

Update on Muskellunge Genetic Research in Wisconsin

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Genetic Analysis of Butternut Lake and Lac Courte Oreilles Muskellunge Populations

A transfer of adult muskellunge from Butternut Lake to Lac Courte Oreilles (LCO) was proposed by Wisconsin Department of Natural Resources (WDNR) personnel to alleviate overpopulation of muskellunge in Butternut and to overcome problems with low recruitment and adult density at LCO. Before proceeding with the transfer, WDNR personnel wanted to determine if there could be adverse genetic consequences to LCO from the translocation of Butternut fish. Genetic concerns for this issue focused on the risk of outbreeding depression (a reduction in fitness following the interbreeding of genetically divergent sources of fish) and introgression (the transfer of genes from one population/species of fish to another through interbreeding).

The WDNR contracted my laboratory to conduct a genetic assessment of muskellunge from Butternut and LCO to determine the relative risk of the proposed transfer. This research is the primary responsibility of Ed Murphy, graduate student at the University of Wisconsin-Stevens Point under my guidance. The following paragraphs explain our findings.

We analyzed DNA variation from nine microsatellite loci (genetic markers) from 43 Butternut muskellunge and 36 LCO muskellunge. In addition, we compared these populations to 2004 production year muskellunge (52 total fish) from the Tommy Thompson State Fish Hatchery that originated from broodstock obtained from Bone Lake. Samples were analyzed in a method commonly known as DNA fingerprinting. Analysis of the data showed significant genetic differences between Butternut and LCO muskellunge including the presence of unique alleles (gene copies) in each of the populations. When Bone Lake fish were included in the analysis, the results showed significant differences among all three populations. This result is very interesting given Bone Lake fish have been stocked into both populations over a number of years.

The totality of the data and statistical results show these two native populations, Butternut and LCO, represent different gene pools that have enough genetic differences between them to suggest they have been separated for a significant period of time. This divergence has been maintained despite the long-term stocking of LCO and periodic stocking of Butternut with Bone Lake fish; a broodsource originally founded with fish from LCO. The scope and scale of this analysis did not allow for landscape-level genetic interpretation. In other words, we cannot say if the levels of divergence we are observing among these populations are consistent with a normal between-population level of genetic difference that occurs within a single stock of WI muskellunge. This is not out of the question. Stocks are not simply significantly different populations but represent a combination of unique populations that share enough genetic similarity to be managed as a genetic unit. If this was the case, the data, while showing significant differences between populations, would not necessarily mean a successful translocation of musky from Butternut to LCO would unduly jeopardize the genetic integrity of the LCO population. However, the study as conducted does show LCO has maintained some degree of genetic uniqueness despite the supposed reliance on propagation to maintain this population. This may be evidence suggesting LCO has maintained some level of natural recruitment over the timeframe when stocking was employed to maintain the population.

Genetic Stock Identification of Wisconsin Muskellunge

The stock identification research being conducted by the Molecular Conservation Genetics Laboratory at the University of Wisconsin-Stevens Point is making progress and proceeding along our anticipated timeline. During last year's sampling season, muskellunge were collected from over 25 naturally recruiting muskellunge populations represent 13 of the 15 counties that are predominately suspected to be part of the muskellunge's native range in Wisconsin. Genetic analysis is underway and Ed Murphy, a graduate student at the University of Wisconsin-Stevens Point, is actively processing samples and collecting/analyzing the genetic data. Initial findings are expected late summer/early fall 2007. The final stock identification data will be collected and analyzed by fall 2009. When the appropriate data have been collected and properly analyzed, initial findings will be released. No preliminary data on this project are or will be available until the release of the interim project report in fall 2007.

Genetic Assessment of Stocking Impact in Lac Courte Oreilles

The Molecular Conservation Genetics Laboratory at the University of Wisconsin-Stevens Point has analyzed historical DNA samples from the 1950's to present for Lac Courte Oreilles and two populations of muskellunge, Mud-Callahan and Big Spider Lake, thought to contain slow-growing muskellunge incapable of achieving trophy size in their current environment. These two lake systems were among the sources of broodstock used to produce eggs at the Spooner Hatchery for several stocking events into LCO (Big Spider Lake in 1950, 1953, and 1956; and Mud-Callahan in 1954 and 1960). The choice of broodsource for these stockings has been a cause of consternation in the question of whether LCO muskellunge still have the 'genetic potential' for trophy size. At issue is the possibility that the use of these two systems may have led to disruption of the genetic integrity of LCO (through introgression and outbreeding depression), subsequently resulting in LCO muskellunge losing their 'genetic potential' for attaining a large ultimate size. Historical DNA samples from five temporal samples of LCO (1956, 1966, 1976, 1992, and 2006), the 1956 Big Spider Lake population, and the 1980 Mud-Callahan Lake population were examined for this study. These samples represent a continuum of pre-stocking and post-stocking samples as well as the populations that were the source of stocked fish. Therefore, the approach was to compare pre-stocking with post-stocking and examine the level of genetic differences between the populations (LCO, Spider, and Mud-Callahan) to ensure genetic differences exist.

The results of this analysis showed no disruption in the genetic integrity of LCO despite significant genetic differences between LCO, Big Spider, and Mud-Callahan muskellunge populations. Evidence was found of a previously undocumented influx of fish into LCO during the mid-1970's. The 1976 LCO sample failed to match any of the other temporal samples included in the analysis. It was suspected an undocumented stocking event had occurred at this time. Subsequent investigations have identified a 1972 stocking of muskellunge from the Woodruff hatchery into Grindstone and Whitefish lakes (both of which have significant water connections to LCO) during the timeframe in question. From a genetic perspective, this stocking appears to have resulted in the stocked fish surviving to the fishery (observed genetic anomaly in 1976 the result of an admixed sample of LCO and stocked fish) but no evidence of successful reproduction of these fish can be seen in genetic analysis of subsequent years (all post 1976 samples were consistent with 1956 and 1966 genetic signature of LCO). This is encouraging on two fronts: 1) the LCO population appears to have avoided significant genetic impact from this stocking, and 2) the genetic approach being used can identify impact from the introduction of stocked fish in this system thereby strengthening the findings of no impact from the two stocking events in question. Efforts are underway to confirm the genetic identity of fish from the 1976 sample to ensure this scenario is indeed correct.