

A proposal for predator control to increase survival of kokanee salmon and rainbow trout

A pilot study, 2011

Study Plan 3/2/2011

Colville Confederated Tribes, Resident Fish Division

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Vision

The Northwest Power and Conservation Council (NPCC) and the Lake Roosevelt Fisheries Managers envision an Upper Columbia ecosystem that sustains an abundant, productive, and diverse community of fish and wildlife, mitigating across the basin for the adverse effects to fish and wildlife caused by the development and operation of the hydrosystem (NPCC 2004). This ecosystem should be comprised of and support viable, diverse fish and wildlife populations, their habitats, and contribute to the social, cultural, and economic well-being of the Pacific Northwest (Lake Roosevelt Management Team 2009; ISRP 2009).

The Colville Confederated Tribe (CCT) Fish and Wildlife Departments goal is to maintain and protect viable populations (numbers and distribution of reproductive individuals) of native and desired non-native species of fish and wildlife, and their supporting habitats, while providing sufficient numbers to meet the cultural, subsistence, recreational and economic needs of the Tribal Membership (Colville Confederated Tribes 2006). This goal is to be reached through the resident fish program as a mitigation measure for lost salmon.

Introduction

The construction of Grand Coulee Dam in 1939 at river kilometer 960 extirpated anadromous salmon species from the upper reaches of the Columbia River in Washington and British Columbia, Canada. Historically large runs of sockeye salmon *Oncorhynchus nerka* utilized the upper reaches of the river, including a key Native American fishing grounds at Kettle Falls, Washington. Records indicate that a large portion of the sockeye salmon run (8- 15%) migrated to Canada for spawning and rearing in the Arrow Lakes system (Koch 1976; Wolvert and Nine 2011).

After construction, large numbers of sockeye/ kokanee were observed above and below Grand Coulee (Gangmark and Fulton 1949). It is hypothesized that these sockeye residualized and adopted a resident/adfluvial lifehistory form and utilized the lake environment provided by Lake Roosevelt and the Sanpoil River (Gangmark and Fulton 1949; Wolvet and Nine 2011). Since 1940, a variety of studies have documented wild kokanee in Lake Roosevelt, including spawning runs that utilized the Sanpoil River and other small tributaries (LeCaire 1999).

After inundation, kokanee fry were stocked in the reservoir between 1942 and 1945 (7.5 million annually), and were found in high abundance (Scholz et al. 1985). However, the completion of the third powerhouse at Grand Coulee Dam in 1974 drastically altered the flow regime in the reservoir. Consequently, kokanee salmon populations suffered and densities declined (Lake Roosevelt Kokanee Management Plan 2010). Additionally, in 1962 a non-native predator, walleye *Sander vitreus*, population began to expand.

Beginning in the late 1980's, Federal, State, Tribal and local stakeholders in the region began looking for ways to enhance resident fish populations in the Lake Roosevelt blocked area. Scholz et al. (1985) developed an enhancement plan for the Lake Roosevelt fishery that centered on spawning habitat enhancement and artificial production of kokanee, which functions today under an umbrella of BPA funded projects that mitigate for loss salmon through a hatchery production program (Lake Roosevelt Fisheries Guiding Document 2009). The enhancement plan, combined with a volunteer net pen program to raise rainbow trout, led to the development of the artificial production program that operates today.

In 1995 the Chief Joseph Kokanee Enhancement Project (CJKEP) was accepted into the Northwest Power and Conservation Councils program. The goal of the project was the protection and enhancement of natural origin kokanee above Chief Joseph and Grand Coulee Dams. Initial objectives included enumerating adult tributary spawning, genetic evaluation, egg to fry survival, and entrainment at Grand Coulee Dam. Adult enumerations indicated limited tributary spawning populations in the Sanpoil River, Barnaby Creek, and Sheep Creek (LeCaire, 1997, 1998, 1999). A basin wide microsatellite genetic analysis indicated the Lake Roosevelt wild population was genetically differentiated from all other kokanee populations that could be seeding the reservoir (Kassler et al. 2010). Currently, the spawning location for these fish is unknown.

The Sanpoil River is the primary river that drains into the lower section of Lake Roosevelt. This river is home to 14 native species including redband rainbow trout, kokanee salmon and nine non-native species (Table 1) (Sears 2006; Wolvert and Nine 2011). Adult trapping data collected in the Sanpoil River over the past 15 years indicated a small wild population of kokanee that intermittently utilized the river (CCT, *unpublished data*). The current adfluvial rainbow trout population maintains harvestable levels; however the adult kokanee population is basically nonexistent.

A variety of limiting factors have contributed to the decline of kokanee and rainbow trout population densities in the Sanpoil River. Possible limiting factors include: habitat degradation, harvest, predation, and entrainment. A 2009 habitat survey conducted on the Sanpoil River indicated that the river can support a kokanee spawning population of 238,464 to 1,703,315 kokanee (Wolvert and Nine 2011b). Predation by non-native fishes was hypothesized to be one of the causes of poor recruitment to the potential habitat that is available for kokanee spawning.

To address the recruitment failures of these species on the Sanpoil River Arm, CCT subcontracted Eastern Washington University (EWU) to investigate predation by nonnative predators in 2010. EWU sampled the waters in the Sanpoil Arm of Lake Roosevelt between 24 March and 14 July, which coincided with wild rainbow trout out-migrations, as well as the out migration of stocked fry and yearling kokanee salmon.

Based on the Wisconsin Bioenergetics Model 3.0 walleye and smallmouth bass *Micropterus dolomieu* combined consumed 94.7% of the kokanee fry released (558,464

of 589,580), 40.1% of the kokanee yearlings released (4,038 of 10,080), 24.0% of the rainbow yearling population (3,499 of 14,578 estimated), and 27.4% of the rainbow trout 2 and 3-yr olds population (6,504 of 23,738 estimated) (Stroud et al. 2011).

Specifically, walleye ages one through three appeared to be the primary culprit. Walleye in this age group were estimated to have consumed 469,991 kokanee fry, of which 100% were consumed by this age group; and 3,766 yearling kokanee, of which 54% were consumed by this age group. Effects on rainbow trout were similar, with a consumption estimate of 2,688 rainbow trout yearlings, of which 92% were consumed by this age group, and 6,394 age 2-3 rainbow trout of which 99% were consumed by this age group (Stroud et al. 2011).

This type of predation was also observed in the lower Columbia River. Predation studies indicated walleye and smallmouth bass consumed fewer smolts as they got older (Beamesderfer 2000; Beamesderfer and Ward 1994; Zimmerman 1999). Most smolts were eaten by walleye smaller than those typically caught by anglers, so angler bounties on these fish would provide little benefit to the salmon survival.

The introduction or invasion of nonnative fishes is a major contributing factor in the decline of native fish faunas (Clarkson et al. 2005; Bestgen et al. 2006; Johnson et al. 2008). Managing nonnative predators, especially ones that have become economically viable recreational fisheries, in large reservoir systems is a challenge to fisheries managers. Mechanical removal has been attempted in a variety of systems with varying success (Spencer et al. 2002; Weidel et al. 2007; Johnson et al. 2008; Beamesderfer 2000).

Gill nets were found to be effective at removing nonnative salmonids greater than 110 mm from alpine lakes when chemical applications were not favored because of impacts to other sensitive species (Knapp and Matthews 1998). Gill nets and trap nets were used to reduce a walleye population in a small lake in Ontario, Canada. It took three years of netting to collapse the population (Spencer et al. 2002). The population was not extirpated and had recovered to 33% of its original levels after 14 years.

Boat electrofishing was used to reduce smallmouth bass densities in an Adirondack Lake. The reduced densities of smallmouth bass (90% reductions) allowed for an increase in abundance of six native fish (Weidel et al. 2007). However the authors found that smallmouth bass are resilient and removal efforts must be continued annually to maintain the reduced densities.

Large river examples are less successful, as explained by Mueller (2005) in the Colorado River. Mechanical removal of nonnative predators was employed for over 10 years, with little positive response from native fish communities. Mueller summarized that attempts to benefit mainstem communities or establish large refuge populations typically failed; decolonization by unwanted species was rapid; success was typically in headwater streams with physical barriers; success was more likely to occur on non-

native species with limited reproduction and large individuals that were more susceptible to capture.

Predation by walleye and smallmouth bass is clearly negatively impacting the survival of kokanee and rainbow trout populations in the Sanpoil River. The consumption rates are unsustainable and will likely depress the population if left unchecked. The Lake Roosevelt Management Team (LRMT) and the Colville Tribe have prioritized the success of native salmonids over harvest opportunities for walleye and smallmouth bass in the Sanpoil River.

Therefore, in the spring of 2011 the CCT, under the Chief Joseph Kokanee Enhancement Project, will begin a pilot study to initiate mechanical removal of two nonnative predators from the Sanpoil Arm of Lake Roosevelt, with the primary goal of increasing survival of out-migrating kokanee and rainbow trout fry and yearlings.

To achieve this goal, the pilot study will focus in the bottleneck area of the Sanpoil Arm, located from the Sanpoil Campground area upstream to reservoir / river interface, referred to as the “free flowing reach” of the Sanpoil River. The objective for 2011 will be to decrease the density of walleye and smallmouth bass in the focus section between May and July, which coincides with out-migrating kokanee and rainbow trout.

List of native and non-native fishes of the Sanpoil River.

Native species	Non-native species
Kokanee salmon <i>Oncorhynchus nerka</i>)	Cutthroat Trout <i>Oncorhynchus clarkii</i>
Redband Rainbow Trout <i>Oncorhynchus mykiss</i>	Brook Trout <i>Salvelinus fontinalis</i>
Burbot <i>Lota lota</i>	Lake Whitefish <i>Coregonus clupeaformis</i>
Mountain Whitefish <i>Prosopium Williamsoni</i>	Walleye <i>Sander vitreum</i>
Northern Pikeminnow(<i>Ptychocheilus oregonensis</i>	Yellow Perch <i>Perca flavescens</i>
Longnose Dace <i>Rhinichthys cataractae</i>	Smallmouth Bass <i>Micropterus dolomieu</i>
Speckled Dace <i>Rhinichthys osculus</i>	Brown Bullhead <i>Ameiurus nebulosus</i>
Large Scale Sucker <i>Catostomus macrocheilus</i>	Tench <i>Tinca tinca</i>
Longnose Sucker <i>Catostomus catostomus</i>	Common Carp <i>Cyprinus carpio</i>
Bridgelip Sucker <i>Catostomus columbianus</i>	
Sculpin <i>Cottidae</i>	
Chiselmouth <i>Acrocheilus alutaceus</i>	
Peamouth <i>Mylocheilus caurinus</i>	
Redside Shinner <i>Richardsonius balteatus</i>	

Study Area

The Sanpoil River became inundated for 13 km after the construction of Grand Coulee Dam. This area, which is bordered on both sides by the Colville Confederated Tribes, is referred to as the Sanpoil Arm (Figure 1). The focus study area will begin just south of the Keller campground (48.040650, -118.668429) and extend 2.5 km to the free flowing section (Figure 2). This area was found to be highly concentrated with walleye and small mouth bass during the 2010 predation study and was the location of the highest predation rates (Stroud et al. 2010; 2011).

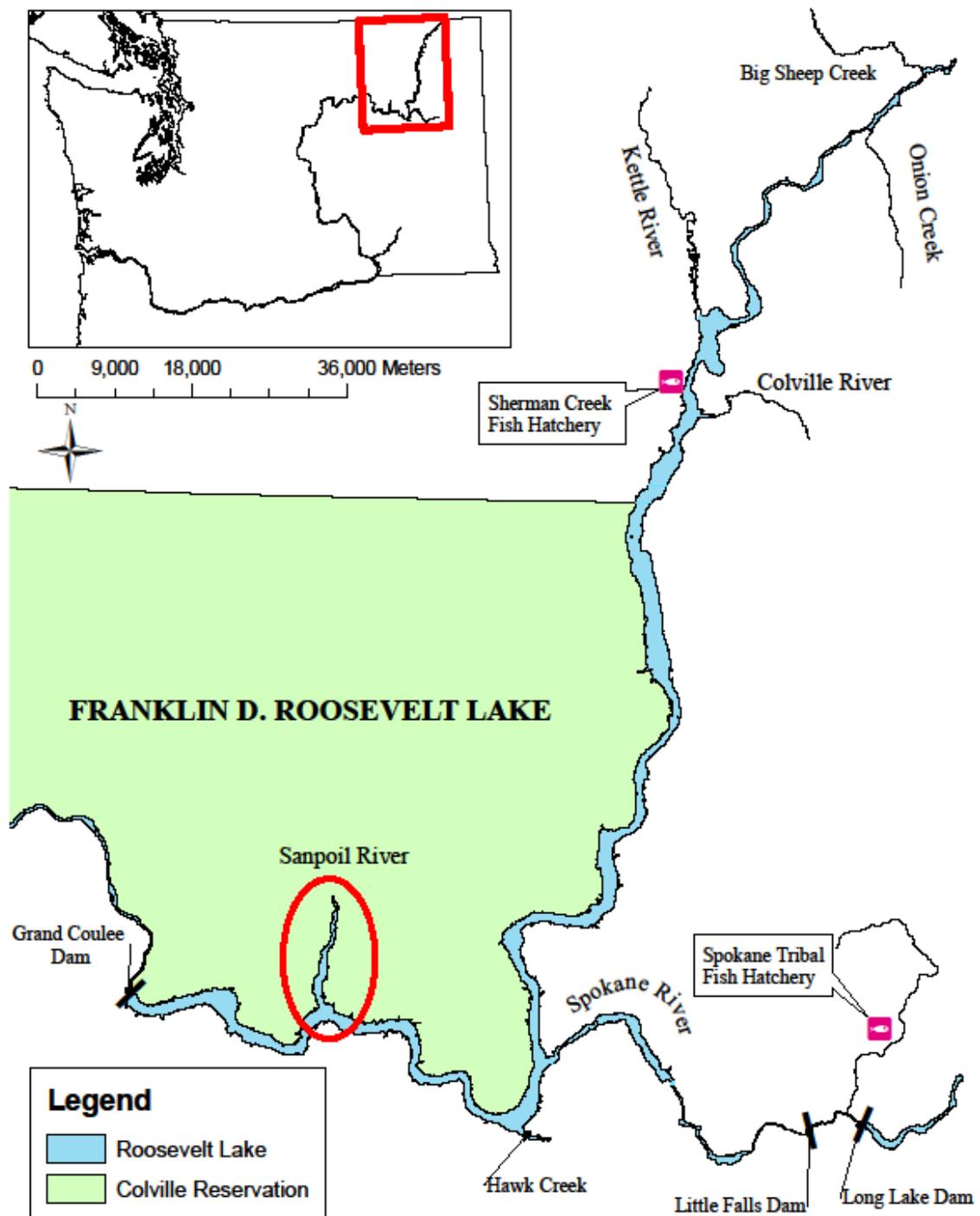


Figure 1. Map Lake Roosevelt, the reservoir behind Grand Coulee Dam, with the study location, the Sanpoil River, circled in red.

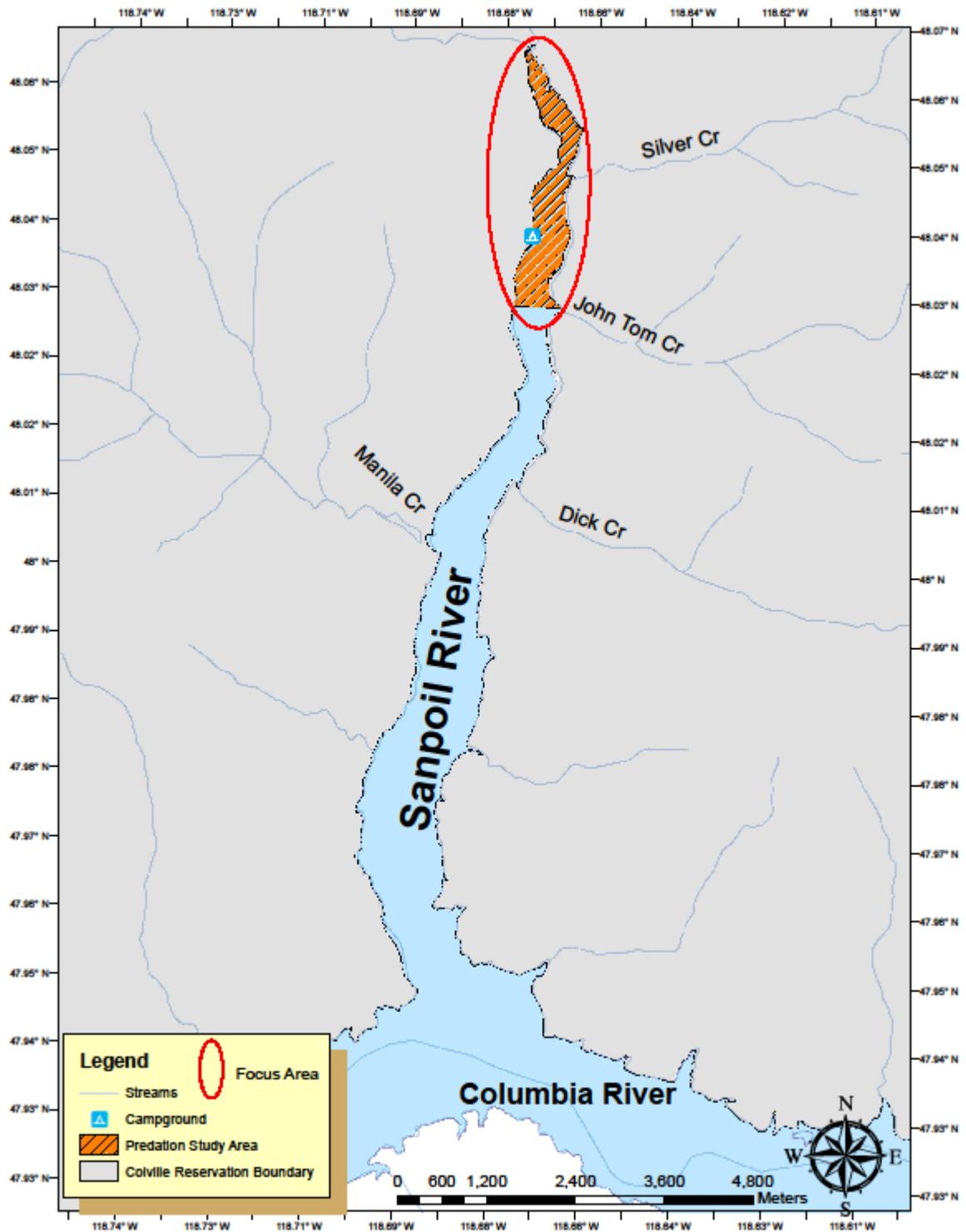


Figure 2. Map of the Sanpoil river, with the focus area highlighted in orange.

Methods

Predator Removal

Predator removal will begin in May, at least two weeks prior to hatchery kokanee stocking. Experimental removal will continue weekly through June, extending two weeks past the last stocking event. Removal may continue into July or August, as rainbow trout may still be out-migrating. Two screw traps installed upstream of the sampling area will assist with monitoring salmonid out migration timing. Two techniques will be employed to reduce densities of walleye and smallmouth bass; gill netting and boat electrofishing.

Gill netting methods- Experimental gill nets will be used (200 ft long by 6 ft in depth). Each net consists of eight 25 ft panels, ranging in size from one to six inches stretch mesh (1", 1.5", 2", 2.5", 3", 4", 5", and 6"). Nets will have sinking line and will be set on the river bed to target walleye diel migration, which stay deep in the water column during the day, and migrate to shallow waters during the evening.

These nets are identical to the Fall Walleye Index Netting (FWIN) nets. This net was selected because FWIN data suggested walleye were captured in all mesh sizes, however specific counts for each mesh size were not available. Therefore during the pilot study a wide variety of mesh was selected. During the pilot survey, special notes will be taken on mesh size and capture rates. This setup will assist us with determining the appropriate mesh size for future years.

Sampling locations will be spatially balanced by employing a generalized random tessellation stratified (GRTS) sampling strategy (Stevens and Olsen 2004). Ten gill nets will be set 1 to 2 times a week, depending on catch. Initially, sets will be stratified into parallel and perpendicular shoreline sets. This will help determine if one of these methods reduces by-catch of rainbow trout while increasing catch on walleye and bass. The nets will be set approximately two hours before dusk to ensure all nets are set by dusk. Nets will then be pulled and picked 5-6 hours later. Length of net soaking will be evaluated, and possibly extended until the morning hours to capture additional walleye.

Electrofishing- Boat electrofishing will be conducted in conjunction with netting. After nets are set, one or two electrofishing boats will shock each bank of the study area. If time allows, the entire focus area will be sampled during each sampling event. If the entire area is not planned for sampling, a GRTS sampling regime will also be employed. Fish will be netted and kept in the live well until the shocking session is finished (approximately 600 m will be sampled during 10 minutes of shocking).

Fisheries Data – After pulling each gill net or electrofishing transect, all fish will be measured and sub-set weighed. Non-target fish will be released. Smallmouth bass and walleye captured via electrofishing will be retained and distributed to tribal members for subsistence. Mesh size of predators captured in gill nets will be noted. These fish will be killed, making sure to pop the air bladder, and disposed of in the reservoir. These fish are not destined for tribal consumption because it is not possible to tell how long the fish were dead in the gill net.

To reduce impacts on wild rainbow trout in the study area, a 10 fish limit will be placed on all sampling gear. If more than 10 wild rainbow trout are negatively affected during either gill netting or boat electrofishing, the survey will be aborted for the evening.

Density Monitoring

CPUE and Relative Abundance -Changes in density will be evaluated using relative abundance and catch-per-unit effort changes from each gear type. It is hypothesized that the removal of these predators will decrease the abundance in the focus area. If the densities decrease, then the probability of survival should increase. If the predator densities do not decrease, but are just replaced by new fish, then our methods will not increase survival.

If feasible, weekly snorkel surveys will be conducted during the night to monitor fish presence. The snorkeler will be able to bin walleye and smallmouth bass into length groups. Specific transects will be pre-determined, and likely be spaced approximately 50 m apart. The same transect will be sampled during each snorkeling event. Water clarity is the likely culprit that will limit this method of monitoring.

Hydroacoustics - An attempt will be made to use hydroacoustics to monitor density changes in the study area (Standard DT-X surface unit with Biosonics Acquisitions software, DT-X split beam digital transducer). Hydroacoustics is typically a poor choice to monitor bottom dwelling fish because the sonar cannot accurately detect changes on the bottom. However, we will attempt to use a variety of echo sounders to test this method. A preliminary survey will be conducted prior to predator removal. After the survey, it will be determined if this is a viable method.

Preliminary acoustics survey - Two or three areas with high walleye concentrations will be selected for the survey. The survey design will include a series of parallel transects at each area. Each transect will be spaced 50 to 75 m apart within each area keeping the inter-transect distances consistent within each area. The transects will run laterally across the narrow dimension of the reservoir.

For data collection, the transducer will be mounted from a pole off the side of the boat vertically orientated. Boat speed during the survey will remain very slow, between 3 and 5 mph. For data collection, a new file for each individual transect will be created. A GPS unit will be used to collect positional data that can be paired with the acoustic data. The Biosonics DTX echosounder has a port for connecting the GPS which will allow for embedding the positional data with the acoustic data.

Processing of the acoustic data will either involve single target tracking (where individual fish traces are selected by the user, this is typically done when target densities are low) or echo integration (which calculates numbers of fish based on average fish size, this is typically done when target densities are high).

The standard software used to process digital hydroacoustic data (which the DTX will collect) with either method is called Echoview. The data will either be processed in-house or sub-contracted out.

Once the acoustic data are collected and processed, the data will be sorted into bins, based on size of targets so the larger predators can be separated from the smaller prey targets (e.g., have two size categories such as > 30 cm and less than 30 cm). Size distribution data from the gill net catches will help inform what those size categories should be. The fish targets will also be separated by depth bin (e.g., 5-m depth increments) and transect segment. This will allow for validation of fish targets using the gill net data from different depths at different locations near the transects.

To obtain fish density estimates for each transect segment, all individual fish will need to be weighted by the nominal width of the beam at the range of the fish. The weighted fish count would then be summed over each transect segment by size class and range bin and then divided by the segment length using this formula:

$$D_i = \frac{\sum_j \frac{1}{b_j}}{l_i}$$

where D_i is the fish density (fish/m²) of segment i , the summation is over all fish j observed in segment i , b_j is the beam diameter (m) at range of fish j , and l_i is the length (m) of segment i .

Abundance estimates will be obtained from area-based or volumetric methods. For area-based calculations the density estimates per segment would be multiplied by the segment area and then summed across all segments to get transect abundance. The transect abundance estimates would then be summed to get an overall abundance estimate (these calculations would be done separately for each size class) (Johnson 2007).

The volumetric method would involve dividing the segment density estimates by the mean segment depth to obtain the number of fish per cubic meter. This value would then be multiplied by the segment volume to estimate number of fish per segment. As above, these values would then be summed across segments to get number per transect. The transect estimates would then be summed by size class to get overall abundance estimates.

Once the estimates of abundance are obtained, GIS tools will be used to present the data in a manner that makes it easy to quickly see patterns of abundance across locations in the study area.

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