Experimental Removal of Lake Trout in Swan Lake, MT: 2012 Annual Report

Prepared for the Swan Valley Bull Trout Working Group

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April, 2013

Background

The Swan Valley has historically been home to a stable bull trout population. However, in 1998 anglers began to occasionally catch adult sized (20-30 inch) lake trout from Swan Lake and the Swan River. This caused alarm because lake trout are not native and are notorious for rapidly expanding and dominating fish communities in lakes with *Mysis* shrimp, particularly at the expense of bull trout and kokanee salmon (Martinez et al. 2009). In 2003, the level of concern was compounded when biologists gillnetted juvenile lake trout from Swan Lake during standard low-intensity sampling efforts, indicating that wild reproduction was occurring. Since 2003, lake trout catch by anglers as well as during Montana Fish, Wildlife and Parks (FWP) biological sampling continued to increase, indicating that the population was expanding. Research efforts since 2006 have focused on lake trout population demographics, and exploring potential techniques to reduce lake trout numbers while minimizing bull trout bycatch. Based on case histories from nearby waters, long-term management alternatives for this increasing lake trout population are necessary in order to maintain the popular bull trout and kokanee fisheries.

In 2009 FWP released an EA for a three-year experimental removal of lake trout in Swan Lake. This removal experiment was essentially a feasibility study to determine the effectiveness of using targeted gillnetting as a technique to reduce the number of lake trout, and thus minimize threats of an increasing lake trout population to kokanee and bull trout. From 2009-2011 over 20,000 lake trout were removed from Swan Lake. Total annual mortality rates for lake trout vulnerable to the nets used in the project were higher than literature suggests are sustainable. While much has been learned with regard to our ability to affect lake trout cohort strength from one year to the next, the overall effect this level of removal has on the lake trout population and other fish populations remains unknown. Therefore, in May 2012 FWP released another EA for a five-year extension of the lake trout removal project to further evaluate the effectiveness of the current lake trout suppression effort. Measurable goals and specific success criteria outlined in the original 2009 EA will be used to evaluate the feasibility and effectiveness of alternatives to control expansion of the lake trout population. Based on the results of this assessment and other relevant considerations, FWP, with recommendations from the Swan Valley Bull Trout Working Group (SVBTWG), will consider whether these actions are appropriate or if other changes are warranted in fisheries management of Swan Lake and the lake trout population.

Previous annual reports can be found at:
http://montanatu.org/resources/swan-valley-bull-trout/

Methods

The five-year extension of the lake trout suppression project is scheduled to closely follow the efforts conducted from 2009-2011. This replication of effort will allow researchers to maximize lake trout removal in Swan Lake, while providing consistent data that allows for year-to-year comparisons. Consistent with the work from 2009-2011,

the project continues to be comprised of two distinct netting events. The first event (Juvenile Netting) is aimed at removing juvenile and subadult lake trout throughout the two deep (>60') basins of Swan Lake. This removal is carried out using small-mesh (1.5 – 3.0 inch stretch) gill nets, set by professional fisheries contractors over a three-week period in late August. This netting is conducted during a time in which most adult bull trout are upstream in the Swan River drainage in preparation for fall spawning and also occurs during the period in which Swan Lake is thermally stratified. Only habitat below the thermocline (>60') is sampled, in order to reduce incidental bycatch of bull trout and other fish species which occupy shallower depths.

The second netting event (Spawner Netting) is directed at removal of adult lake trout during spawning and thus is targeted to directly affect further recruitment. This portion of the project is carried out largely by SVBTWG members and takes place during the month of October. Large-mesh gill nets (3.5 – 5 inch stretch) are set during the nighttime and early morning hours, along spawning areas identified by telemetry work conducted from 2007-2009 (Cox 2010).

Results

Juvenile Netting

Netting for juvenile lake trout has been contracted with Hickey Brothers Fisheries of Baileys Harbor, Wisconsin since 2009. Similar to previous years, the boat was cleaned and disinfected following a Hazard Analysis and Critical Control Point Plan (HACCP) to minimize the risk of spreading aquatic invasive species. Each year, the boat was inspected by FWP personnel prior to entering Swan Lake to ensure proper cleaning procedures had been followed. Netting took place from August 13-31, 2012 which was a week earlier than was done in previous years. This change in timing simplified logistics for the contractor and still provided lake conditions similar to previous years. Additionally, shifting the Juvenile Netting a week earlier ensured that post-spawning bull trout would not have returned to Swan Lake during netting operations. The amount of netting effort and the locations of nets set for juvenile lake trout has been kept constant since 2009. The contract with the Hickey Brothers provides 30 lifts, with one lift being described as an event in which nets are set and retrieved. While the number of lifts has not changed since 2009, the number of net panels set has slightly increased since the beginning, as more panels of small mesh net were set to increase the catch of juvenile lake trout (Table 1). Although the number of net panels has increased slightly since inception of the project, the locations of the nets have remained constant (Figure 1).

Table 1: Dates and numbers of nets set for Juvenile Netting 2009-2012.

Year	Netting Dates	# Lifts	# 900' Net Panels
2009	Aug 24-Sept 11	30	248
2010	Aug 23-Sept 10	30	311
2011	Aug 22-Sept 9	30	399
2012	Aug 13-Aug 31	30	382

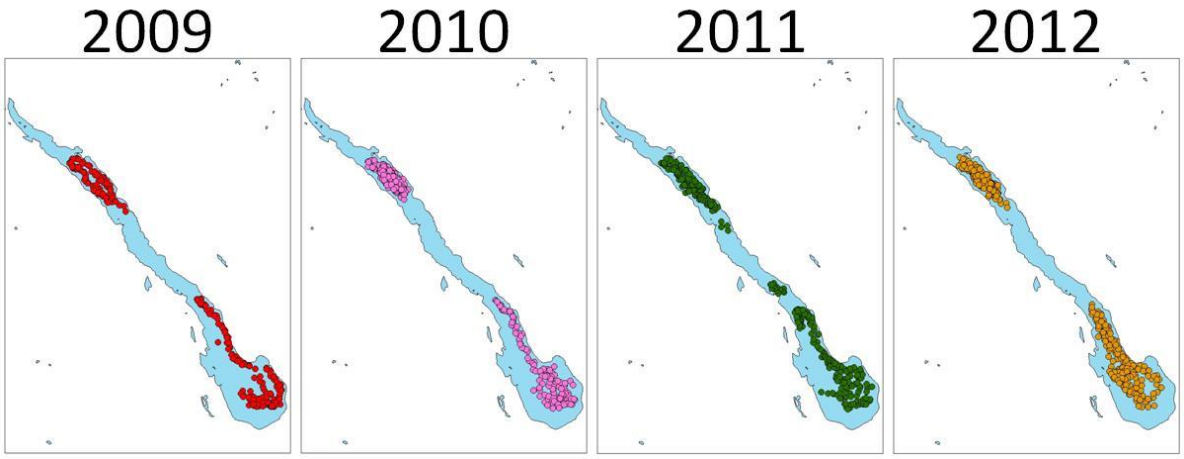

Figure 1: Locations of gill nets set during Juvenile Netting 2009-2012.

A total of 10,414 lake trout from 6”-32” were removed during the 2012 Juvenile Netting period (Figure 2). All fish less than 22” in length were cleaned, packed on ice, and sent to local area food banks for distribution. Fish greater than 22” were not retained for food bank distribution because of human consumption guidelines related to mercury content. Those fish were either given to local wildlife rehabilitation centers or were returned as biomass to the bottom of the lake. The length frequency distribution of lake trout caught during the Juvenile Netting period continues to be skewed heavily toward smaller fish, as a result of targeting their location and fishing smaller mesh nets as the primary method (Figure 3). The majority of the juvenile lake trout catch is comprised of age-3 and age-4 lake trout. Soak times of each panel of net and the depth of nets fished have remained constant throughout the four years of the project. The depth was maximized and duration of these net sets was minimized in an effort to reduce bycatch and associated mortality of non-target species. Bycatch of other fish species during the Juvenile Netting period can be found in Table 2.

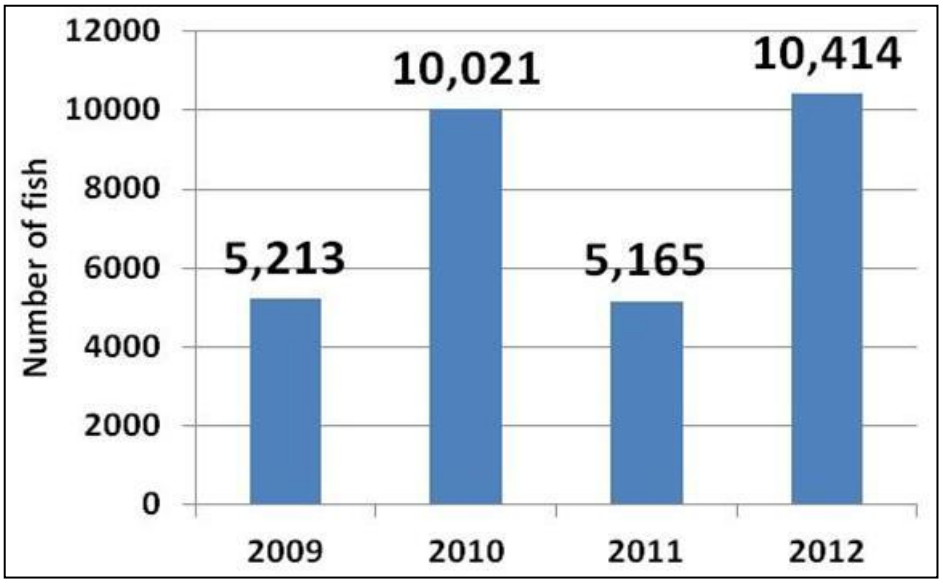

Figure 2: Total number of lake trout removed during Juvenile Netting 2009-2012.

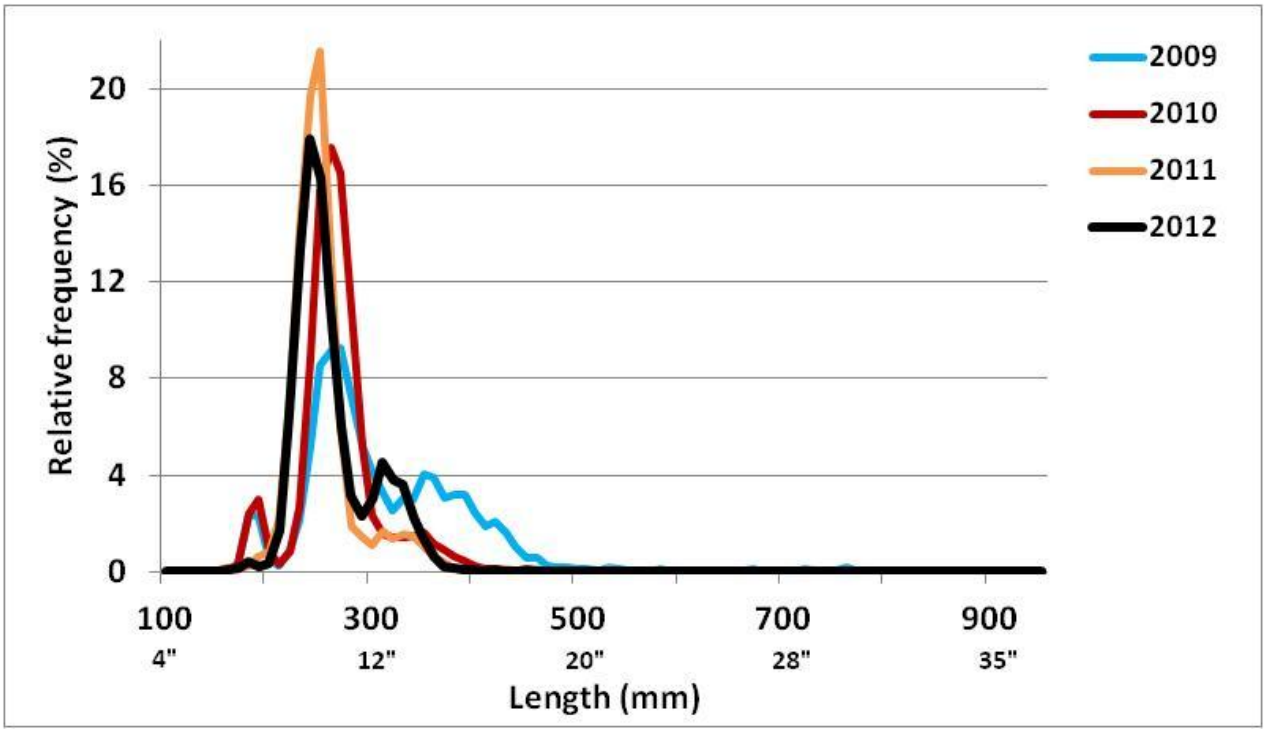

Figure 3: Relative length frequency of lake trout caught during Juvenile Netting in Swan Lake 2009-2012.

Table 2: Bycatch of non-target fish species captured during Juvenile and (Spawner) netting events 2009-2012. Most fish were released alive.

Fish Species	2009	2010	2011	2012
bull trout	238 (26)	212 (87)	237 (104)	229 (101)
kokanee	205 (23)	414 (110)	159 (46)	521 (114)
mountain whitefish	107 (0)	28 (5)	31 (2)	67 (0)
pygmy whitefish	139 (0)	63 (0)	9 (0)	79 (0)
longnose sucker	86 (50)	49 (306)	65 (145)	17 (207)
northern pikeminnow	27 (36)	14 (136)	31 (131)	2 (68)
largescale sucker	0 (58)	0 (109)	0 (111)	0 (54)
rainbow trout	6 (3)	5 (10)	7 (11)	0 (11)
northern pike	0 (2)	0 (0)	0 (7)	0 (2)

Spawner Netting

Removal of the adult component of the lake trout population, in efforts to directly affect further recruitment of lake trout cohorts, continues to be an important aspect of the project. Netting during the lake trout spawning period from 2009-2011 resulted in a total of 931 mature lake trout being removed from the system and provided useful information with regard to the timing and location of lake trout spawning. These three years of Spawner Netting further reinforced confidence in the spawning area and has provided baseline catch data for trends in removal efficacy.

Netting for spawning lake trout was conducted from October 8-25, with nets being set and lifted twice daily, Monday-Thursday. While netting did not occur every day (Friday, Saturday, and Sunday were not fished), the schedule and subsequent effort was similar to previous years of the project. Adult lake trout catch in 2012 was 215 fish. After realizing in 2009 that FWP-owned boats and equipment was inadequate to set and retrieve large amounts of gill net for covering the entire spawning area, the contract with the Hickey Brothers was modified to incorporate the use of their boat during Spawner Netting. This effort was replicated in 2010 and 2011, and continued in 2012. Since 2010, the number of adult lake trout captured during Spawner Netting has decreased by 47% (Figure 4). Similar to 2010 and 2011, relative length frequency of lake trout captured during Spawner Netting has shifted to smaller individuals, suggesting that past efforts have been

effective in removing the larger, older individuals from the population (Figure 5). Bycatch of fish species other than lake trout during Spawner Netting was similar to past years (Table 2).

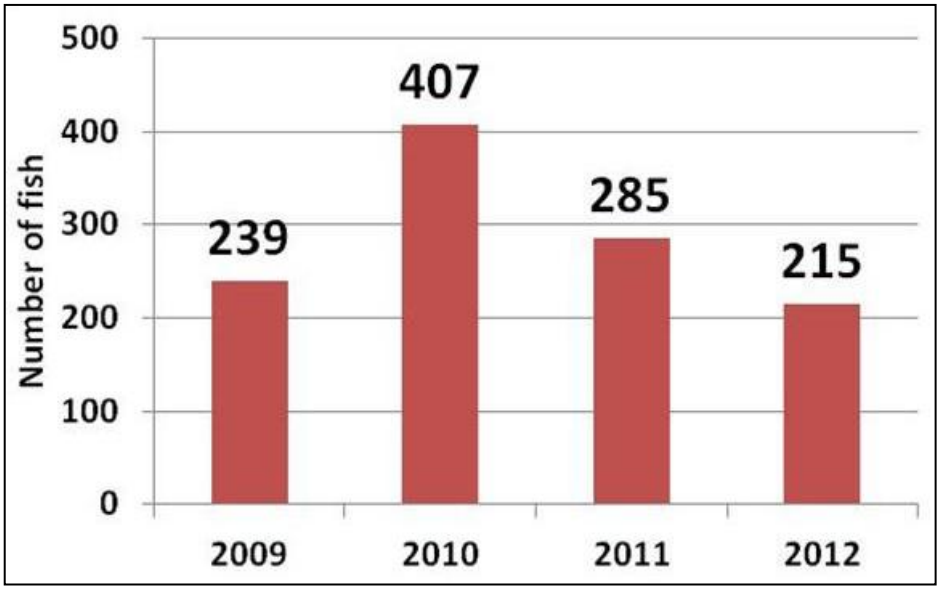

Figure 4: Total number of lake trout removed during Spawner Netting in Swan Lake 2009-2012.

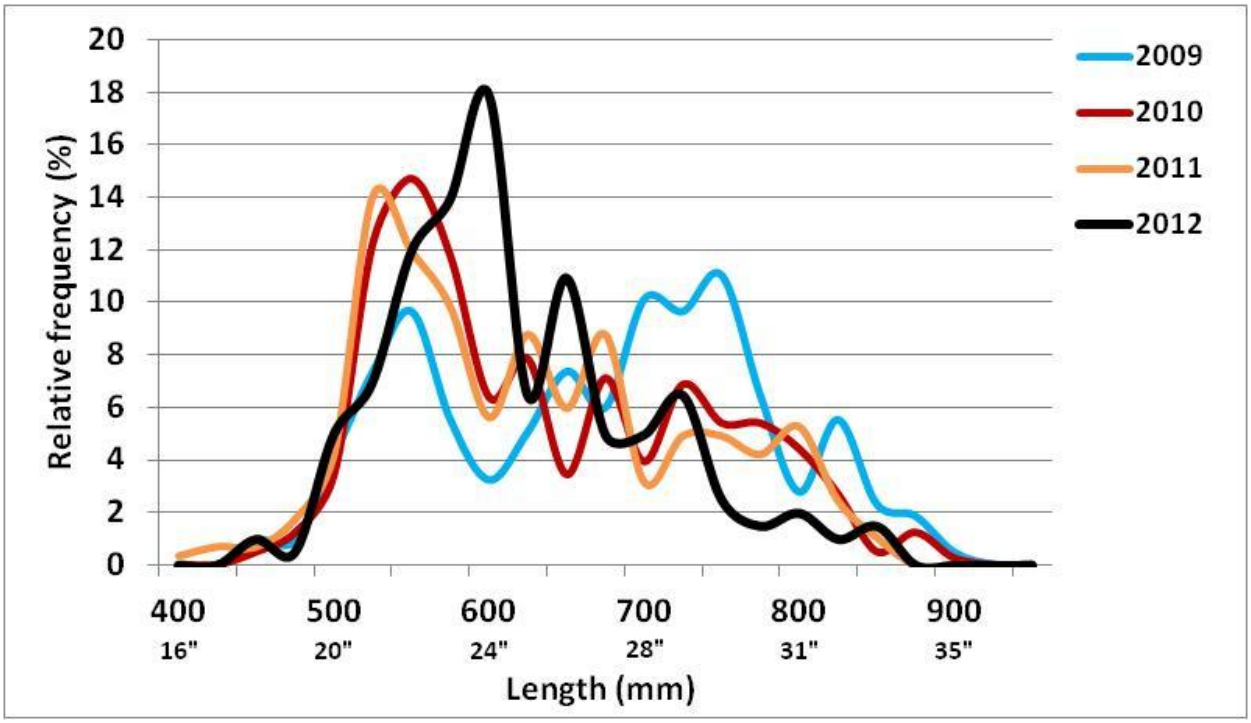

Figure 5: Relative length frequency of lake trout captured during Spawner Netting in Swan Lake 2009-2012.

Bycatch, Bull Trout, and Kokanee

Bull trout bycatch continues to be closely monitored as this project has progressed. Since the inception of the project, decreasing the chances that bull trout would be captured and minimizing the mortality rates of inadvertently caught bull trout has been a priority. The timing of the Juvenile Netting (when many more feet of gill net is actually deployed) has intentionally been conducted when most adult bull trout are upstream of the lake in preparation for fall spawning. Additionally, gill net soak times in both Juvenile and Spawner Netting have been kept relatively short so that inadvertently caught bull trout have a greater chance of being released alive. Released bull trout have been given a conditional score and a Passive Integrated Transponder (PIT) tag so that over time, scientists will be able to estimate total bycatch mortality more reliably. While this project continues to be first and foremost a research experiment, with data being collected in a consistent manner annually, slight changes are being made to reduce bycatch mortality for bull trout. An example of this will be the elimination of 3.5" and 4.0"-mesh gill nets during the Spawner Netting period. Analysis in 2012 revealed that 4.5" and 5.0"-mesh nets accounted for the majority of adult lake trout catch and resulted in the least amount of bull trout bycatch. This change in mesh size will still allow for comparable data and should be considered a benefit of the adaptive management approach the working group is taking on this project.

Adding to the concern of bull trout bycatch has been a recent declining trend in the number of adult bull trout returning to spawn each year. From 2007-2011 the number of bull trout redds (spawning beds) declined considerably (Figure 6). However, a slight increase in the number of redds was observed in 2012. A regulation change in 2012 required anglers to release all bull trout in Swan Lake (prior to that anglers were allowed to keep one bull trout daily). This regulation change was put in place in response to the declining redd count trend and as a measure to offset some of the bycatch mortality. A comprehensive examination of the potential effects to the bull trout population from gill net bycatch was presented in the 3-year summary report for the Swan Lake project (Rosenthal et al. 2012). While analysis has shown that bycatch does have the potential to negatively affect bull trout redd numbers, the subsequent benefits to bull trout from the removal of lake trout remains unknown. These potential benefits are the primary reason this experimental removal was initiated and will be the focus for evaluating the success of the project in future years.

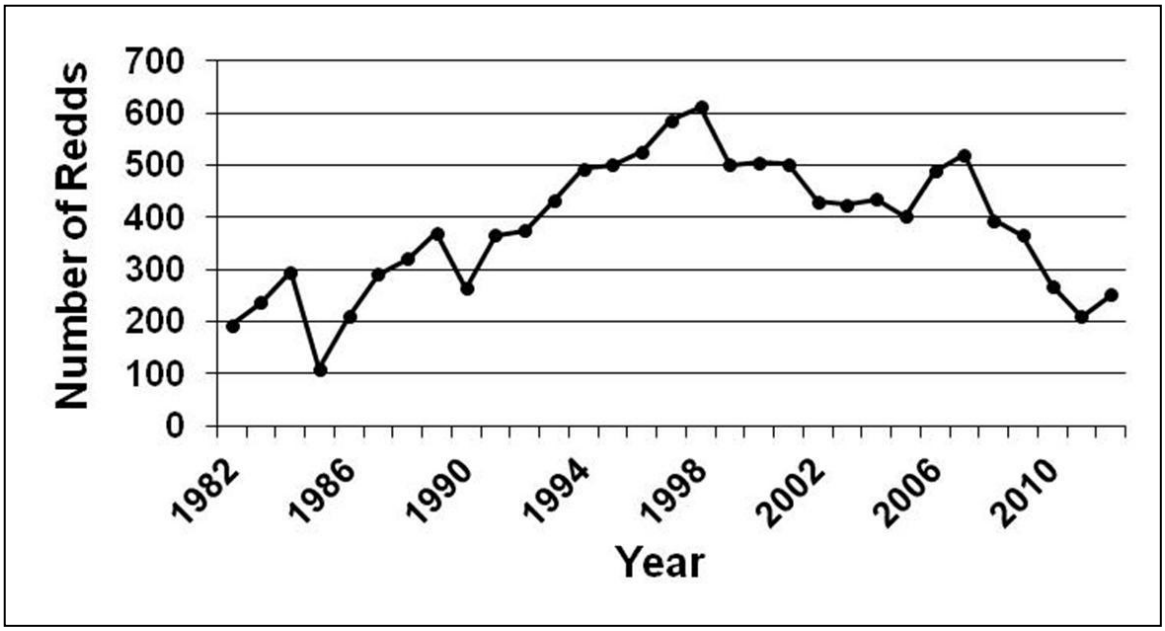

Figure 7: Bull trout redd count data from Swan Lake index tributaries 1982-2012.

Introduced kokanee salmon are another important fish species for Swan Lake. Kokanee provide one of the more popular angling opportunities in Swan Lake for both ice and open-water fishermen, and also represent an important food resource for adult bull trout. Case histories from surrounding area lakes have demonstrated that the combination of *Mysis*, kokanee, bull trout, and lake trout typically results in decreased abundance of bull trout and elimination of kokanee. Therefore, kokanee represent another indicator of potential project success, as increases in abundance may suggest a reduction in lake trout density.

Kokanee abundance in Swan Lake is monitored annually through redd counts along an index reach of Swan Lake. Similar to adult bull trout trends, kokanee spawner abundance had declined from 2005-2011 and then increased slightly in 2012 (Figure 7). Redd count surveys in 2011 revealed the lowest abundance throughout the period of record. The slight increase in 2012 was encouraging, and the trend will continue to be closely monitored to determine if the project is effective in relieving predation from lake trout. In addition to the slight increase in adult kokanee numbers, length frequency analysis of kokanee inadvertently captured during Juvenile Netting reveals no missing age classes of kokanee in Swan Lake (Figure 8). Kokanee in the bycatch range from 6-18 inches (150-450 mm). Kokanee smaller than 6" were likely not captured as a result of the mesh sizes used for the netting. The observation of numerous small kokanee should be viewed as positive, as these fish are likely to be most affected by an increasing lake trout population.

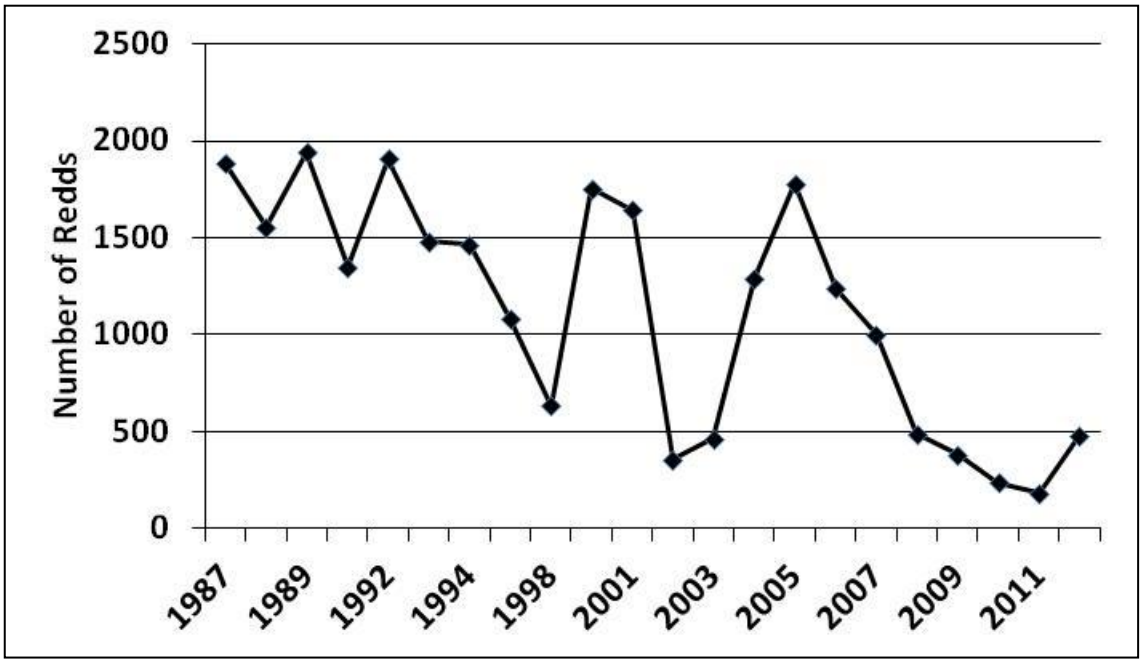

Figure 8: Kokanee redd count data from Swan Lake 1987-2012.

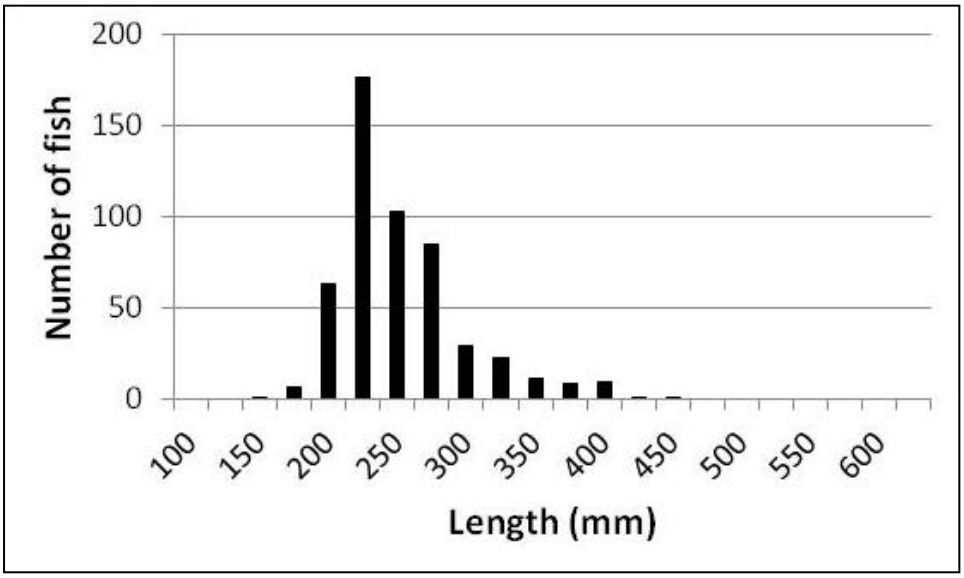

Figure 9: Length frequency of kokanee captured during Juvenile Netting in 2012.

Evaluation Criteria

This lake trout removal project in Swan Lake was initiated to evaluate the efficacy of gill nets as a management tool to control the expansion of the lake trout population while minimizing the impact of these non-native fish on the bull trout and kokanee fisheries. Criteria to evaluate our actions were outlined in the original 2009 EA, and continue to be monitored throughout the study. An in-depth review of these criteria can be found in the 3-year Summary Report (Rosenthal et al. 2012).

Modeled lake trout netting mortality during Juvenile Netting continues to exceed rates which published literature suggests will begin to collapse a population (Healey 1978). Conservative estimates of exploitation (mortality) of age-3 and age-4 lake trout has been in excess of 50% since 2009. These modeled estimates are most accurate for these two age classes of fish, as they are the most vulnerable to the nets being deployed and the locations being sampled. While these results are encouraging, there are some assumptions in the model that require further investigation. Work in 2013 will include testing of these exploitation models.

Lake trout length frequency during both Juvenile and Spawner Netting continues to be skewed toward smaller fish. In the case of Juvenile Netting, this observation suggests that netting is effective at removing a considerable portion of the age-3 and age-4 lake trout, as relatively few fish in the next size class are captured. Similarly, the shift in length during Spawner Netting suggests that netting has been effective in removing many of the older, larger individuals, as most fish captured during Spawner Netting have recently reached sexual maturity.

Netting in 2013 may give researchers the first glimpse of how the past four years of effort has affected the overall lake trout population. Spawner Netting for adult lake trout began in 2009. Undoubtedly some adult lake trout spawned that fall and their offspring would then be age-0 fish during Juvenile Netting in 2010, age-1 in 2011, and age-2 in 2012. Because of fish behavior and the nets being used for this project, lake trout do not fully recruit to the nets until they are age-3. Therefore, netting in 2013 will be the first year sampling a cohort of fish that had been affected by past Spawner Netting. The upcoming years will determine whether past efforts have been sufficient to significantly reduce the lake trout population.

2013 Plans

Netting in 2013 will follow the same schedule as was completed from 2009-2012. Juvenile Netting will be conducted the last three weeks in August. This schedule is identical to that of 2012, starting a week earlier than 2009-2011. Lake conditions are similar throughout the month, and the shift of one week ensures that no post-spawn bull trout will be returning to Swan Lake during netting operations. Spawner Netting will follow the same schedule as was done from 2009-2012.

This field season will also include the third year of research into the destruction of lake trout eggs and embryos using modified electrofishing equipment. This project was initiated in 2011 in an effort to develop alternative technologies to be used to control unwanted non-native fish species. The first two years of the project have given researchers insight into the capabilities of modified electrodes; however changes in design will hopefully allow shock duration to be increased so that electricity is effective at destroying eggs deposited at deeper depths in the substrate. Previous work showed that electricity was effective at destroying eggs, but the duration of the shock was insufficient with the dragging method being used.

In addition to work being conducted in Swan Lake, research will also begin to examine the lake trout populations in Lindbergh Lake and Holland Lake. Lake trout were first detected in Lindbergh Lake in 2009 and were found in Holland Lake in 2012. Both of these headwater lakes also contain their own populations of bull trout and the implications of these newly established lake trout remain unknown. Biologists are concerned with this expansion of the lake trout population, as bull trout numbers in these two lakes are limited. Research in 2013 will include examining lake trout movement throughout the Swan system, including Lindbergh and Holland, and potentially identifying lake trout spawning habitat in Lindbergh Lake through the use of sonic telemetry. Sonic telemetry was used effectively to identify the spawning area in Swan Lake and this has been the focus of netting operations from 2009-2012 (Cox 2010).

Monitoring of the other aquatic organisms will also continue in the Swan Lake system. Annual *Mysis* sampling will occur in early June, bull trout redd counts will happen in October, and kokanee redd counts will be completed in early December. Additionally, spring gill net monitoring will be conducted in Lindbergh Lake to look for trends of all fish species.

References

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