Experimental Removal of Lake Trout in Swan Lake, MT: 2009 Annual Report

Photo courtesy of the Daily Inter Lake

Prepared for the Swan Valley Bull Trout Working Group

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Background

The Swan River drainage contains one of Montana's most stable and healthy bull trout populations, as well as hosting an important fishery for kokanee and northern pike in Swan Lake. A Montana Fish, Wildlife and Parks (FWP) creel survey conducted in 1995 estimated anglers expended 8,833 days of effort on Swan Lake to harvest 10,670 fish, of which 82% were kokanee, 9% were northern pike and 5% were bull trout (Rumsey and Werner 1995). However, in 1998, anglers began catching and reporting adult sized (20-30 inch) lake trout from Swan Lake and the Swan River upstream of the lake. It is suspected lake trout either ascended the Bigfork Dam fish ladder prior to closure in 1993, or they were illegally introduced into Swan Lake. In 2003, FWP gillnetted a 9-inch juvenile lake trout from Swan Lake during annual monitoring efforts, providing the first evidence of lake trout reproduction in the Swan system. Since 2003, lake trout catch from both anglers, as well as FWP monitoring has continued to increase. These data led biologists to conclude that lake trout establishment is a growing threat to the bull trout populations in Swan Lake, the Swan River system, and inter-connected Lindbergh and Holland Lakes upstream.

These findings served as a catalyst in the formation of the Swan Valley Bull Trout Working Group (SVBTWG), in 2004. The SVBTWG is composed of five government agencies (FWP, US Fish and Wildlife Service, Confederated Salish and Kootenai Tribes, Montana Department of Natural Resources and Conservation, US Forest Service) and Montana Trout Unlimited. The SVBTWG determined that, if left unchecked, it is a matter of time until lake trout will become the dominant piscivore (fish predator) in the Swan ecosystem. The SVBTWG was formalized by an MOU in 2005, and in the past four years has made efforts toward evaluating and assessing the lake trout threat. Annual reports have been prepared since 2004. Previous annual reports can be found at www.montanatu.org, under the "Swan Valley Bull Trout Working Group" link.

Considerable efforts were made to learn more about the newly established lake trout population in Swan Lake. Analysis of these results led the SVBTWG to conclude that more focused research efforts were needed to better characterize the lake trout population size and structure. FWP agreed to support a graduate student project on Swan Lake, using Bonneville Power Administration (BPA) funding as a partial source of support. A plan of work was developed and in August, 2006, a graduate student was selected to conduct the research effort through the Cooperative Fishery Research Unit at Montana State University (MSU). Objectives of the study were to: 1) Identify the timing and location of lake trout spawning areas, 2) Evaluate alternative gear types as methods of sampling lake trout, 3) Estimate the population density and structure of lake trout in Swan Lake, and 4) Model various harvest scenarios to estimate effort needed to negatively impact growth of the lake trout population.

MSU conducted a six-week series of gill net surveys on Swan Lake, from mid-September through the last week of October 2006. Single mesh 250-foot gill nets, with 1" bar mesh size (2" stretch) were deployed throughout the lake basin to gather baseline data and attempt to capture adult lake trout for sonic tag implants. During the six-week period, 28

such net sets resulted in capture of 110 bull trout and 194 lake trout. Bycatch of other species was not accurately monitored, but consisted of about 150 mountain whitefish and several hundred cyprinids (mostly peamouth and northern pikeminnow) and suckers. Only one adult lake trout was captured alive, sonic tagged, and released. PIT (Passive Integrated Transponder) tags were implanted into 101 juvenile lake trout to mark individual fish that were subsequently released.

The high catch of small lake trout in the fall 2006 gill net surveys greatly increased the concern of the SVBTWG about the rapidly expanding lake trout population and led to discussions about how to improve capabilities of the research effort. Simultaneously, the US Fish and Wildlife Service (USFWS) secured funding of approximately $40,000 to conduct a lake-wide population estimate of lake trout. The USFWS contracted with professional fisheries consultants to build and deploy deepwater trap nets and gill nets in Swan Lake in the fall of 2007, with the goal of establishing a lakewide lake trout population estimate.

The fall 2007 fish sampling took place over a three-week period from 17 September to 4 October. Short-set gill nets were used to capture live fish for marking and release. Most nets were set in water 80 feet or deeper. The goal of the sampling was to release as many tagged live lake trout as possible, so that a mark-and-recapture population estimate could be achieved. Biologists set a total of 26.5 miles of gill net at various locations around Swan Lake. The nets were checked about every two hours during morning and evening. In addition to gill nets, two deep-water trap nets were set but caught relatively few fish. The total catch included 2,156 lake trout. Of these 735 were mortalities, 30 were sonic-tagged, and 1,391 received PIT tags and were released to aid in population estimates.

Although over 2,000 lake trout were sampled during the 2007 effort, the validity of a population estimate was questioned because of inadequate rates of recapture. Many possible reasons exist for not obtaining a more reliable population estimate, including changes in behavior of marked fish or mortality in marked fish, etc. Because of this uncertainty, another population estimate was obtained using depletion methodology in 2008. Netting was again contracted with fisheries consultants, and was conducted during the period from September 9-23. Different than in 2007, all lake trout captured during the three-week period in 2008 were removed from the system and the reduction in catch rate was used to obtain the population estimate. A total of 3,487 lake trout were removed over the three-week period, and resulted in a population estimate of about 8,800 (95% CI: 7,300-10,500) lake trout between 165 mm (6.5”) and 900 mm (35”). Concomitant with the population estimate sonic-tag implanted lake trout were tracked during the spawning months (October-November) and accurate locations of spawning concentrations were identified. Gill nets set at the spawning locations resulted in an additional 70 adult lake trout and provided evidence that netting during this time period could be a useful method in targeting the adult component of the lake trout population.

The knowledge acquired to that time served as a starting point for a three-year experimental removal of lake trout in Swan Lake. In June of 2009, FWP released an environmental assessment (EA) detailing these plans. This 2009 annual report provides a

summary of the results from the first of three years of the planned suppression project. Measurable goals and specific success criteria outlined in the 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 pertinent information, at the end of three years FWP will consider whether these actions are appropriate or if other changes are warranted in fisheries management of Swan Lake and the lake trout population.

Accomplishments

The three-year experimental suppression project is comprised of two distinct netting events. The first event (Contract 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 gill nets, set by professional fisheries contractors over a three-week period beginning 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 of fall spawning and also occurs during the period in which Swan Lake is fully stratified. Only habitat below the thermocline (>60') is sampled to reduce incidental bycatch of bull trout and other fish species.

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

Contract Netting

Basin-wide netting in 2009 was contracted with Hickey Bros. Fisheries of Baileys Harbor, Wisconsin. Prior to launching, the boat was cleaned and disinfected following a Hazard Analysis and Critical Control Point Plan (HACCP) to minimize the risk of spreading aquatic nuisance species. The boat was also inspected by FWP personnel prior to entering Swan Lake to ensure proper cleaning procedures had been followed. Netting took place from 24 August to 11 September, 2009, taking a short break over the Labor Day holiday to avoid disrupting recreational use. A total of 5,213 lake trout from 6"-36" were removed during the Contract Netting period (Figure 1). 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 Contract Netting period is skewed heavily toward smaller fish, as a result of smaller mesh nets being used as the primary tool for this netting event. The nets were set only in water greater than 60' and had an average soak time of 8.3 hours. The deep depth and short duration of these net sets was done in an effort to minimize bycatch mortality of non-target species. Bycatch of other fish species during the Contract Netting period can be found in Table 1.

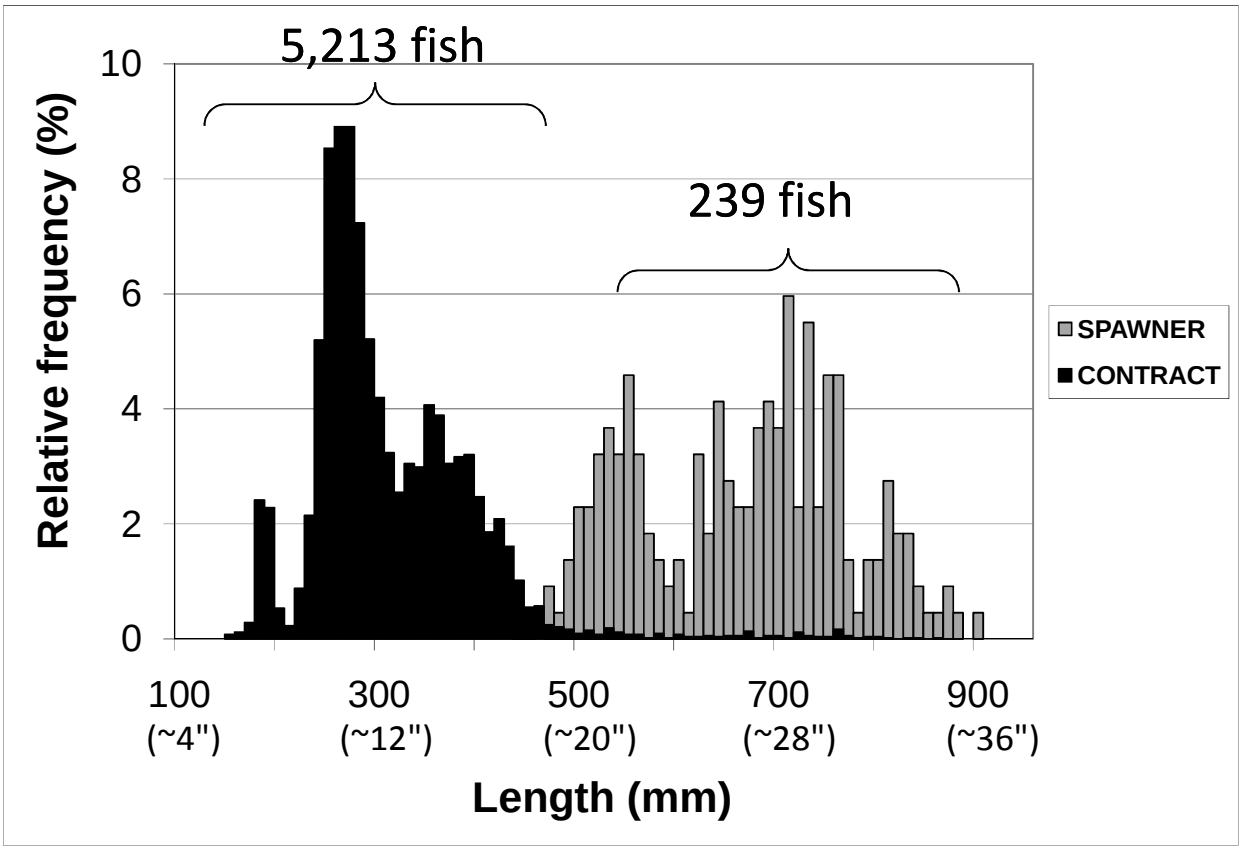

Figure 1: Relative length frequency of lake trout caught during both Contract and Spawner netting.

Table 1: Bycatch of non-target fish species captured during both netting events in 2010.

Fish Species	Contract Netting Number of Fish	Spawner Netting Number of Fish
bull trout	238	26
kokanee	205	23
pygmy whitefish	139	0
mountain whitefish	107	0
longnose sucker	86	50
largescale sucker	0	58
northern pikeminnow	27	36
rainbow trout	6	3
peamouth	1	0
northern pike	0	2

Bull Trout Bycatch

Bull trout bycatch in the 2009 Contract Netting effort was 238 fish. Despite the greatest amount of removal netting effort to date being deployed in 2009, this bycatch is almost identical to 240 bull trout caught in 2008 and considerably lower than the number of bull trout in the bycatch (n = 378) in 2007 (Figure 2). We attribute the reduced bull trout bycatch per unit effort to our increasing success in targeting lake trout in areas of the lake where bull trout numbers are low (primarily in waters deeper than 65-70 feet and especially in the north basin of Swan Lake) and in our increasing use of smaller mesh nets which boost the catch of juvenile lake trout. We also moved the sampling period in 2009 to an earlier date (late August) to further minimize gill net encounters with larger bull trout, which are primarily out of the lake and up in the river system during the early fall prior to the spawning period. The length frequency of bull trout in the bycatch has also reflected this increasing shift toward smaller fish (Figure 3).

Reduction of bull trout mortality, while simultaneously maximizing lake trout catch, requires a balancing act amongst timing, location and net set duration. Nets set at critical times of day when fish movement is greatest (e.g., in the early morning and late evening) are able to capture large numbers of lake trout. By minimizing soak times we have been able to revive and release upwards of 60% of the bull trout captured. Survival of bull trout in the bycatch is also higher in the finer mesh sizes (under 1.5-inch square), where the fish are less likely to roll up and pin their gills, inevitably leading to suffocation even in short duration net sets. During the 2009 Contract Netting, we installed and utilized a Fraser Recovery Box, patterned after a design used to maximize revival of gillnetted Chinook salmon on the west coast. The box is a forced-ventilation chamber in which suffocated fish can be rapidly supplied with moving oxygenated and chilled water, further improving their likelihood of survival. We did not obtain any quantitative estimates of the efficiency of this system, but anecdotally we observed that some fish that may have otherwise expired were revived. We plan to institutionalize and expand the use of this Fraser Recovery Box system in 2010 and beyond.

Sunset on the Contract Netting boat, showing Fraser Recovery Box in foreground.

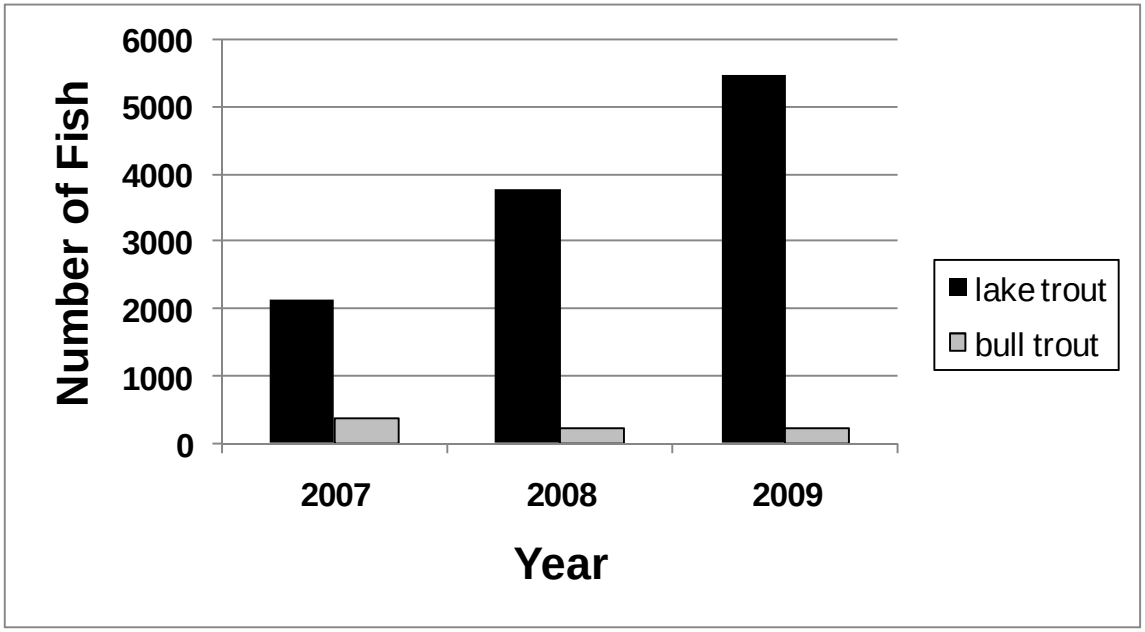

Figure 2: Lake trout catch and bull trout bycatch from contracted netting activities 2007-2009.

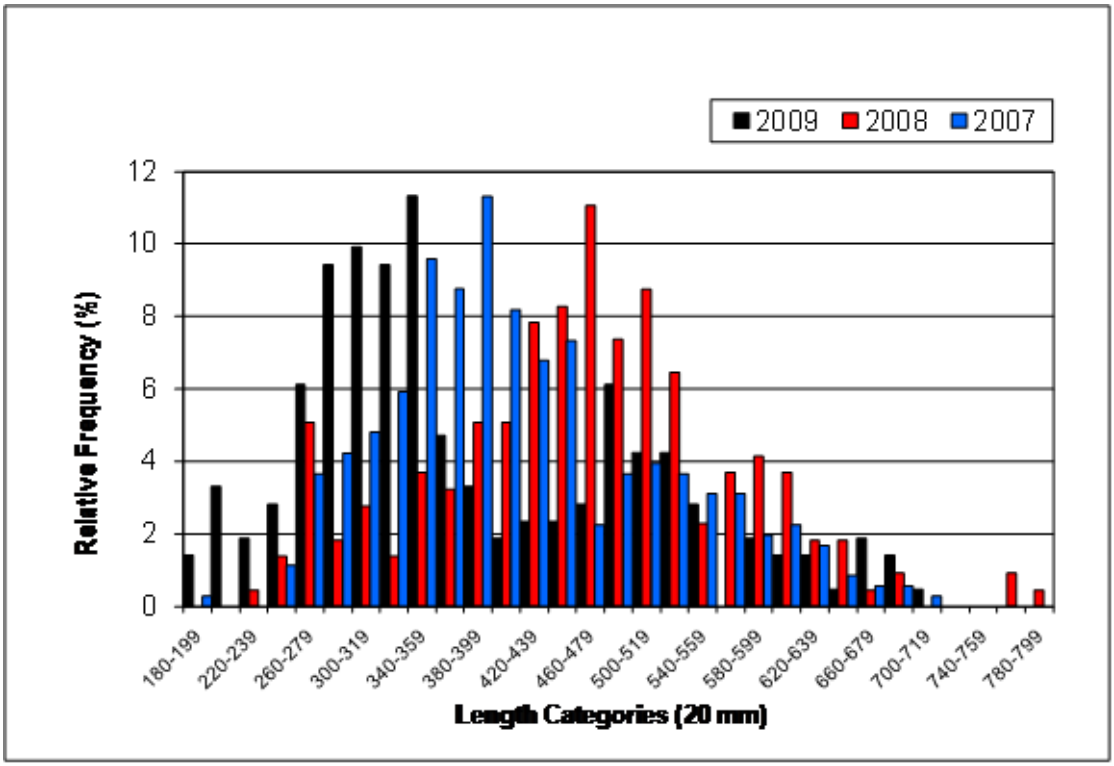

Figure 3: Relative length frequency of bull trout captured during contract netting in 2007-2009.

Sonic Telemetry

Adult lake trout have been implanted with sonic tags and tracked since 2007. Relocation of these tagged fish in 2007 and 2008 (Figure 4), coupled with the successful capture of lake trout eggs in egg traps deployed in 2008, confirmed spawning along two locations adjacent to the Highway 83 road cut (Ben Cox, Montana State University, unpublished data). An additional 18 mature male lake trout were implanted with sonic tags in 2009 to further identify additional spawning sites. Only mature male lake trout were selected to receive tags, as males typically stay near spawning areas for a greater period of time, thus allowing for better identification of spawning habitat (Dux 2005). Lake trout were tracked manually from a boat from 21 September to 3 November, 2009. No additional spawning locations were identified and relocations during the spawning period supported past telemetry work.

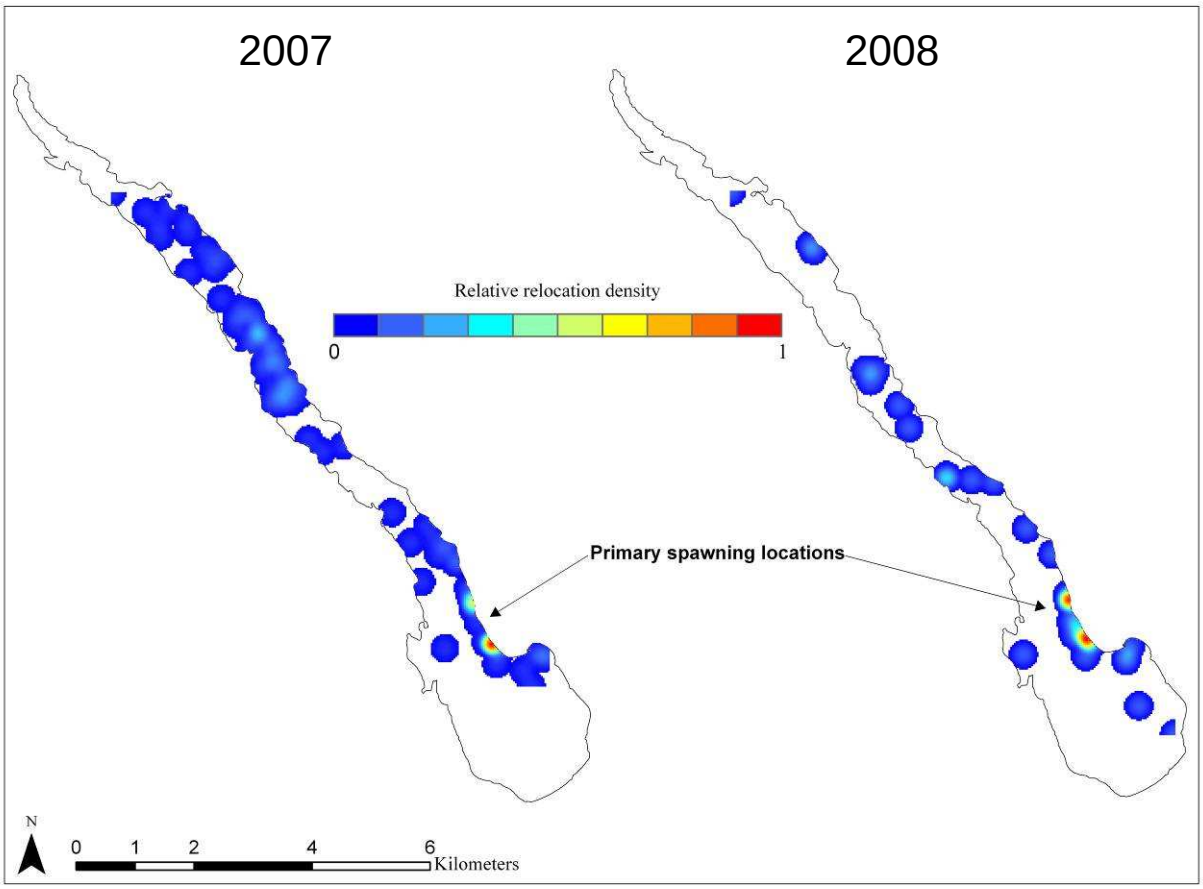

Figure 4: Map displaying density of lake trout relocations collected October-November 2007 and 2008 (B. Cox, Montana State University, Unpublished data).

Spawner Netting

Removal of the adult component of the lake trout population, in efforts to directly affect further recruitment of lake trout cohorts, is an important aspect of this three-year removal project. Exploratory netting along known spawning locations was conducted on six nights

in 2008 to determine if large-mesh gill nets would be effective in capturing spawning adults. That netting amounted to the capture of 70 adult lake trout and confirmed that both the technique and the locations were appropriate.

Starting in 2009, efforts were made to net adult lake trout throughout the entire spawning period. Because this was the first year of this effort, several questions needed to be answered. These included: timing of the lake trout spawning period, optimal locations of nets set for spawning lake trout and bycatch of other fish species. Netting began after telemetry work had determined that adult male lake trout were congregating along the Highway 83 road cut. October 6 marked the first night of Spawner Netting, with 20 mature fish being caught. Netting continued on most nights through November 5, at which time netting efforts were suspended due to reduced catch rates. Captured fish were culled, measured, weighed and examined for sexual maturity. Dead fish were either retained for educational purposes (fish dissection classes), or were returned to the lake as biomass. In total, 239 mature lake trout were removed over 16 nights in 2009, with the majority of the catch (84%) comprised of males (Figure 5). Spawning lake trout ranged in size from 20 to 36 inches, with the majority of fish being greater than 24 inches in length (Figure 1). Of the fish less than 24 inches, the vast majority of fish were small mature males.

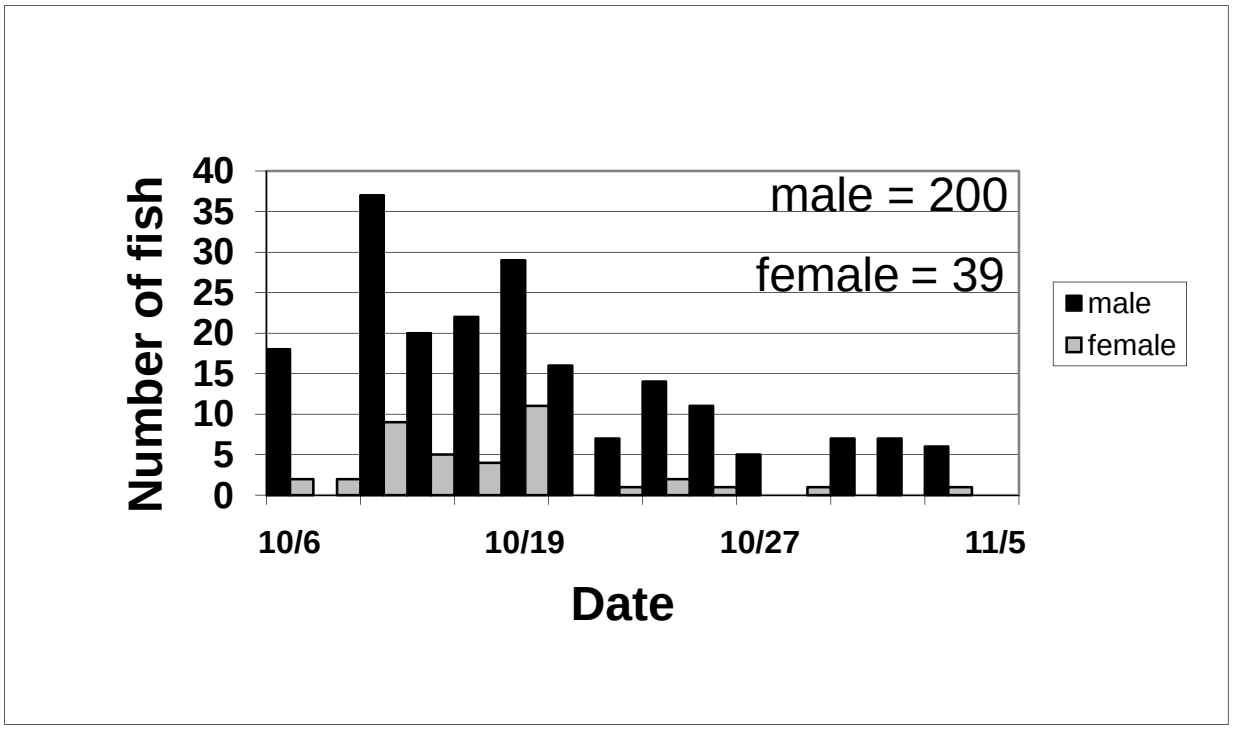

Figure 5: Lake trout catch throughout the Spawner Netting period in 2009.

The timing of the Spawner Netting period we initiated in 2009 appears to have been appropriate. However, 20 lake trout (mostly males) were caught during the first netting night (October 6), suggesting that netting could likely begin up to a week earlier in

subsequent years. Female lake trout catch rates increased as netting progressed, with the peak female catch rate occurring on October 19. The Spawner Netting period ended on November 5, after catch rates had decreased substantially and few or no fish were caught on consecutive evenings. Locations of nets set for spawning lake trout also appear to have been appropriate, with lake trout being caught on rubble-cobble habitats along the Highway 83 road cut. The two spawning areas identified by telemetry efforts from 2007-2009 provided the highest catch rates of adult lake trout. However, spawning lake trout were captured in good numbers in nets set adjacent to these distinct areas.

Bycatch during the Spawner Netting period was low (Table 1). Prior to exploratory netting in 2008, the degree of bull trout bycatch associated with netting during the lake trout spawn period was unknown. We were concerned that bycatch of bull trout would be higher during this time of year, as adult bull trout rapidly return to the lake after spawning in upstream tributaries. However, only 4 bull trout were captured in six nets in 2008, suggesting that bycatch could be effectively minimized. Additional minimization measures such as one-hour maximum soak times and on-board recovery tanks were also implemented in 2009, to reduce bull trout bycatch mortality. Bycatch of bull trout during Spawner Netting in 2009 was consistent with what was observed in 2008, with few bull trout (n=26) being caught. Mortality rates of these fish were slightly higher than those observed during the Contract Netting period, with 60% (n=16) of the bull trout dying as a result of netting. Further efforts to minimize bull trout bycatch mortality will continue in subsequent years. We will incorporate the use of larger-mesh gill nets that will capture large lake trout but avoid bycatch of medium and smaller size bull trout.

Evaluation Criteria

This three-year 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 EA, and will continue to be monitored in each of the three years of the study. Because 2009 represents the first of these years, little inference can be made with regard to the overall effect we have had on the fish populations. However, harvest rates on juvenile and subadult lake trout were encouraging. Based on the 2008 population estimate and accounting for the number of fish removed with that study, we estimated a removal of 4,850 lake trout in 2009 would achieve a 50% fishing mortality on lake trout over 165 mm (6.5”). Gill netting efforts during the Contract Netting period resulted in removal of 5,213 lake trout, exceeding our predetermined goal, and resulting in a 54% reduction.

Data continues to be collected to support other indices outlined in the EA. These include lake trout relative weight and length of spawning lake trout, both statistics that can be useful in helping to determine our overall effectiveness. Additionally, bull trout and kokanee redd counts, as well as mysis densities are examined to evaluate the effect our actions have on their abundance. If our lake trout removal efforts are successful, changes in these indices may occur, however a lag time is likely.

RV Trygg enroute to netting location on Swan Lake.

Researchers measuring captured lake trout prior to cleaning fish for Food Bank.

2010 Plans

The second year of this three-year project will follow the same schedule as was completed in 2009. Contract netting will begin the last week in August, and will continue into the beginning of September, breaking for the Labor Day holiday. Sonic telemetry will resume upon completion of the Contract Netting to further refine our knowledge of

lake trout spawning sites. Spawner Netting will again be accomplished by SVBTWG members, beginning around October 1, with FWP providing use of a 22' boat. Changes in both netting events from 2009 strategy will include further adjustment in net mesh sizes and increasing the amount of effort expended during the Spawner Netting period. Larger mesh nets are being purchased to add to the amount of net that can be set during each night of the spawn. Additionally, these nets will likely minimize bull trout bycatch while maximizing catch of adult lake trout.

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 both Holland and Lindbergh Lake, located in the headwaters of the Swan drainage. Lake trout have never been detected in Holland Lake, however lake trout have been caught in the Swan River near the vicinity of Holland Creek, and the possibility of them invading Holland Lake is a considerable threat. Lake trout were captured in routine gill net monitoring in Lindbergh Lake in 2009. These fish are likely the result of the expanding population in Swan Lake and represent a significant threat to the Lindbergh Lake bull trout population. This newly established lake trout population will continue to be monitored and the implications it has on the overall Swan system will continue to be evaluated.

Other Relevant Information

Although the exact mechanism in which lake trout found their way into Swan Lake remains unknown, progress has been made in examining how these fish can establish new aquatic species assemblages. Genetics samples collected from Swan Lake gillnetting in 2006 and 2007 were used to examine the original founding population size (Kalinowski et al. 2010). This recent analysis determined that the lake trout population in Swan Lake has virtually no genetic variation and was likely founded by as few as two individuals, further emphasizing the need to minimize colonization opportunities for this species in waters where lake trout populations are not wanted.

Swan Lake continues to be one of the few places in Montana where anglers can fish for bull trout. Additionally, anglers make Swan Lake their fishing destination for abundant kokanee salmon and northern pike. Year-long angler creels were conducted in 1984 and 1995, and assisted fisheries managers by estimating the annual catch and harvest of these fish species. However, several changes have occurred since the last creel including the listing of bull trout under the Endangered Species Act and the discovery of lake trout (both occurring in 1998). A new year-long creel was initiated by FWP in 2009 and will conclude in the beginning of May 2010. This creel will be compared to previous creels to establish a baseline of angler effort and success. This information will be useful for evaluating future changes in the fishery.

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