2015 Proposal to AGFC SWG Program – Eggleton et al.

Project Title: Native Fish Assemblage Structure in Relation to an Asian Carp Density Gradient 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; thus, their importation from another country and their transport across state lines is prohibited. Some economic damage has resulted from loss of recreational fishing and boating opportunities in areas with large populations of Silver Carp due to their jumping tendencies. But in spite of high population numbers and assumed ecological consequences, no negative ecological damage has been adequately documented or quantified for either carp species. Management potential for Silver Carp and Bighead Carp are unknown (AGFC 2013), though alternatives for their control have been included in the Asian Carp Management and Control Plan (Conover et al. 2007). Data will be analyzed separately for the two species.

Project Co-Leaders:

Dr. Michael A. Eggleton, Associate Professor of Fisheries, Aquaculture/Fisheries Center, University of Arkansas at Pine Bluff (UAPB), 1200 N. University Drive, Box 4912, Pine Bluff, AR, 71601; eggletonm@uapb.edu; phone: 870-575-8100.

Billy G. Justus, Aquatic Biologist, U.S. Geological Survey – Lower Mississippi-Gulf Water Science Center, 401 Hardin Road, Little Rock, AR, 72023; bjustus@usgs.gov; phone: 501-228-3626.

Project Partners:

Roger (Lee) Holt, U.S. Fish and Wildlife Service, Refuge Inventory and Monitoring, Wheeler National Wildlife Refuge, Decatur, AL 35603; roger_holt@fws.gov; phone: 256-353-7243, x28).

Arthur (Jay) Hitchcock, U.S. Fish and Wildlife Service, Refuge Biologist, Dale Bumpers White River National Wildlife Refuge, PO Box 205, St Charles, AR, 72140; arthur_hitchcock@fws.gov; phone: 870-282-8246.

Justin Homan, Arkansas Game and Fish Commission, District Fisheries Supervisor, 1201 Hwy 49 N, Brinkley, AR 72021, justin.homan@agfc.ar.gov, 870-734-4581.

Micah Tindall, Arkansas Game and Fish Commission, Assistant District Fisheries Biologist, 1201 Hwy 49 N, Brinkley, AR 72021, micah.tindall@agfc.ar.gov, 870-734-4581

Project Budget: The total project cost is $207,281; this project requests $129,000 over a 3-year (fiscal year) period from the SWG Program. Non-federal matching funds provided total $78,281 (38% of total project cost), and are composed of state biologist time, AGFC equipment use, non-resident tuition waiver for the UAPB graduate student, and unrecovered UAPB overhead. Three years are needed for the grant because UAPB requires a 30-month funding commitment for all M.S. assistantships.

Project Statement

Project Need: The Silver Carp (SC) has become highly abundant in large-river systems such as the Mississippi 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 (Clark 2006; Lubinski et al. 2008). Personal communications with state and federal biologists working in the lower White River verify that Silver Carp and Bighead Carp (i.e., SC/BC) have successfully invaded and are dominating samples in many oxbow lakes. In light of the SC/BC invasions into many Arkansas waters and the potential for continued range extensions, their effects on native fish assemblages needs further investigation. This area of research is consistent with Arkansas State Wildlife Grant (SWG) priorities established for the period 2009-2014 concerning invasive species effects on species of greatest conservation need. This proposed project also is consistent with the recently released Arkansas Aquatic Nuisance Species Management Plan, which acknowledges that the economic and ecological damage potential of SC/BC are unknown (pg. 49, AGFC 2013). Recent historical datasets compiled by the University of Arkansas at Pine Bluff (UAPB) and Arkansas Tech University (ATU) are ideally suited to serve as a baseline for this proposed work.

SC/BC feed largely on phytoplankton and zooplankton with some detritus (Pongruktham et al. 2010; AGFC 2013). High abundances of these carps could potentially alter aquatic food webs, 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/BC. Similar concerns exist for Paddlefish *Polyodon spathula* (Schrank et al. 2003), which is a species of concern for the Arkansas Game and Fish Commission (AGFC). Given the continued population increases and range expansions of SC/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 is proposing to conduct comprehensive assessment of SC/BC populations and all other native fishes from 25 representative oxbow lakes in the White River basin. Quantification of carp densities across so many oxbow lakes allows comparison of native fish assemblage characteristics versus SC/BC 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 recent (2002-2005) historical datasets that preceded the SC/BC invasions. We feel this type of approach represents a critical first step towards development of future hypothesis-driven studies to elucidate causation with respect to SC/BC effects. The proposed study area includes the White River Basin in eastern Arkansas, with the majority of oxbows selected anticipated to be located within the White River National Wildlife Refuge. The refuge represents an ideal study area due to the substantial existing database – all compiled previous to SC/BC invasions.

The specific objectives of this project are:

1. Characterize SC/BC populations and native fish assemblages in 25 oxbow lakes in the White River basin using a multiple-gear sampling approach,
2. Assess relationships between native fish assemblage structure and SC/BC population densities and other oxbow lake characteristics, and
3. Assess the sampling methods most effective at sampling SC/BC in oxbow lakes.

Location: Selected oxbow lakes of the White River basin in eastern Arkansas (see map in Lubinski et al. 2008). As needed, oxbow lakes in the lower Cache, Black, and adjacent river basins will be considered to represent lakes where SC/BC are not present or at low densities.

Objective 1. Characterize Silver/Bighead Carp populations and native fish assemblages in 25 oxbow lakes in the 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 values; fish trophic/reproductive guild classifications; and weight-length equations and condition indices for selected sport fishes (Justus 2003). SC/BC abundances will be expressed as measures of catch-per-unit-effort (CPUE) defined for each gear type used. SC/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 SC/BC density gradient that will serve as the independent variable during subsequent modeling of fish assemblage metrics. Concurrently with all fish sampling, standard water quality, oxbow lake morphometrics, and river-floodplain connectivity variables will be recorded generally following Clark (2006) and Lubinski et al. (2008). 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 SC/BC densities.

Objective 2. Assess relationships between native fish assemblage structure and Silver/Bighead Carp population densities and other oxbow lake characteristics.

Following the compilation of all datasets outlined above, statistical relationships will be assessed using SC/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 research. 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/BC densities. This will be done largely through examination of scatterplots and correlation/regression analyses. Second, canonical correspondence analysis (CCA; ter Braak 1986) 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/BC densities. Overall, analyses will provide a basis for examining assemblage structural differences in relation to SC/BC densities. Appropriate data transformations, and alterative distributions and link functions will be considered as warranted, with models selected on the basis of minimized Akaike's Information Criterion values.

Objective 3. Assess the sampling methods most effective method at sampling Silver/Bighead Carp in oxbow lakes.

SC/BC densities and other metrics will be tabulated by individual gear type, and used to determine the best gear type(s) for sampling SC/BC. Although the ideal sampling gear(s) for SC/BC is/are unknown, we anticipate that boat electrofishing, trap and mini-fyke nets, and experimental gill nets will be used. Ordination techniques also will be used to identify whether the fish assemblage sampled differed significantly across gear types (e.g., Eggleton et al. 2010).

Timeline: Upon being awarded this grant, it is expected that preliminary pilot sampling, site reconnaissance and selection, and equipment purchases will be completed during fall 2015. The entire field schedule would be completed during 2016-2017. The grant would be initiated on

October 1, 2015 and end on March 31, 2018. A minimum of 2.5 years are needed to complete this grant in order to accommodate the 2.5-year M.S. assistantship commitment (required by UAPB) that is needed to complete the work (see budget section).

Expected Results and Outcomes: This proposed study will provide the first large assessment of SC/BC effects on other Arkansas fishes. The information can be used by AGFC and USFWS to better understand the consequences of SC/BC on native fish assemblages, and possibly assess future risks of SC/BC invasions. The study should also provide guidance as to how SC/BC are best sampled, which would benefit future eradication measures, if deemed necessary. At least one M.S. thesis will be produced at UAPB, and at least two journal articles will be published. This study would be a logical first step preceding future studies on bioenergetics, predator-prey interactions, and more detailed studies of population dynamics.

Budget: A total of $129,000 is being requested from SWG for the project, with an additional $78,281 (38%) being provided as non-federal matching support by UAPB and AGFC. UAPB match is provided from unrecovered indirect costs and non-resident graduate student tuition remission. Additional matching support is being provided as the prorated time for two AGFC biologists, and AGFC equipment usage. One M.S. assistantship (31% fringe) and the prorated time of one USGS scientist provided through subcontract also are included.

A. Salaries/Wages & Benefits	Year 1	Year 2	Year 3	Total
1. Salaries – M.S. Graduate Assistant (UAPB)	17800	18800	9400	46000
TOTAL SALARIES AND WAGES	17800	18800	9400	46000
2. Fringe Benefits--UAPB (31% of S&W)	5518	5828	2914	14260
TOTAL SALARIES, WAGES & BENEFITS	23318	24628	12314	60260
B. Travel, Supplies, Contractors, etc.				
1. Travel	2500	2500	0	5000
2. Equipment (sampling gear mainten./replacemnt.)	2000	2000	0	4000
3. Supplies (preservative, field supplies)	500	500	200	1200
4. Consultants/Contracts - B.Justus (USGS)	17023	17023	12767	46813
5. Project Total Direct Costs (TDC)	45341	46651	25281	117273
6. Recovered Indirect Cost	4535	4665	2528	11727
TOTAL REQUESTED FUNDS	49875	51316	27809	129000
C. Match				
1. State Biologist Match-J.Homan (150 h/yr x $45/h)	6750	6750	6750	20250
2. State Biologist Match-M.Tindall (150 h/yr x $35/h)	5250	5250	5250	15750
3. AGFC Transportation (est. 3 months rental for 1 truck)	1800	1800	900	4500
4. AGFC Electrofishing Boat (est. 2 months usage)	500	500	250	1250
5. AGFC travel (est. 2 weeks x 2 people@$350)	2100	2100	1000	5200
6. AGFC nets, field equipment, etc.	300	300	150	750
7. AGFC Fuel (boats, generators)(est. 2 tanks/week for 3 months with 1 truck)	2600	2600	1300	6500
8. AGFC miscellaneous supplies	300	300	150	750
9. Unrecovered UAPB Indirect Cost (59.4% of S&W minus Recovered Indirect Costs Above)	6039	6502	3055	15597
10. Nonresident tuition remission ($221/credit hr for 35cr)	3094	3094	1547	7735
TOTAL MATCH	28733	29196	20352	78281

Total Cost of Project: $207,281 with 38% match provided.

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, and worked previously at the University of Oklahoma. He has been employed with UAPB since 2003, and has worked on a variety of sportfish-oriented projects with 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 graduated several students and produced several 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 which 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 for AGFC as a fisheries biologist. 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 working at the White River refuge since 2009.

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.

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