Hungry Horse Mitigation

Flathead Lake

Annual Report
2001 - 2002

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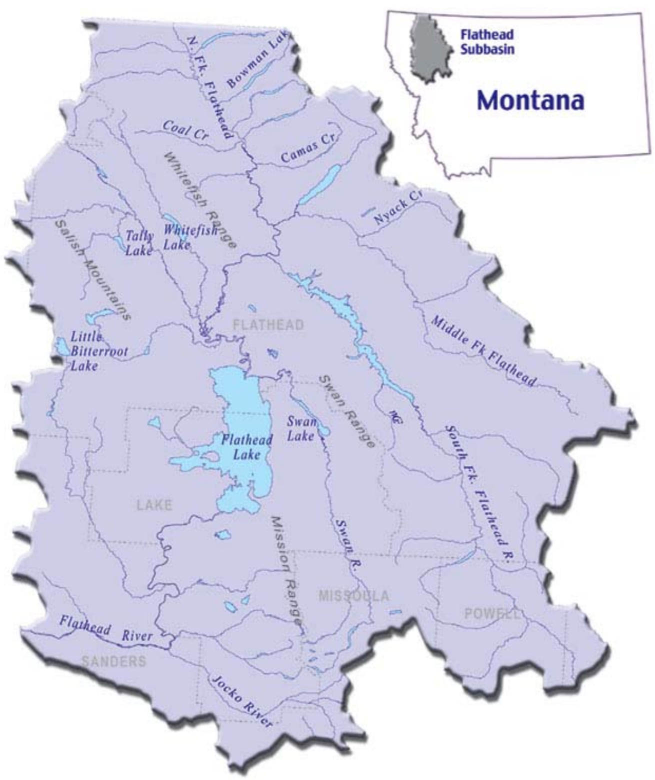
Hungry Horse Mitigation Flathead Lake

Annual Progress Report 2002

Project 9101901



by:

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Confederated Salish and Kootenai Tribes

INTRODUCTION

The Confederated Salish and Kootenai Tribes (CSKT) and Montana Fish Wildlife and Parks (MFWP) wrote "Fisheries Mitigation Plan for Losses Attributable to the Construction and Operation of Hungry Horse Dam" in March 1991 to define the fisheries losses, mitigation alternatives and recommendations to protect, mitigate and enhance resident fish and aquatic habitat affected by Hungry Horse Dam. On November 12, 1991, the Northwest Power Planning Council (NPPC) approved the mitigation plan with minor modifications, called for a detailed implementation plan, and amended measures 903(h)(1) through (7). A long-term mitigation plan was submitted in August 1992, was approved by the Council in 1993, and the first contract for this project was signed on November 11, 1993.

The problem this project addresses is the loss of habitat, both in quality and quantity, in the interconnected Flathead Lake and River basin resulting from the construction and operation of Hungry Horse Dam. The purpose of the project is to both implement mitigation measures and monitor the biological responses to those measures including those implemented by Project Numbers 9101903 and 9101904.

Goals and objectives of the 1994 Fish and Wildlife Program (Section 10.1) addressed by this project are the rebuilding to sustainable levels weak, but recoverable, native populations injured by the hydropower system. The project mitigates the blockage of spawning runs by Hungry Horse Dam by restoring and even creating spawning habitats within direct drainages to Flathead Lake. The project also addresses the altered habitat within Flathead Lake resulting from species shifts and consequent dominance of new species that restricts the potential success of mitigation measures. Specific goals of this project are to create and restore habitat and quantitatively monitor changes in fish populations to verify the efficacy of our mitigation measures. The project consists of three components: monitoring, restoration and research. Monitoring, for example, includes a spring gillnetting series conducted annually in Flathead Lake and builds on an existing data set initiated in 1981. Monitoring of the experimental kokanee reintroduction was a primary activity of this project between 1992 and 1997. Lake trout, whose high densities have precluded successful mitigation of losses of other species in Flathead Lake, have been monitored since 1996 to measure several biological parameters. Results of this work have utility in determining the population status of this key predator in Flathead Lake. The project has also defined the baseline condition of the Flathead Lake fishery in 1992-1993 and has conducted annual lakewide surveys since 1998. The restoration component of the project has addressed several stream channel, riparian, and fish passage problems. The research component of the project began in FY 2000 and measured trophic linkages between *M. relicta* and other species to assist in predicting the results of potential mitigation strategies. Only Objective 1 in the workplan is funded entirely by Hungry Horse Mitigation funds. Additional funds are drawn from other sources to assist in completion of Objectives 2-6.

1. Summary of significant results.

Objective 1: Monitoring: Determine relative abundance of bull and cutthroat trout in Flathead Lake.

We set six floating and six sinking gillnets in Flathead Lake in cooperation with Montana Fish, Wildlife and Parks. The data generated by this sampling contributes to a long-term monitoring index of abundance of westslope cutthroat trout (Figure 1) and bull trout (Figure 2) in the Flathead system. There has been so much variability in capture rates during the period of sampling that there is no clear evidence of increased abundance since sampling began.

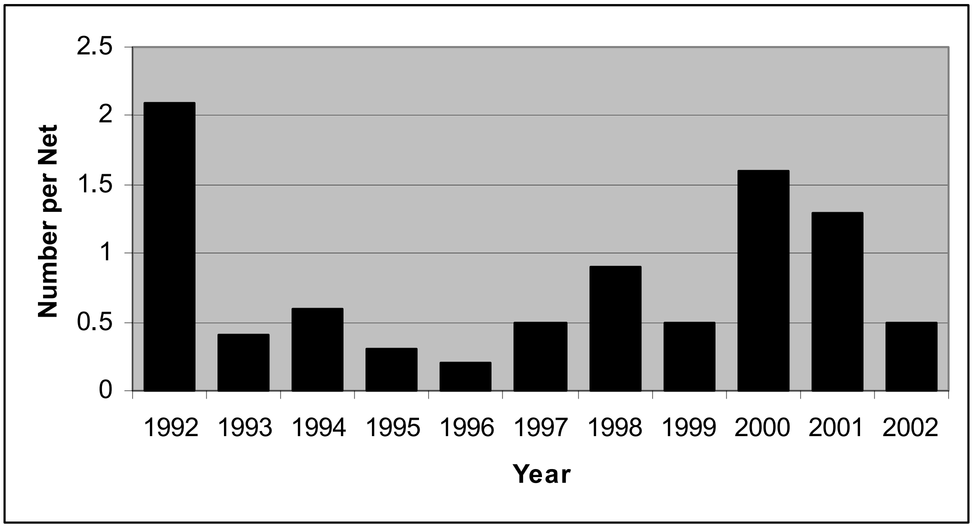

Figure 1. Number of westslope cutthroat trout caught per floating net during spring in Flathead Lake, 1992-2002.

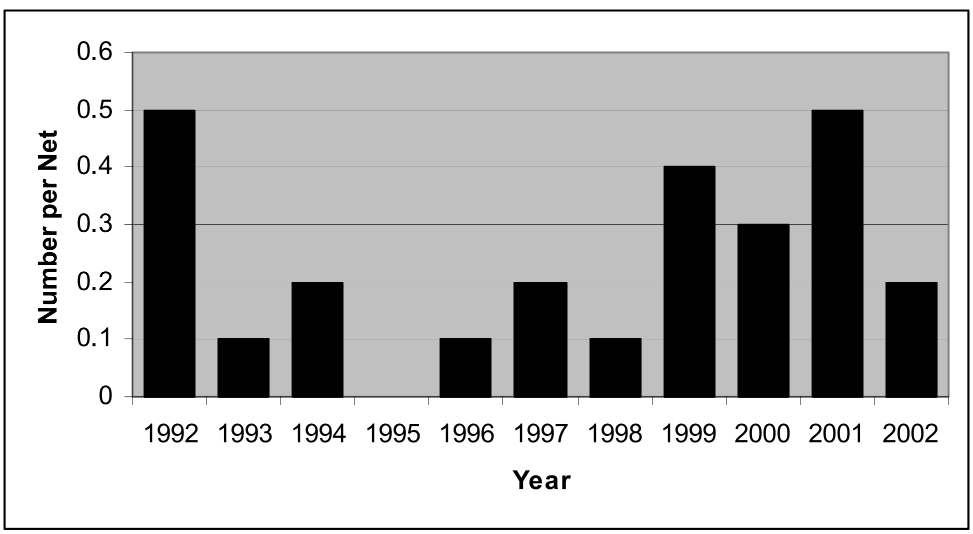

Figure 2. Number of bull trout caught per sinking net during spring in Flathead Lake, 1992-2002.

Objective 2: Implementation: Improve habitat conditions and biological productivity in direct tributaries of Flathead Lake to replace recruitment losses attributable to Hungry Horse Dam.

We conducted several projects in 2002 to improve habitat conditions in the basin. Objectives of these projects included: reduction of sediment delivery, improvement of fish passage, and restoration of riparian vegetation.

Project No. 1: Hewolf Creek road removal

Hewolf Creek supports an isolated population of pure westslope cutthroat trout. We removed 1.5 miles of road within the riparian corridor of Hewolf Creek by recontouring and completely excavating the roadbed (Figure 3). Much of this road was located on the

Figure 3. Recontouring of Hewolf riparian road, July 2002.

bank of the stream, where it caused direct sediment input, precluded development of riparian vegetation, and threatened to capture flood flows. The road was also a corridor for cattle use, further affecting the stream and riparian area. Slash was placed on the reclaimed road prism to hold soil in place and inhibit use by cattle.

Project No. 2: Laudermilk Dam Removal

We removed a privately owned, in-channel, earthen dam on DuCharme Creek that was acting as a fish passage barrier and as a chronic sediment source to the stream and to

Flathead Lake (Figure 4). A complete summary of this project is available in a separate report entitled: DuCharme Creek Watershed Restoration Program: Laudermilk Dam Removal Project. Landowner neglect allowed the stream to breach the dam, which represented an enormous sediment source threatening the stream and Flathead Lake.

Figure 4. Laudermilk Dam prior to removal, August 2002.

The DuCharme Creek watershed comprises almost 1625 acres, excluding Centipede Creek above the Turtle Lake Feeder Canal. Although the DuCharme Creek watershed is relatively small, it has with numerous disturbances and modifications. This dam is one of four that have been identified in the watershed. Of the four dams, the Laudermilk dam was the highest priority for removal because it was unmaintained and failing.

Historically, the dam was used to impound water for irrigation but had not been utilized or maintained for years, and had filled with sediment. The dam was entirely earthen (no rock was found during excavation) and consists of clay to fine sand. The threats presented by the dam are that it prevented upstream passage of fish and that it was a major and chronic source of sediment to the stream and lake. When the Tribal Fisheries Program identified the problem in 1999, the dam had already been breached (Figure 5). The stream had downgraded through the dam and followed a path around its east side. Someone placed logs across the stream at the point of breaching to arrest the head cutting of the stream. We estimate that the breaching resulted in the release of 180 cu. yds. of sediment downstream.

Figure 5. Location of breach of Laudermilk Dam by DuCharme Creek, July 2002.

We identified two possible removal strategies, partial or complete. Complete removal was appealing because it accomplishes full restoration. Also, it carried the least long-term risk because no unnatural sediments would remain within the floodplain. Complete removal would have entailed removing not only the dam but also the entire volume of sediments deposited behind the dam. The depositional area is about 200 m long, 25 m wide, and averages about 1 m in depth. The extent of these deposits illustrated the rate of erosion that had occurred in this small watershed over the last century. The deposits equate to about 500 dump truck loads of material.

We chose not to remove the deposited sediments because of the great expense it would entail, and the fact that the depositional area had developed into a wetland. We decided that preserving the wetland was more desirable than restoring the drier riparian condition that is likely more similar to that which was present historically. This choice also simplified our process because of the difficulty in obtaining permits to remove a wetland. Retaining the wetland also required that a portion of the dam be retained at the same elevation as the depositional area to protect its stability. The design modified the dam into a valley bottom feature with a low profile and broader base than the original. This was an effort to integrate the remaining portion of the dam into the landscape, both in function and appearance. The decision to retain the depositional area also required that we design a short high-gradient reach of stream to accommodate the elevational drop imposed by the dam and depositional area. We designed a stable reach with three rock weirs to lower stream elevation 0.8 m in a distance of 37 m.

Dam removal took place between August 19th and 27th , 2002. The dam was effectively converted from a high obtrusive feature positioned perpendicular to the stream, to a lower and broader feature within the floodplain around which the stream travels. The extent of removal of the dam ranged from about 0.3 m at the west end to about 2 m on the east end (Figure 6). The final surface elevation of the dam was determined by the elevation of the depositional area. The west end of the dam surface is above the depositional area and the east end is lower. The excavated material was utilized in two locations. About two thirds of the material was used on the west side of the valley bottom to widen and shape the footprint of the dam into a gentle contour, giving the feature greater stability and more natural appearance. About one third of the dam material was hauled away to a low area within the property boundaries.

Figure 6. Excavation of dam, providing indication of depth of removal, August 2002.

The junction between stream reaches was stabilized with rock weirs, that consisted of three step pools made from approximately 40 large rocks (Figure 7). The channel dimension through the dam reached equilibrium prior to construction, so we did not alter the portion downstream of the weirs. We constructed a floodplain through the dam that is 0.1 m above stream level and 3 m wide. Vegetation on the face of the dam was removed and stockpiled prior to excavation and replanted after excavation was complete. Additional vegetation was planted in spring 2003.

This project accomplished both on and off-site objectives. It reduced the available in-channel sediment supply by removing about 200 cu. yds. from the valley bottom and by stabilizing roughly 3000 cu. yds. that remain in the dam and depositional area. The benefits are accrued to the stream and downstream in Flathead Lake. The project provided long-term stability to the retained sediments by constructing rock weir steps that have adequate mass to withstand large flood events. The project also restored fish passage within this reach of stream which represents an incremental improvement in the functional value of the fish habitat in DuCharme Creek.

Figure 7. Completion of construction phase of rock weirs, August 2002.

Project No. 3: Centipede Creek Culvert Removal

Prior to runoff in spring of 2002, we removed a culvert from Centipede Creek, which supports a population of pure westslope cutthroat trout (Figure 8). The culvert had been a barrier to fish passage, had caused a change in channel gradient, and was an imminent risk for failure.

Figure 8. Centipede Creek after removal of culvert, April, 2002.

Objective 3: Monitoring: Conduct creel survey to quantify catch and harvest rates in Flathead Lake.

During 2002 we interviewed 1760 anglers and conducted 204 aerial counts of anglers. Final summarization of the data has not been completed. The average length of lake trout caught by anglers was 498 mm (Figure 9). Harvest of lake trout is down from the peak in 1999 (Figure 10). The decline in harvest is totally attributable to the decline in angler pressure, because catch rates are continuing to increase and harvest rates are roughly stable. We presently do not have an explanation for the decrease in pressure.

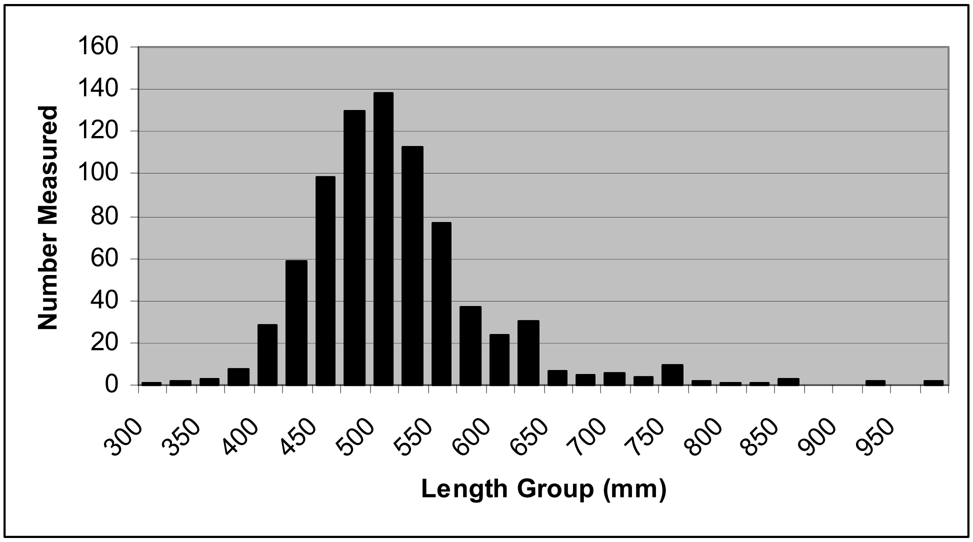

Figure 9. Lengths of lake trout measured during creel survey, July 2001 to June 2002.

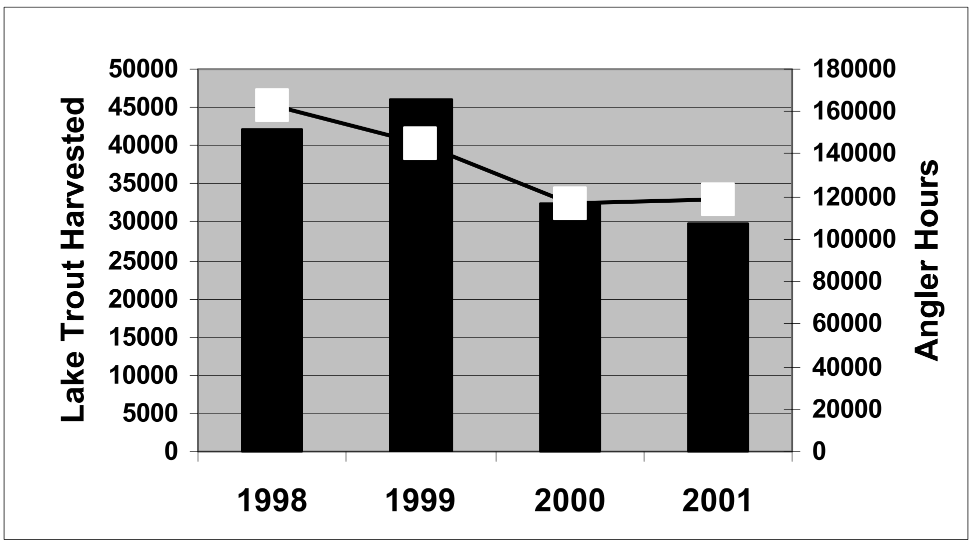

Figure 10. Estimated harvest of lake trout (bars) and estimated angler pressure on Flathead Lake, 1998-2001.

Objective 4: Monitoring: Evaluate parameters of lake trout biology (fecundity, growth, age and length at maturity, cohort strength, and mortality in Flathead Lake to monitor changes in the abundance of this predator.

We use fall gillnetting throughout the lake to sample lake trout for the purpose of estimating population parameters. Between October 13th and 25th, we employed a stratified random design to set 48 sinking gill nets, each consisting of 12 randomly arranged mesh sizes. We captured a total of 326 lake trout ranging in size from 198 to 1130 mm TL. During our analysis we reduced the sample of lake trout by 57 fish based on coefficients of retention probabilities, and increased the sample by 43 based on coefficients of encounter probabilities. The resulting sample of fish was then partitioned into year classes based on the previously established relationship between age and total length (Figure 11). Because ages 0-5 are not fully recruited to the sampling gear, their relative abundance could not be accurately estimated. A fairly uniform decline in survival between age 6 and 15 is evident, representing a mortality rate of 0.38 as computed by the Robson Chapman method.

Lake trout in Flathead Lake begin maturing at age 5 indicating that there are at least nine strong age classes of mature fish that are well represented in the population. The presence of so many mature year classes and a mortality rate of 0.38 indicate that this population is not under severe harvest pressure. This conclusion is consistent with results from the creel survey in which we have estimated a reduction in total harvest in recent years. The expected population response to increasing angler pressure or unsustainable levels of harvest is a steepening of the age distribution and a reduction in total number of year classes as observed over several years. Such a shift is not presently evident.

Figure 11. Estimated age structure and mortality rate of lake trout captured in fall 2002.

Lake trout fecundity was measured from fish captured during fall 2002 sampling (Figure 12). This parameter was also measured in 1996 and 1999 and no trend or pattern is evident. The information gathered to date has been valuable for modeling the reproductive potential of the population, but appears to not have the utility for defining population trends that we had hoped.

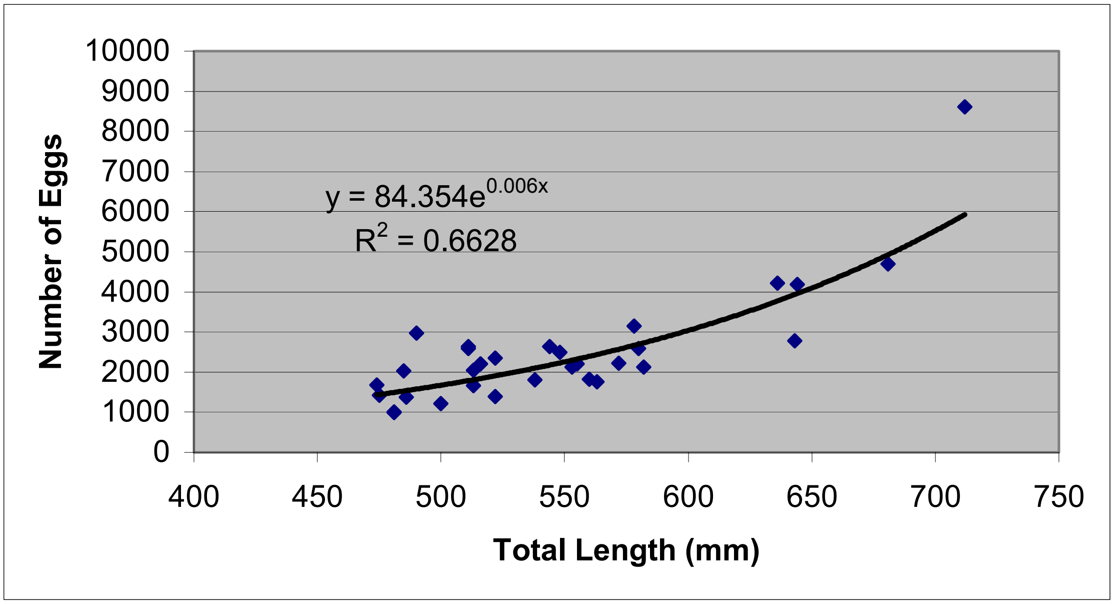

Figure 12. Fecundity of lake trout captured in fall 2002.

We examined 140 male and 135 female lake trout. Females reached 50% maturity at 572 mm TL (Figure 13) and males at 504 mm TL (Figure 14).

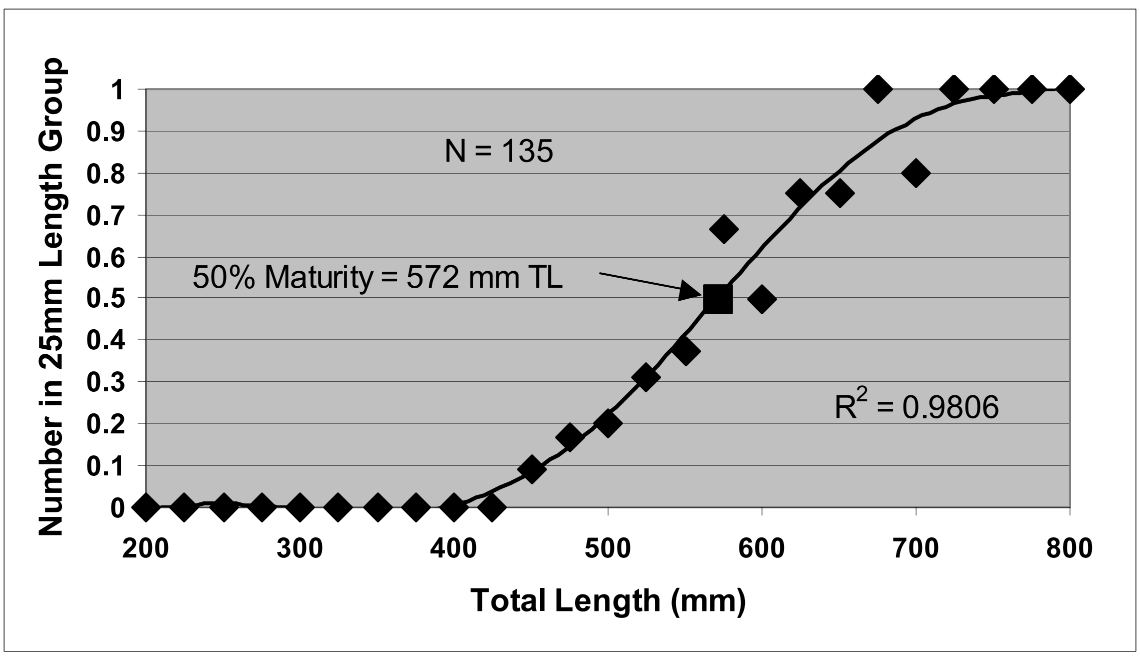

Figure 13. Percent maturity at length of female lake trout captured in 2002.

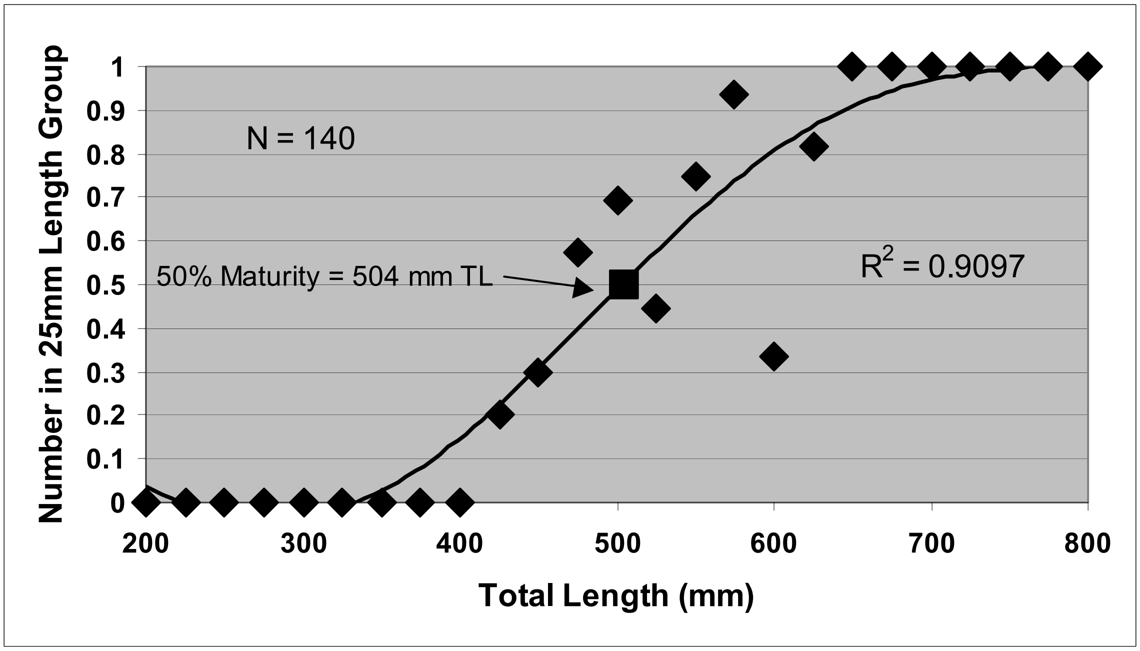

Figure 14. Percent maturity at length of male lake trout captured in 2002.

The period spanning from the onset of maturity to full maturity in females ranged from ages five to twelve (Figure 15), and in male lake trout ranged from ages five to ten (Figure 16). Based on this information, male and female lake trout do not make substantial contributions to population recruitment until ages six and eight respectively. These parameters provide supportive evidence that the goal in the Flathead Lake and River Fisheries CoManagement Plan to reduce lake trout is obtainable. Lake trout enter the recreational fishery in substantial amounts at age four and are fully vulnerable by age six. Therefore substantial numbers of lake trout are harvested prior to maturity, which should have a suppressing effect on population resiliency.

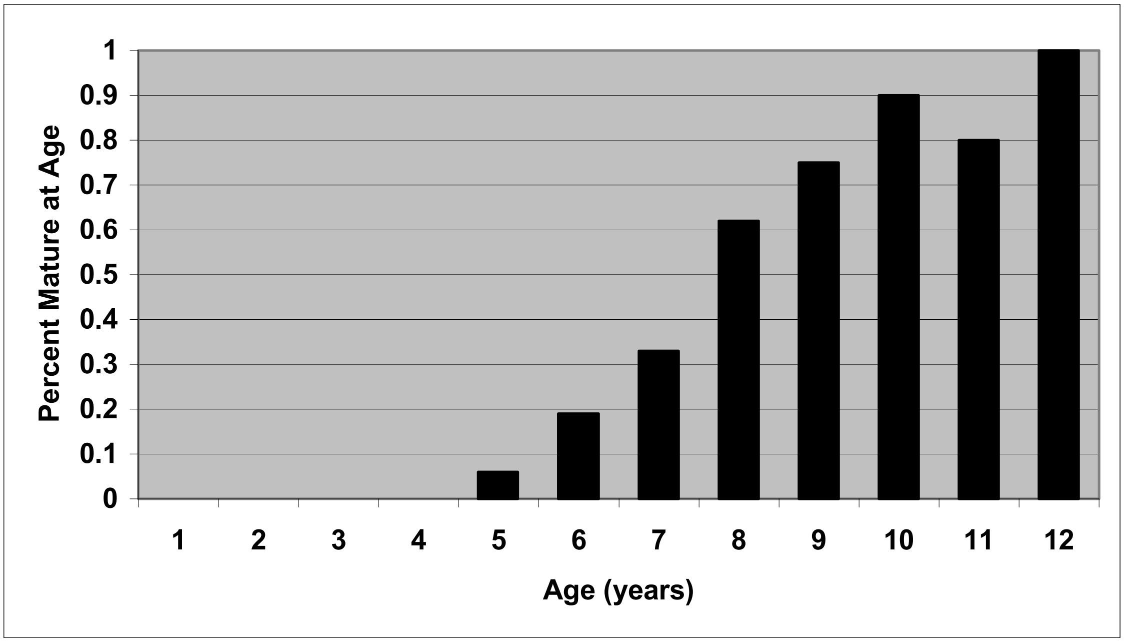

Figure 15. Percent maturity of female lake trout for ages 1 to 12 captured in 2002.

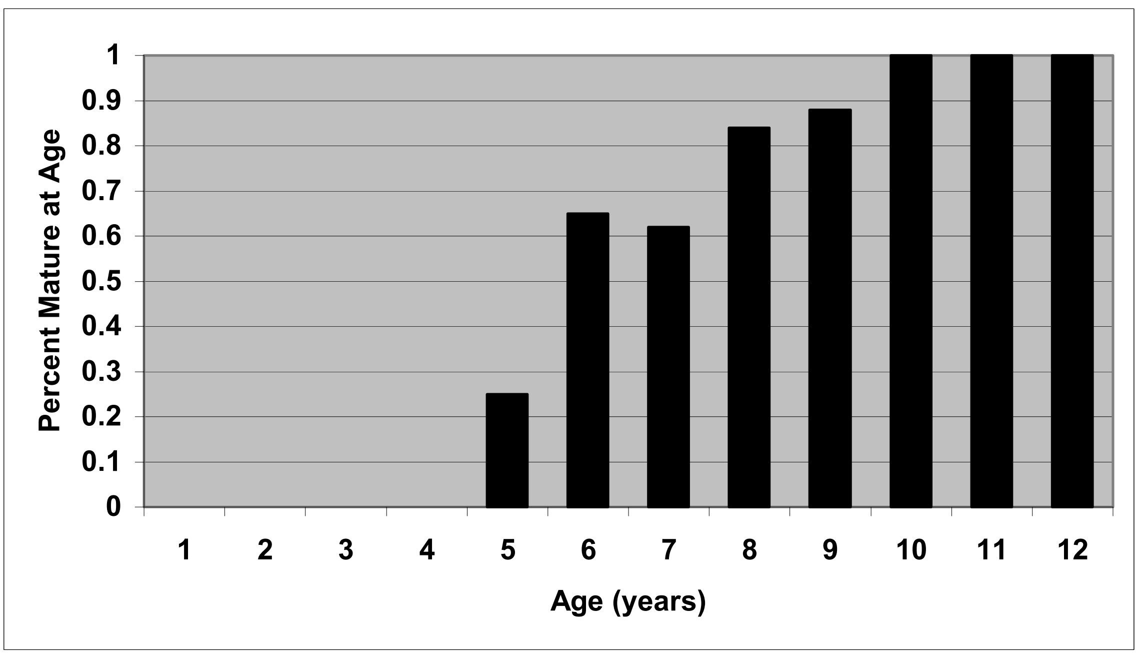

Figure 16. Percent maturity of male lake trout for ages 1 to 12 captured in 2002.

Objective 5: Monitoring: Evaluate success of westslope cutthroat and rainbow trout releases in off-site reservoirs.

There was no quantitative evaluation conducted during this reporting period. Numerous anecdotal accounts were received.

Objective 6: Research: Quantify nutrient, zooplankton, and Mysis relicta dynamics in Flathead Lake as part of a comprehensive study to determine how to mitigate losses of native species.

Dr. Beauchamp of the University of Washington has nearly completed the bioenergetics model describing competitive interactions between species in Flathead Lake. The contents of about one hundred lake trout stomachs that contain unidentified salmonids remain for final analysis. Because these unidentified fish may be bull or cutthroat trout, it is especially important that they be identified. The question of the extent of predation by lake trout on native salmonids is one of the largest to be answered by this modeling exercise. Therefore we are investigating additional methods, such as comparison with local reference collections, and the use of genetic analysis to resolve the identify of these remaining fish.

Drs. Dan Wicklum and Jack A. Stanford of the Flathead Lake Biological Station, the University of Montana, completed a study to resolve outstanding questions about the diets of *M. relicta* and the possibility that some diet components may digest too rapidly to be quantified. Some of the results of bioenergetic analysis have been unexpected and counter-intuitive, raising questions about the accuracy of some of the data collection methods. Therefore it was necessary to resolve the suspicion that the diet data may be subject to sampling errors. The following is a condensed summary of their report. They posed the question: Why are *Daphnia* sp. the only zooplankton found in *Mysis* foreguts, especially when Daphnia sp. are assumed to enjoy a thermal refuge from M. relicta during stratification. They examined the potential that other species are preyed upon by *Mysis* but the remains of those species are poorly represented in *Mysis* gut analyses because of rapid digestion. To address this issue a feeding experiment, where *Mysis relicta* were fed known copepod zoopolankton taxa and lifehistory stages, was conducted. The question addressed in this study was: Can the remains of different lifehistory stages of copepods be recognized in *Mysis relicta* guts after consumption?

Mysis relicta were collected using standard methods from midlake deep in Flathead Lake. Approximatley 20 *Mysis relicta* were placed in each of four one liter plastic containers filled with surface lake water. The plastic containers were each emptied into separate aquaria that had been filled with aerated filtered lake water (64 μm) and chilled to 10 °C in environmental chambers. *Mysis relicta* were acclimated and starved of macroprey for 48 hours, and all *Mysis relicta* that were damaged, as deemed by visual inspection, were removed. All collection, acclimation, and experimental procedures were conducted in total darkness, or the minimum amount of light necessary to effectively inspect the organisms.

Zooplankton for the experiment were collected from Flathead Lake using standard methods (vertical tows of a 64 μm mesh net). All copepods were physically separated into one of three groups,

1) adult copepods and late copepodites (the vast majority were probably instar V)
2) copepodites (the vast majority were probably instars III – IV)
3) nauplii and early copepodites (the vast majority were probably instars I-II).

Copepods were separated into the treatment groups by initially filtering the zooplankton sample through three successive mesh sizes 1mm, 500 µm and 125 µm. This process yielded four size fractions of zooplankton 64 – 124, 125 to 499, 500 to 999 µm, and > 1mm. Using these size grouping as starting points, dissection probes and micropipettes were used to separate the copepods into the three lifestage groupings to be used as the *Mysis relicta* feeding treatments.

Each treatment consisted of individual 500 ml glass containers (n=10) filled with 250 ml aerated filtered (64 µm) lake water to which a known number of zooplankton, from one of the treatment groups, were added. One starved *Mysis relicta* was then added to each container, removed after four hours, and preserved in ETOH. *Mysis relicta* foregut contents were quantified using standard methods and the zooplankton abundance in the test solutions were recounted using the same methods as above.

A paired t-test was used to test if the final zooplankton concentrations were different from the initial concentrations. Linear regression was used to determine how well the number of zooplankton found in the *Mysis relicta* foreguts predicted the apparent amount of consumed zooplankton, taken as initial minus final zooplankton concentration, in the treatment solutions.

Table. 1. Mean initial and final zooplankton concentrations in the *Mysis relicta* feeding experiments.

Treatment	Initial Count	Final Count	Difference	P
Adult	13 (4)	9 (2)	4 (4)	0.008 $t_{9,0.05} = 3.39$
Copepodite 1 ml subsample of 5ml concentrate	58 (14)	49 (14)	8 (16)	0.12 $t_{9,0.05} = 1.7$
Nauplii 1 ml subsample of 5ml concentrate	111 (18)	108 (12)	4 (23)	0.60 $t_{9,0.05} = 0.53$

For all treatments, consumed zooplankton could be identified in the foreguts. However, there was not always good correspondence between the number of zooplankton counted in the foreguts and the number estimated to be removed from the test solution by consumption. Scatterplots of the estimated number of zooplankton in each *Mysis relicta* foregut vs. the number estimated to have been removed from the test solution (initial count minus final count) are presented in Figs. 17-19.

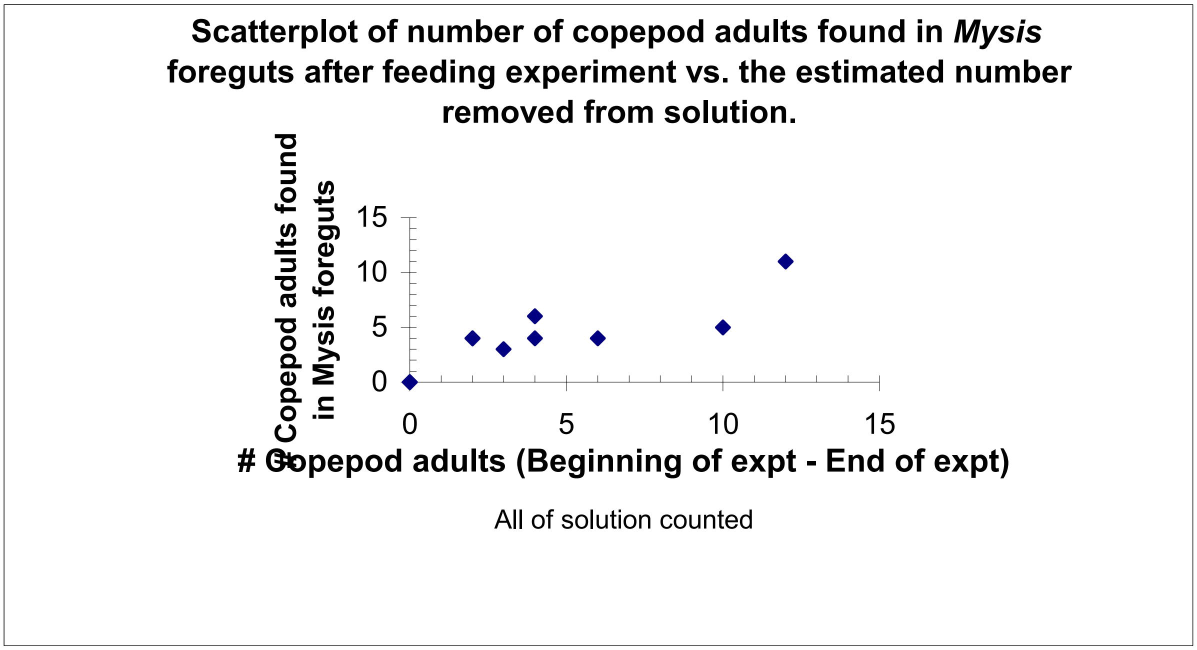

Figure 17. Number of copepodites found in Mysis foreguts after feeding experiment vs. estimated number removed from solution.

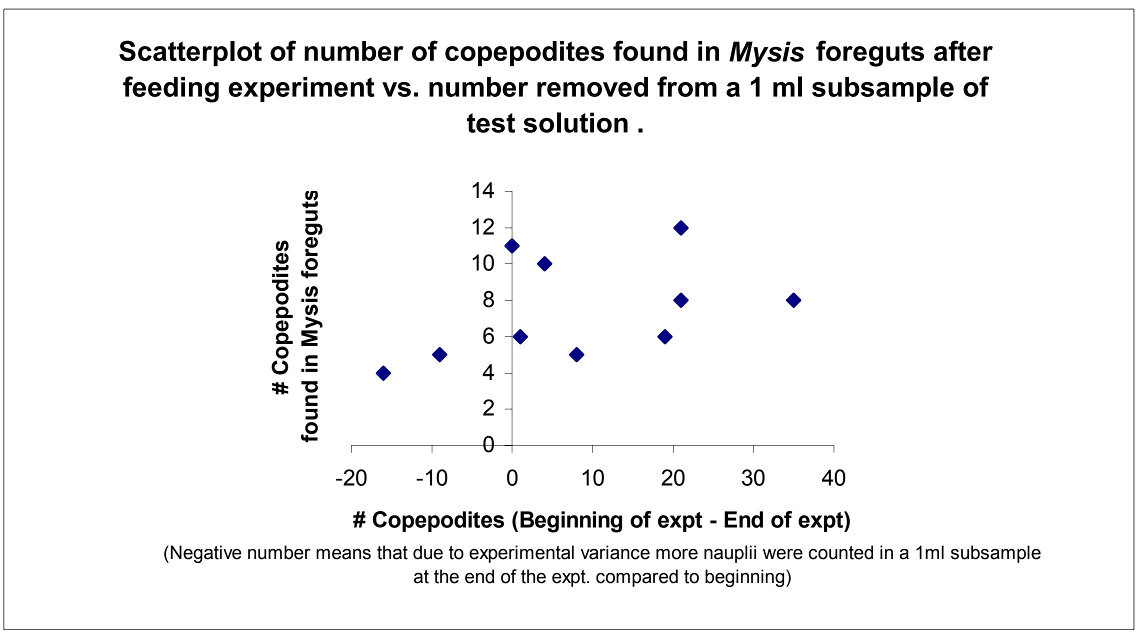

Figure 18. Number of copepodites found in Mysis foreguts after feeding experiment vs. estimated number removed from a 1 ml test solution.

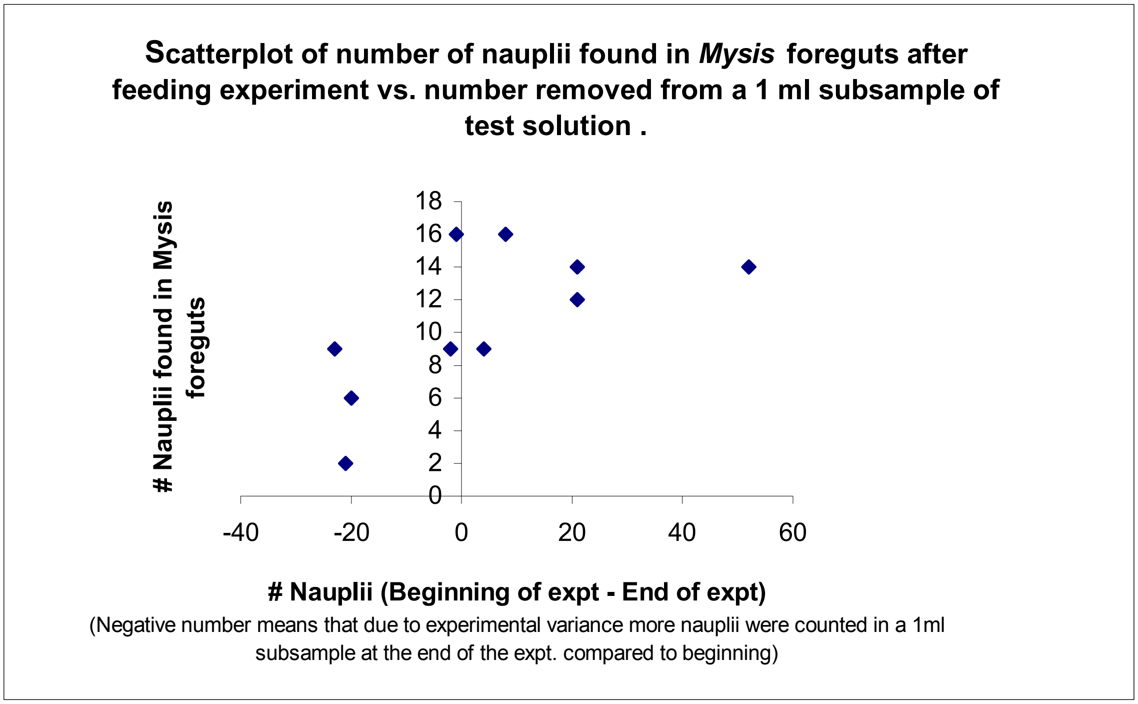

Figure 19. Number of nauplii found in Mysis foreguts after feeding experiment vs. estimated number removed from a 1 ml test solution.

There was good correspondence (correlation coefficient of 0.71) between the number of adults identified in the Mysids foreguts and the number calculated removed from the test solution. This is probably because the body size of the adults was sufficiently large and the absolute number of adults was sufficiently small to allow for the counting of all individuals in solution. As a result there was no subsampling error. Also, adult body parts were fairly easily identified so the error in enumeration of individuals in the guts was small. It was apparent that the number of adults actually consumed by an individual *Mysis relicta* was systematically underestimated by the number found in the gut although clearly the skill and experience of the observer will affect this result. Based on the data collected in this experiment the number of copepod adults consumed by a *Mysis relicta* can be estimated using the equation:

# of copepod adults actually consumed = 1.27 + 0.66(# copepod adults found in foregut)

We concluded from this experiment that all lifestages of copepods are consumed by *M. relicta* and all lifestages can be observed in the foregut. The experiment reinforced our supposition that *Daphnia* sp. are the primary prey of *M. relicta*. This conclusion further supports conclusions drawn from earlier work that *M. relicta* are not forage-limited.