# Native Planktivore Task Group Update

Chuck Bronte, USFWS

Lake Michigan Committee Meeting
March 20-21, 2017
Ypsilanti, Michigan

# Expert Panel of Geneticists

Julie Turgeon/Louis Bernatchez – University of Laval (Quebec)

Thomas Dowling – Wayne State University

Christopher Wilson – Ontario Ministry of Natural Resources

Wendy Stott – U.S. Geological Survey

Kim Scribner – Michigan State University

Jim Reist – Department of Fisheries and Oceans Canada

Brian Sloss – University of Wisconsin-Stevens Point

# Genetic questions regarding *C. artedi*

1) **Genetic Diversity** – Is the genetic diversity of potential Lake Michigan source populations of *C. artedi* similar to other Great Lakes?

2) **Effective Population Size** – Do substantial differences occur in estimates of effective population size $N_e$ among the *C. artedi* populations from lakes Michigan, Huron, and Superior?

3) **Genetic Differentiation** – What is the level of genetic differentiation among populations of *C. artedi* in lakes Michigan, Huron, and Superior?.

4) **Best Donor Populations** – For those populations where genetic data are available, which population(s) would serve as the best genetic source(s) for a reintroduction program into Lake Michigan?

5) **Secondary Sources** – Which populations would serve as an acceptable choice as a gamete source?

June 2015 - Questions and data from Dr. Stott's lab went out to panel.

Fall 2015 - Responses were received by 6 of the 8 scientists

January 2016 - Presented and discussed at the LMTC meeting.

- Results varied considerably among respondents on most questions
- Responses centered on 4 possible scenarios for cisco re-introductions

# Intent and issues

Provide management options that the could be considered.

Provide background information and framework for decisions on options but agreement on a rationale was lacking.

We have not identified a common set of facts on the ecology of cisco.

# Intent and issues

Recent and rapid proliferation of new information, including genetics, on the forms of *C. artedi* that came after the panel review

New information has not been aggregated and distributed yet.

No time to discuss implications for reintroduction.

Anticipate that a workshop aimed at resolving areas of contention is needed. Better define risks and weight them.

Any decision on these options at this time would be subject to new findings and conclusions

# New information forthcoming

- Over the coming months, a comprehensive morphometric analysis of cisco from Lake Michigan will be complete and will provide more certainty regarding extant forms.

- Within the next six months to a year, analyses of neutral genetic markers and otolith microchemistry of extant Lake Michigan ciscoes will be complete and will inform discussions on diversity and ecology.

- Within the next two years, analysis of adaptive genetic markers in Great Lakes cisco will be complete and further inform our understanding of ecology and genetic structure.

# Cisco

**Option A: No stocking.** Do not propagate and stock Cisco.

Benefits: no genetic risks, allow better understanding population expansion

Risks: Marginal or no increases in stock size or expansion

Feasibility: Feasible. No resources or actions required.

Information needs: Seasonal distribution/abundance to document new populations, changes in distribution, and done lake wide. Benchmarks, with metrics comparable to other populations outside Lake Michigan. Observations compared with historic information on Lake Michigan populations.

# Cisco

**Option B: Stock using gametes only from Lake Michigan**

Benefits: no genetic risks; resident populations may provide adaptive advantage over other stocks; no disease transfer issues, reliable gamete source

Risks: LM populations may have less genetic diversity; Inbreeding depression; eliminates any new genes on which selection could act, genetic drift could result in losses of variation in small pops. Stocking on top of existing pops has risks of reducing the effective population size (inbreeding).

Feasibility: Feasible. On-going.

Information needs: Status and distribution of other Cisco stocks. Verification of adequate gamete volume to satisfy production needs and to maintain genetic diversity is required.

# Cisco

**Option C: Stock from gametes from larger populations from outside Lake Michigan (Lake Superior)**

Benefits: Slightly higher genetic diversity; would provide reliable, consistent, and more logistically feasible sources; could be accessed via commercial fishers and independent sampling. Repeated sampling poses no impact. Pelagic, broadcast spawners. Was the dominate form in all lakes (except Erie)

Risks: Hybridization leading to outbreeding depression or extinction with existing stocks-reduced by stocking distant from existing populations; disease risks-reduced with fish health SOPs.

Feasibility: Feasible and could begin immediately. Numerous large stocks identified as potential candidates.

Information needs: Disease status, re-verification of gamete volume.

# Cisco

**Option D: Stock using gametes from a broad range of donor populations.** Reared separately and survivors would interbreed creating genetically more diverse progeny.

Benefits: Maximize genetic diversity for natural selection to act on.

Risks: Outbreeding depression with existing stocks-reduced by stocking distant from existing populations; intermediates may not be adaptable to local environments (e.g. outbreeding depression; disease transfer risks-reduced with fish health SOPs.

Feasibility: Logistically difficult and expensive to maintain separate brood. Lacking SOPs that specify proportions from each source and how to match donor sources with target stocking location

Information needs: genetic data, Abundance, genetics and health information potential donor stocks. Verification of adequate gamete volume .

# Cisco

## Option E: Habitat restoration in selected areas

Restoration of habitat in areas where improvements may increase recruitment.

Benefits: This option could benefit either existing populations or newly stocked populations.

Risks: No biological risk, particularly if research is conducted to inform restoration efforts. There is no evidence that habitat is limiting in Lake Michigan. Costs associated with perceived habitat improvements could be wasted.

Feasibility: Feasibility situationally dependent.

Information needs: habitat definitions, limitations, and restoration potential needs to be assessed to inform restoration projects.

# Kiyi

Gamete collections from Lake Superior or Lake Nipigon for broodstock development and stocking of production fish

Benefits: Populations in Lake Superior are large; deepwater bentho-pelagic feeder on Mysis; foster betho-peglic coupling; young will serve as forage.

Risks: No genetic within-form risk as kiyi extirpated. Outbreeding depression with existing bloater populations . Disease risks-can be accommodated with SOPs.

Feasibility: Feasible only if sufficient gametes can be collected to establish brood stock. Culture is feasible given progress in rearing Cisco and Bloater.

Information needs: Location and seasonality of spawning aggregations and maturity schedules, and fish health needed as ascertain gamete availability.

# Blackfin (nigripinnis)

Gamete collection Lake Nipigon or potentially lakes near Algonquin Park region, for captive broodstock development and production fish.

Benefits: Occupy deepwater with bloater. Provide deepwater forage.

Risks: No within-form genetic risk. Outbreeding depression with hoyi. Disease risks but can be accommodated with SOPs.

Feasibility: Unknown/low because they are rare; dependent on the size, availability, and logistics of source populations.

Information needs: everything!

# Shortjaw (zenithicus)

Gamete collections from Lake Nipigon for broodstock development and stocking of production fish. Lake Huron (extirpated) and Lake Superior populations too small.

Benefits: Prey at intermediate depths. Re-establishment would provide a buffer against potential further extirpation.

Risks: Lake Nipigon fish are James Bay ancestral line compared to other Great Lakes stocks that belong to the Atlantic drainage ancestral line- ????

Feasibility: Unknown/low because of their rarity.

Information needs: Genetic diversity, abundance, stock location and seasonality of spawning aggregations, maturity schedules, and fish health.

# Continuum of difficulty for reestablishing ciscoes in Lake Michigan

# Best donor populations

1. High genetic diversity
2. From the same habitat type
3. Present no disease risks
4. Large enough populations to support routine gamete collections
5. Logistically feasible

# Helpful (?) Definitions

**Genetic Drift** - changes in gene frequencies, resulting from random chance. Genetic drift occurs most rapidly in small populations.

**Introgression** -the transfer of genetic information from one species to another as a result of hybridization between them and repeated backcrossing. Introgression hybridization is an important source of genetic variation in natural populations and may contribute to adaptation. Simple hybridization is a 50:50 contribution of genes and unwanted here.

**Outbreeding Depression** - when progeny from crosses between genetically distant individuals have lower fitness than parents, or progeny from crosses between more closely related individuals. An outcome of hybridization along with extinction and hybrid swarms.

**Inbreeding Depression** - the reduced biological fitness in a given population from breeding of related individuals.