RM-CESU -Progress Report, FY 11

Project Title: Tracking Lake Trout Trophic Interactions in Blue Mesa Reservoir Using Stomach Contents and Stable Isotopes

Parks: Curecanti National Recreation Area

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Project Description:
Blue Mesa is a 9000 acre reservoir which is the largest impoundment of the Aspinall Unit of the Colorado River Storage System. It is also the largest body of water in Colorado and supports a renowned recreational salmonid fishery. Administered by the National Park Service (NPS) under a memorandum of understanding with the Bureau of Reclamation (BoR), Curecanti National Recreation Area receives over one million visitors annually (National Park Service, 2008). The majority of these visitors are anglers on Blue Mesa Reservoir.

The kokanee salmon (*Oncorhynchus nerka*) sport fishery in Blue Mesa and throughout the state of Colorado is sustained almost entirely by stocking. Kokanee are highly desirable sport fish to maintain from ecological, fishery management and economic standpoints. Kokanee are relatively innocuous to native species and are very unlikely to emigrate from reservoirs and become established elsewhere. They are very ecologically efficient at exploiting the productive capacity of reservoirs. Because they are stocked at a very small size, they are highly cost-effective for hatchery-dependent sport fisheries. They are desirable sport fish that have the potential to generate an enormous amount of fishing recreation, which in turn generates a large economic benefit to the communities located near kokanee fisheries. For example, in 1993 prior to their current declines, the kokanee fishery in Blue Mesa reservoir supported about 400,000 angler-hours per year of fishing recreation. Using standard economic multipliers, this translates to economic activity for the Gunnison area of more than $8,000,000 per year.

Beginning in the mid-1990's, angler creel data and open-water hydroacoustic sonar surveys have clearly shown a precipitous decline in kokanee salmon numbers in Blue Mesa Reservoir. Seasonal sonar surveys have shown a nearly 90% decline in pelagic fish signals despite increased stocking rates during this time. These data have been corroborated through a 14 year creel survey which shows nearly identical decreasing trends in catch rate of kokanee. During this time period, the number of sub-30 inch lake trout (*Salvelinus namaycush*) has greatly increased along with a growing population of introduced yellow perch (*Perca flavescens*). Perch became apparent in the creel in 2000 and were not part of sanctioned stocking. Given the apparent state of the kokanee fishery, the Colorado Division of Wildlife (CDOW) instituted the active removal of sub-30 inch lake trout through netting in 2009 and will continue this effort in addition to other management actions until the kokanee population stabilizes.

Work by Johnson et al. (2002) using stable isotope analysis provides excellent baseline information about trophic relationships before the recent increase in yellow perch and lake trout populations and the decline of the kokanee population. A follow up study of the food web using stable isotopes will provide clues to the cause(s) for kokanee decline and suggest future fishery management strategies for NPS and CDOW.

The sustainability of Blue Mesa Reservoir as a kokanee egg source for other waters in Colorado is in serious jeopardy, as well as its future role as an important fishery resource within the National Park Service. This stand-alone study will utilize advanced techniques in order to answer outstanding questions which are paramount to the management of the fishery of Curecanti National Recreation Area.

Objectives and Methods:

We are in the process of completing the following objectives:

1. Open and analyze the contents of preserved stomachs from lake trout and brown trout, including identification of prey items to the lowest taxonomic level possible dependent on amount of digestion. Percent composition by weight as well as number of prey items will then be quantified.

2. Prepare tissue samples from the dorsal musculature of lake trout and all potential fish prey species that exist within the Blue Mesa reservoir system by drying the tissue at 60° C for 24 hours and grinding. Invertebrate prey species (whole organism) will be prepared through the same drying and grinding methods. Samples will then be analyzed for $^{13}C/^{12}C$ and $^{15}N/^{14}N$ signatures at the Cornell Isotope Laboratory.

3. Current diet and stable isotope data will be compared to those collected from previous research to determine if a shift in prey composition has occurred due to a change in availability of prey species in three seasons (spring, summer, and fall).

4. An assessment document will be produced that includes a synthesis of all data collections and analyses as well as conclusions regarding the current prey of lake trout compared to previous completed research.

Proposed Task Schedule:

Spring 2010: Initial sample collection of stomachs and tissues from lake trout and prey species.

Summer 2010: Analyze stomach contents of lake trout and create a database for quantification of diets. Continued sample collection from Blue Mesa Reservoir.

Fall 2010: Continued stomach content analysis and tissue preparations for stable isotope analyses. Ship stable isotope samples from spring and summer 2010 to be analyzed by mass spectrometry. Continued sample collection from Blue Mesa Reservoir.

Winter 2010: Continued stomach content analysis and tissue preparations for stable isotope analyses. Ship stable isotope samples from fall 2010 to be analyzed by mass spectrometry. Analyses of returned data from mass spectrometry and stomach contents.

Spring 2011: Continued stomach content analysis and tissue preparations for stable isotope analyses. Continued sample collection from Blue Mesa Reservoir.

Summer 2011: Analyze stomach contents of lake trout captured in spring 2011. Ship stable isotope samples from spring 2011 to be analyzed by mass spectrometry at Cornell University. Continued sample collection from Blue Mesa Reservoir.

Fall 2011: Continued stomach content analysis and tissue preparations for stable isotope analyses. Ship stable isotope samples from spring and summer 2011 to be analyzed by mass spectrometry. Continued sample collection from Blue Mesa Reservoir.

Winter 2011: Ship stable isotope samples from fall 2011 to be analyzed by mass spectrometry. Analyses of returned data from mass spectrometry and stomach contents.

Spring 2012: Draft report delivered to the park.

June 2012: All final copies of the report delivered; end date of project.

Project Progress:

Collection and Analyses of Stomach Samples – Spring, Summer, and Fall 2010

Stomachs were collected from lake trout, brown trout, rainbow trout, kokanee salmon, and yellow perch in Blue Mesa Reservoir in all three sampling seasons completed thus far. A total of 452 stomachs from the spring sampling season, 68 from summer, and 1,334 from the fall of 2010 were preserved in formalin and returned to the Fisheries Ecology Lab at Colorado State University. Stomachs from both the spring and summer sampling season have been opened and contents analyzed, and were entered into the database for further quantification. A sub-set (325) of stomachs from the fall 2010 sampling season have also been analyzed. This includes all stomachs from lake trout <425 mm TL and >600 mm TL as well as a random sampling of those from fish in between those lengths.

Collection and Preparation of Tissue Samples – Spring, Summer, and Fall 2010

Tissue samples for stable isotope analysis were collected in all three sampling seasons occurring in 2010. There were 507 tissue samples collected in the spring, 128 from summer, and 1,353 tissue samples from the fall of 2010. Samples from both the spring and summer (635) of 2010 have been prepared through drying and grinding and a subsample of 200 were shipped to Cornell University for analysis of $^{13}C/^{12}C$ and $^{15}N/^{14}N$ signatures, as well as %carbon and %nitrogen.

Invertebrate Collection and Data Analyses – Spring, Summer, and Fall 2011

Another 100 tissue samples from the fall 2010 sampling season were also prepared in early 2011. All samples collected in 2010 have been analyzed at the Cornell University Isotope Laboratory, and data was returned in the summer of 2011. Additional invertebrate samples from spring and summer 2011 were collected from Blue Mesa Reservoir, and have been prepared and are currently undergoing analysis at Cornell University. Also, stable isotope samples from 1997-2002 have been prepared and shipped for analysis in order to give a more direct and precise comparison at the decadal scale.

Future Work – Winter and Spring 2012

All stomach and stable isotope analyses will be completed by the end of 2011. After which, conventional mixing models will be used to estimate fractional consumer diets based on the isotopic signatures stomach contents of consumer and potential prey organisms for both 2000 and 2010 samples. These estimates will provide valuable information on possible trophic shifts and/or diet alterations post-perch introduction/kokanee decline in Blue Mesa Reservoir.

Expected Final Report:

Final assessment expected June 2012.

Were there students involved in the project, or degrees expected as a results of this work?

This work is being completed by a MS candidate, William Pate, and was assisted by six undergraduate work-study students in the Fisheries Ecology Lab at Colorado State University. One undergraduate student (Katie Fialko) received highest honors award at the 2011 CSU Undergraduate Creativity Symposium for her work on this project.