# WDNR Office of the Great Lakes AOC Capacity Grants 2012

***Project Title:*Monitoring for white sucker tumors in the Sheboygan AOC: testing spatial history using stable isotopes**

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***Person responsible for quarterly reporting:*Dr. Peter McIntyre**

***Project Location:*** Sheboygan River AOC and other Lake Michigan tributaries in Wisconsin

***Problem Statement:***  In coordination with WDNR, USGS, and USFWS, my team will be capturing white suckers in the Sheboygan River AOC to assess whether the tumor BUI can be delisted. These tumors are believed to reflect long-term exposure to chemical contaminants in many AOCs. A fundamental challenge in interpreting results from migratory species—such as white suckers—is resolving whether they have resided in the contaminated area, or instead entered the area to breed after spending their lives elsewhere. Chemical tracers are a common approach for assessing the spatial history of migratory fish, and can fruitfully be applied to the Sheboygan context.

We will use stable isotopes to test habitat use by migrant white suckers, thereby strengthening the potential request to delist that BUI and the Sheboygan River AOC as a whole. Stable isotopes are useful for determining habitat use because the stable isotope ratios of organisms reflect both their diets and environmental gradients. Isotope ratios of consumers reflect their diets in predictable ways (carbon isotopes directly reflect the diet, while nitrogen isotopes increase consistently with trophic level by ~3.4‰ from prey to consumer).We expect to find distinct nitrogen isotopic ratios between the stream and the open lake because agricultural nitrogen inputs create strong isotopic enrichment relative to the natural background in Wisconsin streams (Diebel and Vander Zanden 2009), and the Sheboygan River watershed is 67% agricultural by area. For carbon isotope rations, EPA scientists (Hoffman et al. 2010) identified gradients in carbon isotope ratios along the transition from the St. Louis River to Lake Superior, and my past research has revealed sharp contrasts in carbon isotope ratios between stream biota and lake-dwelling suckers in northern Green Bay. Thus, I expect to find gradients of both nitrogen and carbon isotopes that can be used to identify whether suckers running into the Sheboygan River are residents within the river, the Sheboygan harbor, or Lake Michigan more broadly. If the suckers sampled for tumors include a mixture of river and lake-dwelling fish, we would also be able identify which individuals have spent the most time in the Sheboygan River and harbor compared to dwelling in Lake Michigan, thereby refining the tumor assessment in important ways.

This two-pronged approach comparing Sheboygan River suckers to both macroinvertebrates from the Sheboygan region and suckers migrating into other watersheds will enable us to draw inferences about the spatial scale of habitat use by Sheboygan River suckers. Our results will aid in interpreting the significance of shifts in white sucker tumors and other BUIs in the Sheboygan River AOC. Specifically, the argument to delist the tumor BUI will be much stronger if stable isotopes indicate that the Sheboygan population is localized (and thereby subject to contaminants remaining within the river), yet still shows low tumor rates.

***Proposed Work:***

Stable isotope ratios are generally similar within migrant sucker populations, hence we can achieve a representative estimate of typical isotope ratios from 10 fish per site. To be absolutely sure that we effectively capture the variability in the Sheboygan River suckers, we propose to analyze isotopes ratios from muscle of 40 white suckers from the Sheboygan River. Suckers feed mainly on benthic macroinvertebrates, so we will also analyze stable isotopes for macroinvertebrates from the following 4 locations to provide reference points for interpreting isotope data from suckers collected in the Sheboygan River: the river itself, the harbor at the river mouth, and the Lake Michigan shoreline north and south of the harbor. We would analyze five replicates of each of three invertebrate taxa at each site, for a total of 60 samples. For reference, we propose to analyze stable isotopes of 10 white suckers from each of 12 other Lake Michigan watersheds to evaluate spatial variation in sucker isotopic ratios. These sites will include 3 watersheds within the Fox River AOC, thereby providing results relevant to restoration of other contaminated areas of Wisconsin.

If suckers mix widely, we would expect isotopic ratios to be similar across wide spatial scales. By identifying which invertebrates most closely resemble sucker tissues (after correcting N ratios for trophic fractionation), we can establish where the fish are spending the majority of their time.

At a broader scale, both my previous work in northern Green Bay and studies of riverine white suckers (Doherty et al. 2011) indicate that these fish return consistently to the same watershed to spawn every year. If suckers remain close to their spawning watershed throughout the year, we would expect to observe distinct isotopic ratios among populations due to local environmental conditions. Our comparisons to other populations will test whether the Sheboygan River run of white suckers represents a local sub-population that would be exposed to toxicants only in the Sheboygan region, or instead these fish mix freely along the Lake Michigan shoreline before selecting a tributary to reproduce within.

***Collaboration with partners:***

The proposed work will complement WDNR’s broader studies on the Sheboygan AOC, and field work will be performed in collaboration with WDNR, USGS, and USFWS staff.

***Timetable:***

April-May 2012: Field sampling must occur during the sucker migration

June-August 2012: Samples stored frozen at UW-Madison

September 2012: Samples dried, ground, and analyzed for stable isotope ratios

October 2012: Results received from analytical lab

November 2012: Statistical analysis and preliminary report preparation

December 2012: Final report and data provided to WDNR and USEPA.

***Deliverables***:

In addition to quarterly and final reports, we will provide compiled data and sampling GPS coordinates to WDNR for archiving purposes. The final report will include a full statistical analysis of the spatial scale at which suckers mix along the Wisconsin shoreline of Lake Michigan, with reference to both the Sheboygan and Fox River AOCs.

***Project Budget:***

 Staff salaries: LTE field assistant for collection of suckers: $1000

 Travel: Vehicle, lodging, per diem during sucker collection: $1500

 Equipment: $0

 Supplies: Supplies and analytical fees for stable isotope analyses: $3000

 Contracts

 Other: Fringe benefit costs for LTE assistant: $190

Indirect costs: 15% of direct costs: $854

Total request: $6544

*References:*

Doherty, C.A, R.A. Curry, and K.R. Munkittrick. 2011. Spatial and temporal movements of white sucker. *Transactions of the American Fisheries Society* 139:1818–1827.

Implications for Use as a Sentinel Species

Diebel, M.W. and M.J. Vander Zanden. 2009. Nitrogen stable isotopes in stream: effects of agricultural sources and transformations. *Ecological Applications* 19: 1127-1134.

Hoffman, J.C., G.S. Peterson, A.M. Cotter, J.R. Kelly. 2010. Using stable isotope mixing in a Great Lakes coastal tributary to determine food web linkages in young fishes. *Estuaries and Coasts* 33: 1391-1405.