

Project Title: Assessment of Dietary Overlap and Effects on Native Fish

Geographic Location: Lower Mississippi River Basin.

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Participating Agencies: Louisiana State University Agricultural Center (LSU AgCenter)

Statement of Need: Bigmouth Buffalo is the second most landed and second most valuable freshwater commercial finfish in Louisiana. It shares habitat with Silver Carp, both of which are planktivorous; therefore, dietary overlap between these two species is likely. Previous research has examined changes in fish communities and body condition of various species as a result of Silver Carp introductions in upper portions of the Mississippi River Basin (Bouska 2020). However, no such investigations have been undertaken in the Lower Mississippi River Basin. In Louisiana there is the potential that lower body condition in Bigmouth Buffalo may result due to competition with Silver Carp. We can infer similar impacts on other planktivores in the region (i.e. Paddlefish). Further, Silver Carp have the potential to impact recreationally important species higher up the trophic level, such as Largemouth Bass, through a trophic cascade resulting from a reduction of invertebrate biomass.

The information collected during this project will quantify the impacts of Silver Carp on two economically important fish species in the Lower Mississippi/Atchafalaya region.

Project Objectives:

- 1) The objective of this project is to determine the impacts of Silver Carp *Hypophthalmichthys molitrix* on commercially important Bigmouth Buffalo *Ictiobus cyprinellus* and recreationally important Largemouth Bass *Micropterus salmoides*.

Project Highlights:

- A gradient of Silver Carp densities is apparent in these five lakes. Once the stable isotope analysis is completed, inferences can be made about the impacts of Silver Carp on Bigmouth Buffalo and Largemouth Bass.

Methods:

LSU collected fish using electrofishing, gill nets, or hoop nets, and lower trophic level detritus samples will be collected from southeastern Louisiana waterbodies across a suspected gradient of Silver Carp density. Specifically, Lake Fausse Pointe, East Grand Lake within the Atchafalaya River basin, Lakes Verrett/Palourde, Lac Des Allemands, and Lake Cataouatche/Salvador will be sampled a minimum of three times each in year one of the study. A minimum of 20 Silver Carp, 20 Bigmouth Buffalo, 20 Largemouth Bass and 10 basal food resource samples was collected from each location (total tissue/sample collection ~ 350 samples). Gizzard shad were also collected to determine if Silver Carp may have impacted them. Largemouth Bass will be analyzed to test for trophic cascades and impacts to higher trophic levels. The Atchafalaya River basin was selected based on a long history of Silver Carp presence and previous stable isotope analyses (Nico and Jelks 2011; Nico et al. 2011). Other sampling locations were selected to reflect a gradient of Silver Carp densities. Based on observation and anecdotal reports, more Silver Carp are expected in Lake Fausse Pointe and fewer are expected in Lakes Verrett/Palourde, Lac Des Allemands, and Lake Cataouatche/Salvador.

Data collected from basal food resource samples will be used to describe the natural variation in trophic structures across these lakes. The tissue and basal resource material samples will be analyzed for isotopic ^{13}C and ^{15}N composition for statistical analyses of dietary overlap. Additionally, physicochemical measurements will be taken to describe habitat variation across the sampled lakes.

Silver Carp density per lake will be estimated by number of adults observed during multiple, low-speed transects using various disturbance methods. Bigmouth Buffalo condition will be compared with historic LDWF data, where available, to assess modern condition estimates against pre-Silver Carp condition estimates providing a second assessment of impacts to fish condition.

This analysis will produce fish condition and ^{13}C and ^{15}N data for Silver Carp, Bigmouth Buffalo, and Largemouth Bass in potentially impacted systems, as well as a quantified measurement of dietary overlap. Information regarding the relative abundances of these fish across systems will be used to provide a fishery-independent assessment of Bigmouth Buffalo and Silver Carp.

Results and Discussion:

Twenty-six sampling trips were conducted on the five target waterbodies. The electrofishing effort and total trips are shown in Table 1. The effort between the sites was consistent with the exception of East Grand Lake, which required less sampling effort. Table 2 lists primary consumer, diet, and baseline samples collected at each site for stable carbon and nitrogen isotope analysis. Signatures of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ for suspended particulate organic matter from each waterbody will serve as baseline samples for this study. Dorsolateral white muscle tissue and gut contents were collected from the fish and will be analyzed for $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$. This will allow a direct comparison of gut contents to muscle tissue isotope ratios as well as comparing gut content signatures to the food and energy sources available in the water column. This will assist in determining if diet or niche overlap and resource partitioning is occurring based on stable isotope mixing models (Fry 2002; Post 2002; Quezada-Romegilli, et al. 2018; Wang et al. 2018).

Previous studies have indicated that dietary overlap can occur between invasive carp and Bigmouth Buffalo; however, it is often greater between invasive carp and Gizzard Shad (Sampson et al. 2009; Coulter et al. 2019). Therefore, Gizzard Shad samples were collected and may provide additional information regarding food web interactions and the potential impacts of Silver Carp.

Table 1. Electrofishing effort and sampling effort for the samples collected during the project.

Site Name	Site Code	Total EF Time (m)	Total EF Time (hr)	N EF Trips	Distance Traveled (mi)	Elapsed Time (hr)	N Total Trips
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Lake Fausse Pointe	LFP	360.85	6.01	6	103.3	26.27	7
East Grande Lake	EGL	225.13	3.75	4	124.2	21.69	5
Lake Verret/Palourde	LVP	129.8	2.16	4	72.8	20.00	5
Lac Des Allemands	LDA	206.05	3.43	5	138.7	19.03	6
Lake Cataouatche/Salvador	LCS	210.20	3.50	5	186.9	18.74	7
Grand Total of Sampling Trips							30

Table 2. Primary consumer, diet, and baseline samples collected at each site for stable carbon and nitrogen isotope analysis.

		Lake Fausse Pointe (LFP)	East Grande Lake (EGL)	Lakes Verret / Palourde (LVP)	Lac Des Allemands (LDA)	Lakes Cataouatche/ Salvador (LCS)	TOTAL
Primary Consumers	Silver carp	18	25	1	2	0	42
	Bigmouthed Buffalo	20	29	21	21	2	62
	Largemouth bass	21	24	23	23	25	67
	Gizzard Shad	24	23	21	21	22	81
	TOTAL	83	64	66	63	49	252
Diets	Silver carp gut contents	18	6	0	2	0	26
	Bigmouthed Buffalo gut contents	18	3	12	8	2	43
	Largemouth Bass gut contents	15	1	3	4	18	41
	Gizzard shad gut contents	13	3	0	3	5	24
	TOTAL	64	13	15	17	25	110
Baselines	suspended particulate organic matter	5	5	5	5	5	25
	Phytoplankton	5	5	5	5	5	25

	Zooplankton	5	5	5	5	5	25
	Nutrients	2	1	1	1	1	6

Table 3. Summary of invasive carp seen and captured during sampling trips associated with this project at each site.

Lake Fausse Pointe (LFP)		East Grande Lake (EGL)		Lake Verret/Palourde (LVP)		Lac Des Allemands (LDA)		Lake Cataouatche/Salvador (LCS)	
Carp Spotted (captured)		Carp Spotted (captured)		Carp Spotted (captured)		Carp Spotted (captured)		Carp Spotted (captured)	
37 (19)		43 (31)		8 (1)		17 (2)		0 (0)	
Total Trips	6	Total Trips	4	Total Trips	5	Total Trips	5	Total Trips	6

Recommendation:

Early analysis of the Silver Carp sighted and collected does indicate that a gradient does exist in these five lakes. No additional recommendations or inferences can be made until the stable isotope analysis is complete.

References:

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