used to examine relationships between fish assemblages and measured environmental variables (e.g.,

water quality, lake morphometrics, and connectivity), which will include SC and BC densities. Overall, analyses will provide a basis for examining assemblage structural differences in relation to SC and BC densities. Appropriate data transformations and distributions will be considered as warranted, with models selected on the basis of minimized AIC or other relevant values.

**Timeline:** Upon being awarded this grant, it is expected that preliminary pilot sampling, site reconnaissance and selection, and equipment and supply purchases will be completed during fall 2016. The entire field schedule will be completed for all lakes during 2017. The grant would be initiated on October 1, 2016 and end on September 30, 2018. The UAPB M.S. student conducting the research would graduate in December 2018.

**Expected Results and Outcomes:** Analyses will first be conducted separately for each carp species; however, an additional set of analyses also will be conducted that combines the two carp species. This proposed study will provide the first assessment of SC and BC effects on other Arkansas fishes. The information can be used by AGFC and USFWS to better understand SC and BC effects on native fish assemblages, and possibly assess future risks of SC and BC invasions. At least one M.S. thesis will be produced at UAPB, with at least two journal articles published from this work. This study would be a logical first step preceding future studies concerning carp bioenergetics, more detailed studies of carp population dynamics, and studies of carp-sportfish interactions. This research also is planned to be the foundation for future experimental work concerning invasive species' effects on aquatic ecosystems, with focus on native fish assemblages and sport fisheries.

**Budget:** A total of \$38,842 is being requested from SWG, with an additional \$36,404 (48%) being provided as non-federal matching support by UAPB and AGFC. UAPB match is provided in the form of nonresident tuition waiver for the graduate student. Additional matching support will be provided from the prorated time for three AGFC biologists and AGFC equipment usage. The prorated time of one USGS scientist provided through subcontract also is included.

| <b>A. Requested Funds – Travel, Supplies, Contractors, etc.</b>  | <b>Year 1</b> | <b>Year 2</b> | <b>Total</b>    |
|--|---------------|---------------|-----------------|
| 1. Travel  | 2500          | 2500          | 5000            |
| 2. Equipment (sampling gear maintenance/replacement)             | 3000          | 3000          | 6000            |
| 3. Supplies (preservative, field supplies)                       | 750           | 750           | 1500            |
| 4. Consultants/Contracts - B.Justus (USGS)                       | 11405         | 11405         | 22811           |
| 5. Project Total Direct Costs (TDC)                              | 17655         | 17655         | 35311           |
| 6. Recovered Indirect Cost (10% of TDC)                          | 1766          | 1766          | 3531            |
| <b>TOTAL FUNDS REQUESTED</b>                                     | <b>19421</b>  | <b>19421</b>  | <b>\$38,842</b> |
| <b>B. Matching Support Provided</b>                              | <b>Year 1</b> | <b>Year 2</b> | <b>Total</b>    |
| 1. State Biologist Match-J.Barnett (80 h/yr x \$55/h)            | 4400          | 4400          | 8800            |
| 2. State Biologist Match-J.Homan (80 h/yr x \$45/h)              | 3600          | 3600          | 7200            |
| 3. State Biologist Match-M.Tindall (80 h/yr x \$35/h)            | 2800          | 2800          | 5600            |
| 4. AGFC Transportation (1 month rental x 2 trucks)               | 750           | 750           | 1500            |
| 5. AGFC Electrofishing Boat (1 month rental)                     | 250           | 250           | 500             |
| 6. AGFC travel (2 weeks x 2 samples x 3 people)                  | 1500          | 1500          | 3000            |
| 7. Miscellaneous supplies (net repair/replacement)               | 1500          | 1500          | 3000            |
| 8. Nonresident tuition remission (\$243/credit hr for 28 cr)     | 3402          | 3402          | 6804            |
| <b>TOTAL MATCH PROVIDED</b>                                      | <b>15642</b>  | <b>15642</b>  | <b>\$36,404</b> |
| <b>Total Cost of Project = \$75,246 which includes 48% match</b> |               |               |                 |

## **Project Personnel Qualifications:**

**Dr. Michael Eggleton** is an Associate Professor in the Aquaculture/Fisheries Center at UAPB. He earned graduate degrees at Tennessee Tech University and Mississippi State University. He has been employed with UAPB since 2003, and has worked on a variety of sportfish-oriented projects for the Arkansas Game and Fish Commission. He was involved in a prior study of White River floodplain lakes, and has worked extensively in the lower Mississippi and Arkansas rivers. These projects produced several graduate students and publications.

**Billy Justus** is a biologist for the USGS Lower Mississippi–Gulf Water Science Center (Little Rock Office). He received his M.S. degree from Arkansas State University in 1990. Prior to beginning with USGS in 1997, he was an aquatic biologist for the Mississippi Department of Environmental Quality. He has published 25 reports or journal articles that investigated anthropogenic and natural effects on aquatic biological assemblages in streams and wetlands, provided aquatic (biology) sampling protocols, or documented aquatic assemblage distributions.

**Lee Holt** is an aquatic ecologist for the USFWS Region 4 (Southeast) Inventory and Monitoring Program. He has been with the USFWS for 2 years, prior to which he worked 9 years as a fisheries biologist with AGFC. He currently works with national wildlife refuges throughout the southeastern U.S. to address aquatic resource issues. He has experience working with and addressing various aquatic resource topics, including hydrological regimes, water quality/quantity, fish communities, and invasive species monitoring.

**Arthur (Jay) Hitchcock** is the Refuge Biologist at the Dale Bumpers White River National Wildlife Refuge, located along the lower course of the White River in St. Charles, Arkansas. He received his M.S. degree from Southern Illinois University–Carbondale in 2008, and has been employed at the refuge since 2009.

**Jimmy Barnett** is the Aquatic Nuisance Species Coordinator for the Arkansas Game and Fish Commission. He has been employed with AGFC for 28 years. He spent 6 years on the Joe Hogan Hatchery as a Hatchery Technician, and served as the Aquatic Resources Education Coordinator for over 20 year until he became the first agency’s Aquatic Nuisance Species (ANS) coordinator in September 2015. His primary task in this new position is to oversee and implement Arkansas’ ANS plan.

**Justin Homan** is a fisheries biologist with the Arkansas Game and Fish Commission. He has been employed with AGFC for 1.5 years, and previously worked as a biologist with the North Carolina Wildlife Resources Commission. He earned his M.S. degree in Fisheries and Wildlife Biology from Arkansas Tech University, and has a B.S. degree in Fisheries Science from Virginia Tech University. Justin also is an AFS Certified Fisheries Professional.

**Micah Tindall** is a fisheries biologist with the Arkansas Game and Fish Commission. He has a B.S. degree in Fisheries and Wildlife Biology from Arkansas Tech University, and has been employed with AGFC for 3 years. He previously worked as a hatchery biologist at the Jim Hinkle Spring River State Fish Hatchery before moving into the Fisheries Division.

## Appendix A. Literature Cited

- AGFC (Arkansas Game and Fish Commission). 2013. Arkansas aquatic nuisance species management plan. Arkansas Game and Fish Commission, Little Rock. 266 pp.
- Clark, S. J. 2006. Relation of floodplain lake fish communities and river connectivity in the lower White River, Arkansas. Master's thesis. Arkansas Tech University, Russellville.
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- Williamson, C.J. and J.E. Garvey. 2005. Growth, fecundity, and diets of newly established silver carp in the middle Mississippi River. *Transactions of the American Fisheries Society* 134:1423-1430.

## Appendix B. Proof of Assistantship Award

Note: There is no formal award letter with the assistantship. An email response is that is received, with approval to begin advertising for a new student. I have run an ad and received over 15 applicants. I will select a student for this position, with plans to begin them in May or June 2016.

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**From:** Rebecca Lochmann  
**Sent:** Tuesday, November 10, 2015 5:10 PM  
**To:** Michael Eggleton  
**Subject:** assistantship

Hi Mike: Good news- you got the assistantship! You can start advertizing and hopefully get someone in for Spring 2016.....(other unrelated items)

Thanks, Rebecca

Rebecca Lochmann  
University of Arkansas at Pine Bluff  
Dept. of Aquaculture and Fisheries

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**From:** Rebecca Lochmann  
**Sent:** Tuesday, November 17, 2015 3:39 PM  
**To:** Michael Eggleton  
**Subject:** RE: assistantship

Mike: You can start the assistantship in May 2016 as I really don't think anyone except maybe \_\_\_\_ is ready to bring in a new student in January.

.....(other unrelated items)

Thanks, Rebecca

Rebecca Lochmann  
University of Arkansas at Pine Bluff  
Dept. of Aquaculture and Fisheries

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Note: The proposal that I submitted for the assistantship award is on file here in the department. A copy may be provided upon request.