

## Genetics Subgroup White Paper

March 17, 2015

The Genetics Subgroup of the Technical Expert Working Group (TEWG) has met several times over the course of the past year to discuss data gaps and conservation needs for river herring in the area of genetics. The below table is a compilation of these discussions. It is a list of research topics, complete with the topics' relevance, time frame and relative cost. The Genetics Subgroup has individually ranked these research needs according to priority, to be considered in the future as funding becomes available or as researchers develop projects.

Research topic	Relevance to restoration	Generality	Time Frame	Rank	Relative cost	Relevant Citations
			"E" = Exists already "S" = Short-term (1-3 yrs) "M" = Medium term (3-5 yrs) "L" = Long-term (5+yrs)	(Use each value of 1 to 18 once, 1 being highest, 18 being lowest)	\$=1-9K \$\$=10-99K \$\$\$=100-199K \$\$\$\$=200K+	
<b>Molecular marker development</b>						
Single Nucleotide Polymorphism (SNP) discovery	Highly relevant; useful in a variety of contexts	Very general; broad applications (bycatch, marine ecology, life history, etc.)	S	2	\$\$\$	
Restriction site Associated DNA (RAD) markers	Relevant; valuable for examining adaptive genetic variation	General; useful in designating Distinct Population Segments (DPSs) and understanding evolutionary potential, etc.	M	9	\$\$\$	

Integration of molecular markers with other data types (e.g., otolith microchemistry, morphology data, growth patterns) ; obtain baseline data from specific rivers (TBD)	Relevant; where molecular markers provide only coarse resolution for genetic stock identification, other data types may aid in assignment at finer spatial scales	General; valuable for hierarchical approach to stock/population assignment for individuals sampled in mixed stock assemblages	M	4	\$\$\$	Turner 2014 (PhD dissertation)  Payne 2014 (MSc thesis)
<b>Life History</b>						
Rangewide population structure (Canada and US)	Highly relevant; invaluable baseline data	Very general; broad applications (bycatch, marine ecology, distribution of standing genetic variation, population structure)	S	1	\$\$\$	Palkovacs et al. 2013 (USA range, both species)  McBride et al. in review (Canadian range, both species)
Straying rates	Highly relevant; crucial for connectivity, re-colonization, setting expectations for 'natural' recovery	Very general; broad applications (identify source of migrants, understand timelines for re-colonization after dam removal, resolve range expansion/shifts)	M	6	\$\$\$	
<b>Demography</b>						
Effective population size ( $N_e$ )	Relevant; could provide important information about relative population abundance (several important caveats)	Specific; promotes integration with Stock Status subgroup	M	14	\$\$\$	

Effective number of breeders (Nb)	Relevant; provides critical link between population size and juvenile production. Captures variation in reproductive success and aspects of juvenile survival	General; applies rangewide. However, the degree to which this can be estimated and the link to freshwater productivity need to be tested	M	12	\$\$\$	
<b>Incidental harm</b>						
Impacts of catch in non-targeted ocean fisheries and mixed stock fisheries conducted by some states	Highly relevant; potentially important source of mortality	Very general; important for understanding which stocks/populations are most at risk to catch	M	3	\$\$\$	Bethoney et al. 2012  Cournane et al. 2012
Additional sources of mortality	Highly relevant; could impact recovery efforts	Very general; important to determine the extent to which specific stocks and populations are impacted by dams, hydropower, etc.	M	11	\$\$\$	
<b>Marine Ecology</b>						
Distribution, migration, mixing	Highly relevant; crucial information about spatiotemporal distributions, migratory routes, extent of intermixing among stocks and populations	Very general; broad applications because factors that influence population dynamics for the freshwater portion of their lives cannot be easily separated from marine factors	M	5	\$\$\$	

<b>Restoration</b>						
Impacts of stocking activities	Relevant; important data about effects of stock transfers etc. on population structure and genetic diversity	General; important for understanding whether stocking activities undermine restoration objectives by homogenizing genetic variation	M	10	\$\$\$	Labbe 2012 (MSc thesis)  McBride 2013 (MSc thesis)
Natural recolonization	Relevant; crucial information about timelines for recovery and sources of migrants	General; needed for understanding whether stocking activities are required for restoration following dam removal/fish passage modification	M	8	\$\$	
Ecological and evolutionary implications of interactions between landlocked and anadromous populations following dam removal or provision of fish passage	Highly relevant; introgression between landlocked and anadromous forms could impact prospects for recovery/restoration	General; broad application to a variety of watersheds where dam removal/improved fish passage is underway or being considered	M	15	\$\$\$	
<b>Hybrids</b>						
Selection against hybrids vs. hybrid vigor	Somewhat relevant; are hybrids at a disadvantage (or advantage) in the ocean? Need to know rate of hybridization.	Specific; need to understand the extent to anadromous hybrids reproduce with purebred river herring or other hybrids	M	18	\$\$\$	Hasselman et al. 2014

Archival collections (natural resource agencies, museums, etc.)	Relevant; archival collections could reveal whether the proportion of hybrids is increasing (decreasing) over time	General; hybrid proportions could be impacted by the extent of dam construction on various rivers, broader applications beyond hybrids (could reveal temporal patterns/trends in genetic diversity, etc.)	M	13	\$\$	
<b>Miscellaneous</b>						
Additional marking methods (e.g., oxytetracycline marking, tagging)	Relevant; potentially useful in combination with genetic methods and otolith techniques	Somewhat specific; most applicable for determining and quantifying impacts of mixed stock fisheries	M	17	\$\$	
Predation effects (stomach contents)	Relevant; valuable for understanding whether predation impacts recovery	Somewhat specific; most applicable where predators are already suspected to have a negative impact on recovery	S	16	\$\$	
Establish standardized rangewide sampling protocols and dedicated monitoring for specific populations to establish long term data series	Highly relevant; developing standardized (lethal and non-lethal) sampling protocols ensures consistency in data collection across species ranges	Very general; broad application for sampling tissues and collecting data will generate rangewide data that is directly comparable and will provide meaningful insights on rangewide patterns	S	7	\$\$	