NWRT Project #3-13-27 – Interim Report

Project Title: Growth and Sustainable Yield of Lake Trout in Nunavut

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Summary: Lake trout are an important resource in Nunavut, providing a subsistence fishery for many Inuit residents, and increasingly forming a valued target for charter fishing operations. However despite their widespread abundance, and although lake trout biomass is often high in unfished lakes, lake trout populations are easily overfished and slow to recover. Using state of the art ageing methods, we propose to study a range of lakes across Nunavut to determine the age and growth of the resident lake trout populations, then develop a predictive model which will allow the lake trout growth rate in unstudied lakes to be predicted based only on lake characteristics. Over the three-year term of the project, these results will be incorporated with other information to predict the sustainable long-term yield of lake trout from each lake. The final stage of the project will develop an overlay for Google Earth which will allow fishery managers and HTOs to simply point and click on a web-based map to determine the long-term yield of lake trout in any lake in Nunavut.

Project Objectives: Lake trout (*Salvelinus namaycush*) are the most abundant large fish in the Arctic and sub-Arctic regions of Canada. Second only to Arctic charr, lake trout are also of major economic value in the Arctic, providing a subsistence fishery for many Inuit residents, and increasingly forming a valued target for charter fishing operations. The continued good health of lake trout populations in Nunavut is an important component of Nunavut's future prosperity, both in terms of tourist dollars and an Inuit food supply. Yet despite their widespread abundance and distribution, the continued abundance of lake trout in Nunavut is by no means assured. The long-term sustainable yield of lake trout has been determined for only a very small number of lakes, and most of these have been based on out-dated fish ageing methods which are now known to have grossly underestimated the age (and thus the growth rate) of the older fish, leading to unreliable and overly-optimistic estimates of yield and productivity. Perhaps more importantly, it is virtually impossible to assess lake trout status in every one of the thousands of lakes in Nunavut. Over a three-year period, the proposed research will not only develop a predictive model of sustainable lake trout yield based on modern ageing methods, but seamlessly incorporate the model into a web-based application which will allow point-and-click determination of long-term lake trout yield in any lake in Nunavut.

The objectives of this research are to:

1) use modern, accurate ageing methods to determine the age composition, mean and maximum ages of lake trout in a cross section of lakes across Nunavut (Years 1-3);

2) estimate growth rate and von Bertalanffy growth parameters for each of the studied lakes (Years 1-3);
3) measure the key defining characteristics of each of the studied lakes, including area, shoreline, mean and maximum depth, location, altitude, mean water temperature, degree days, relative abundance of lake trout and Arctic charr, and a proxy for fishing history (such as proximity to people) (Years 1-3);
4) develop a growth model for lake trout which will predict growth based on the defining characteristics of the lake (Years 2-3);
5) map the expected surplus production and yield of lake trout throughout the Canadian north based on location and lake characteristics (Year 3);
6) develop a simple, semi-automated overlay for Google Earth which will allow managers to simply point and click on a web-based map to determine the long-term sustainable yield of lake trout in any lake in Nunavut (Years 1-3).

Materials and Methods: In this first year of the project, lake trout were sampled from seven lakes on Victoria Island. In addition, some previously-collected otolith samples were obtained from 10 additional lakes in western Nunavut. The physical characteristics of each lake were measured and recorded, and temperature-depth recorders were deployed to measure water temperature throughout the year. All otoliths are currently being processed for age determination using modern, accurate embedding, sectioning and image analysis methods. Growth will be modelled using the von Bertalanffy growth equation, while long-term, sustainable yield will be calculated using standard yield equations. Using sampled lakes as a guide, the expected growth rate and yield of lake trout will be modelled, and the resulting model used to predict sustainable yield in all other, unsampled lakes. The final stage of the project will be the development of a Google Earth overlay which will automatically calculate lake characteristics for all lakes in Nunavut, then use the statistical yield model to display the estimated long-term yield, mean and maximum size, age composition and other fishery variables for the selected lake.

Project Schedule: Since the original project submission was for a 3-year project, and NWRT funding was for one year, the following schedule addresses only the first year of the project. Project progress is slightly ahead of schedule.

- Lake sampling – Aug/Sept 2013 [completed]
- Otolith prep and ageing – Aug 2013-June 2013 [50% complete]
- Acquire previously-collected otolith samples from other researchers – Sept 2013-June 2014 [70% complete]
- Statistical analysis of lake and lake trout data – Oct 2013-June 2014 [underway]
- Prepare Google Earth overlay – not originally scheduled for Year 1 of project [substantial progress made]
- Hire Nunavut student for fishermen surveys – Oct 2013-Mar 2014 [hiring completed]

Preliminary Results: Progress to this point has been excellent. A total of 155 lake trout were sampled from seven lakes on Victoria Island in Aug 2013. Otoliths intended for age determination were collected successfully from all fish, and the physical characteristics of each

lake were measured. Year-long temperature recorders were deployed at the bottom of three of the lakes. In addition, 247 previously-collected lake trout otoliths were obtained from other researchers who had sampled 10 other lakes in Nunavut in recent years. Therefore, we have sufficient otoliths to prepare a representative growth curve for lake trout from 17 different lakes in this, the first year of the project.

About one half of the otoliths have been embedded, sectioned, image enhanced and aged to this point. Based on previous bomb radiocarbon assays confirming the accuracy of our age determinations, we know that our ages are accurate to within ±2 years, at least on average. The lake trout that have been aged in this project to date have ranged between 3 and 62 years old, with most of the trout being more than 20 years old. These are extremely old trout, and based on their growth curves, are much slower-growing than populations further south.

A student in Cambridge Bay was hired to interview western Nunavut residents about their lake trout fishing history in the region. Interviews have proceeded well to this point, and an inventory of lakes that have been fished for lake trout is developing.

Although not originally planned for the first year of this project, considerable project has been made in developing a Google Earth overlay for Nunavut lakes and lake trout yield. Algorithms have been developed which will allow the system to automatically estimate the lake characteristics of any Nunavut lake which is "point and clicked" in Google Earth, including lake depth. In addition, the "proof of concept" has been completed, demonstrating that the Google Earth popup overlay is feasible.

Reporting to communities/resource users: Since the original project submission was for a 3-year project, and NWRT funding was for one year, project reporting for this first year of the project was limited to the region which was sampled. Therefore, a preliminary project progress report has been sent to the Ekaluktutiak Hunters and Trappers Organization. A more complete project report will be sent in June 2014.