Independent Scientific Review Panel
for the Northwest Power & Conservation Council
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Memorandum (2018-3) **April 23, 2018**

To: James Yost, Chair, Northwest Power and Conservation Council

From: Steve Schroder, ISRP Chair

Subject: Response Review of *Northern Pike Suppression and Monitoring* (project #2017-004-00)

Background

In response to the Northwest Power and Conservation Council's March 12, 2018 request, the ISRP reviewed a March 9, 2018 response to the ISRP's January 2018 review of a proposal titled *Northern Pike Suppression and Monitoring* (#2017-004-00). The proposal and subsequent response were from the Lake Roosevelt Co-managers, including the Colville Confederated Tribes (CCT), Spokane Tribe of Indians' (STOI), and Washington Department of Fish and Wildlife (WDFW). The goal of the proposal is to suppress northern pike in the Lake Roosevelt watershed and prevent the species from spreading and expanding into other water bodies, especially those that support anadromous salmon. The proposed approach to achieve this goal is multi-tiered and includes mechanical removal techniques, angler incentives, and targeted monitoring and research.

Summary of January 2018 ISRP Review (ISRP 2018-1)

The ISRP requested a response to enable a full assessment of the proposal. The proposal included a review of the northern pike problem and suppression efforts in Lake Roosevelt, the upper Columbia Basin, and in regions beyond the Columbia Basin. The ISRP's January 2018 review noted that expansion of piscivorous, non-native northern pike is a concern for the conservation of native resident fishes in the upper Columbia Basin and for anadromous salmon in downstream areas. The ISRP found that the proponents provided a reasonable argument for the need to control northern pike abundance, which is consistent with the vision of the Fish and Wildlife Program and its strategy to control invasive species. In addition, the ISRP found that the proposal partially addressed the planning needed for an expanded effort to suppress northern pike in Lake Roosevelt in Spring 2018. However, the ISRP's review stated that substantially more detailed information was needed for a full assessment of the proposal by the ISRP, particularly in regard to the monitoring program and adaptive management.

Documents Submitted for Review

The Lake Roosevelt Co-managers provided the following documents for the ISRP's review:

- Cover letter from the co-managers to Tony Grover, with responses to the ISRP
- Support Document titled, *Lake Roosevelt Northern Pike Suppression and Monitoring Plan 2018-2022*

ISRP Recommendation and Summary Comments

The ISRP provides a "Meets Scientific Review Criteria (Qualified)" assessment of the proponents' response. The ISRP's comments and qualifications are at two levels: (1) general comments with a programmatic qualification that needs to be addressed to determine whether long-term suppression efforts are justified and meet the ISRP's criterion of providing benefits to fish and wildlife, and (2) project-specific comments with qualifications regarding changes to methods and other conditions that need to be met to fully justify the short-term project.

Suppression efforts in the short term can be justified as experimental, precautionary interventions, but broader analysis and discussion of potential long-term effects and actions are essential. By its design, the Lake Roosevelt suppression project could quickly and significantly change the abundance of northern pike, as well as our knowledge of their status. Accordingly, we recommend that the ISRP regularly review annual reports from the project.

General Comments on Northern Pike Suppression

The ISRP is skeptical about the long-term effectiveness and ecological benefits of efforts to reduce northern pike abundance in the Upper Columbia Basin and prevent northern pike from spreading downstream in the Columbia River system. This is a programmatic concern that should be addressed by the Council and managers in the Columbia Basin before more significant, long-term commitments are made to northern pike suppression.

Introductions and establishment of northern pike populations have occurred in reservoirs of the Upper Columbia River Basin. These reservoirs have become sources for continual downstream movements of northern pike. It appears that northern pike from a population in Lonepine Reservoir in the Little Bitterroot River system, where northern pike were introduced in the 1950s, have spread downstream in the Flathead River into Clark Fork Reservoir and Lake Pend Oreille, and further downstream into the Pend Oreille River, Box Canyon Reservoir, and Lake Roosevelt. Northern pike appear to be well established in all of these waters. The presence of northern pike populations upstream from Box Canyon Reservoir and Lake Roosevelt provides a continual source of northern pike into these two reservoirs. Consequently, continued suppression efforts in Box Canyon Reservoir and Lake Roosevelt cannot be expected to eradicate northern pike in these reservoirs. To be successful in reducing the abundance of northern pike in the Upper Columbia Basin, long-term and large-scale suppression efforts will have to extend upstream throughout the distribution of northern pike. Even with such efforts

the ISRP is skeptical that northern pike populations can be adequately reduced to prevent their downstream spread in the Columbia River.

The ISRP has previously expressed concerns about the ability of managers to suppress populations of northern pike in the Upper Columbia River. For example, in regard to Lake Roosevelt suppression, the ISRP's follow-up assessment of the proponents' response to our review of the initial proposal expressed continuing concerns regarding the likely effectiveness of proposed efforts to suppress the northern pike population in the reservoir (ISRP 2016-6). The proponents' of the Lake Roosevelt suppression effort provided a detailed argument as to why they believe the proposed removal efforts will be adequate, based on experiences of other projects (e.g., Box Canyon Reservoir). However, the ISRP remained skeptical that the proposed level of effort would be adequate to suppress northern pike in Lake Roosevelt. Consequently, the proponents of the Lake Roosevelt suppression project proposed to expand the suppression efforts. In the ISRP's review of the expanded proposal for northern pike suppression in Lake Roosevelt (ISRP 2017-6), the ISRP remained skeptical as to whether the proposed levels of effort can be successful in reducing the abundance of northern pike in Lake Roosevelt and preventing downstream spread of the species in the reservoir and the Columbia River. While these ISRP comments were specific to Lake Roosevelt, the concerns extend to present and future northern pike suppression efforts in the Columbia River Basin.

Beyond questions about the adequacy of removal efforts to suppress northern pike abundance, the ISRP is unconvinced that northern pike pose a more acute threat to salmonids and other native fish species than do other nonnative piscivorous fishes (i.e., walleye and smallmouth bass) already established in the Columbia River Basin. To justify the expense of long-term, large-scale northern pike suppression efforts, it must be demonstrated that piscivory by northern pike poses a threat to salmonids and other native fishes. It is well known that northern pike are opportunistic piscivores (Chapman et al. 1989, Beaudoin et al. 1999) and that they prefer soft-rayed fishes such as catostomids and salmonids (Mauch and Coble 1973, Wahl and Stein 1988). In lake and reservoir systems where salmonids are abundant, salmonids can make up a substantial proportion of the diet of northern pike (Rich 1992, Scott 2002). In some reservoirs, introduced populations of northern pike can impact native salmonids (e.g., Westslope cutthroat trout) or desired sport fishes (e.g., kokanee) (Walrath et al. 2015). However, in other systems where northern pike have been introduced, their overall effect on anadromous salmon has been low (Sepulveda et al. 2013). In places where northern pike and anadromous salmon are sympatric, there is no apparent effect of northern pike on the native salmonids (Chihuly 1976). Within reservoirs in the Columbia River Basin it remains unknown what impacts northern pike may have on populations of native fishes, particularly salmonids. Further, it is unknown what effects northern pike may have on anadromous salmon populations if they spread downstream from Lake Roosevelt. Predation by northern pike, as well as other nonnative piscivores, on native fishes is not only a northern pike problem but also a fish community and food web problem.

The ISRP is highly skeptical that northern pike can be eradicated from reservoirs in the Upper Columbia Basin using currently available removal methods (i.e., gill netting, electrofishing,

trapping, and seining). We believe that it is very unlikely that the methods will prevent the downstream spread of northern pike in the Columbia River. It may be possible that continuous suppression efforts will diminish the effects of northern pike on native fishes in Lake Roosevelt and Box Canyon Reservoir, but the spread of northern pike into the Lower Columbia River and anadromous salmonid habitat may be inevitable. Within the Kalispel Tribe of Indians' report *Box Canyon Reservoir Northern Pike Mechanical Suppression Project: Summary of 2012-2015 Project Results*, it is stated, "Although some northern pike have been entrained from the system, maintaining a suppressed population ensures large emigration events are prevented during peak river flows." This assumption has not been confirmed (see ISRP 2016-7). The ISRP cautions that much more analysis and policy development is needed to justify long-term programs to suppress northern pike in individual reservoirs.

In our previous reviews of northern pike suppression efforts, the ISRP pointed out the need for northern pike diet data, analyses relative to prey availability, and bioenergetics modeling. For example, in our most recent review of northern pike suppression in Box Canyon Reservoir (ISRP 2016-7), the ISRP suggested that it would be desirable for the proponents of northern pike suppression projects to collaborate in research on northern pike diet and bioenergetics in the Columbia River Basin. The ISAB/ISRP's 2016 Critical Uncertainties Report (ISAB/ISRP 2016-1) identified nonnative species and their effects on native fishes as a top priority uncertainty. Among the approaches identified to address this uncertainty is the use of bioenergetics modeling coupled with diet data to estimate consumption of salmonid species by nonnative piscivorous fishes. Consumption estimates could be used to compare predation-related mortality of salmonids under different scenarios of suppression and with northern pike expansion in the Columbia River Basin. Because the diets of northern pike and other nonnative piscivorous fishes are likely to vary among reservoirs and sites within reservoirs, substantial sampling will be needed to describe diets in different reservoirs and enable accurate bioenergetics modeling.

Programmatic Qualification: The ISRP cautions that much more research and analysis is needed to justify support for long-term, large-scale programs to suppress northern pike abundance in individual reservoirs. Before long-term commitments and funding are approved, broader discussion within the Fish and Wildlife Program is needed to develop an overall strategy for controlling northern pike and other nonnative piscivores in the Columbia River Basin. The ISRP observes that suppression projects for northern pike and other piscivorous fishes share common themes, so there is potential for increased coordination among projects. An overall strategy for controlling northern pike and other nonnative piscivores in the Columbia River Basin is warranted and requires broader discussion within the Fish and Wildlife Program.

The ISRP recognizes that discussions have occurred between the Council and proponents of northern pike suppression efforts (June 9, 2015; December 11, 2017) and that a science/policy exchange on "Predation in the Columbia River Basin" (August 9, 2012) has occurred. While these efforts have been informative, the ISRP believes that the issues of predation by both non-native (northern pike, walleye, smallmouth bass) and native (northern pikeminnow) piscivorous fishes need to be more fully assessed. We recommend that a special fish suppression workshop

involving the ISRP/ISAB, Council members and staff, BPA, project proponents, and fish and wildlife managers be conducted to discuss management of both non-native and native piscivorous fishes and address the linkages among these fishes. The workshop could include assessment of the status of both non-native and native piscivorous fish suppression projects, the species' effects on food webs and ecosystems, and future orientation of research and monitoring regarding piscivorous fishes. The outcomes of the workshop could support policy development on the issue of norther pike suppression efforts.

Specific Comments on Lake Roosevelt Northern Pike Suppression Proposal

The suppression and monitoring plan and the responses below address most of the ISRP's conditions and concerns. The ISRP appreciates the effort and level of detail provided in these new documents. The ISRP believes these improvements will greatly benefit the overall northern pike suppression project.

The proponents meet expectations in their description of sampling and laboratory methods to be used in monitoring the northern pike population (Section 1.1), natal origin monitoring (Section 1.2), early detection monitoring – eDNA (Section 1.3), mechanical removal (Section 2.1), the rewards program (Section 2.2), and public outreach (Section 3.0).

Project-specific Qualifications:

1. The proponents took a major step toward development of an adaptive management framework, but the adaptive management plan is incomplete. Figure 1 is insightful, but it is an incomplete description of the process. Further description of metrics that may be computed from population monitoring (CPUE, length frequency, age structure, maturity, etc.), eDNA, and otolith microchemistry data; quantitative objectives with time lines for suppression of the northern pike population (i.e., Interim Targets) using the array of metrics; and procedures for assessment of quantitative objectives and making adaptations are needed. Objectives included in some sections of the Plan (i.e., Section 1.1, 2018 Fall Sampling and 2019-2022 Monitoring Surveys) are mostly lists of steps to be accomplished. The proponents need to develop a full description of the adaptive management process that includes a complete list of quantitative objectives and timelines for key metrics in all aspects of the project. A complete adaptive management plan should be reviewed by the ISRP prior to any multi-year funding commitment.

2. Planning for the reservoir operation study (Section 1.4) is incomplete as noted by the project proponents. More work is needed to develop a study plan for this research component. In the preparation of the reservoir operations study, consultation is needed with reservoir operators to determine the extent to which reservoir levels can be manipulated. The study plan should be reviewed by the ISRP before subsequent activities are initiated.

3. Assistance from biometric statisticians is needed to finalize the monitoring program. Key

statistical issues involve the number of samples (i.e., level of effort) within each study reach that need to be obtained to detect changes in northern pike metrics. Biometricians should also assist with the statistical and experimental elements of the monitoring designs and analyses of data that are applied to assessments of individual gears used in the suppression efforts. The ISRP requests specific information on sampling designs, sampling intensities, likely precision of metrics to be computed, and statistical tests to be conducted to assess progress toward the specified quantitative objectives.

4. The suppression plan should clarify how northern pike originating from the Upper Columbia River Basin in Canada (i.e., one of three key areas of interest) will be identified. The isotope concentrations presented in Figure 4 differ little between the Canadian Columbia River Basin and Lake Roosevelt, which suggests they will not be useful to distinguish northern pike originating from the Canadian Columbia River Basin. Responses are needed to the following questions: Will otoliths and water chemistry be analyzed for metals that might have originated from a smelter in the vicinity? Will metal concentrations (i.e., zinc, lead, and cadmium) need to be compared with metal concentrations collected from water and northern pike in Lake Roosevelt, as well as other sampled tributaries?

5. The suppression plan noted that eDNA breaks down rapidly and that the probability of detection was only 10.8% in a sample collected 40 m downstream from a test fish carcass. Although this finding suggests that false positive results are unlikely when sampling downstream areas, it also suggests that northern pike might escape detection unless densities are fairly high. Responses are needed to the following questions: What is the efficiency for detecting northern pike occurrence using eDNA throughout a large reservoir? Can an eDNA study be conducted to define minimum detection limits for northern pike eDNA in a large reservoir or river?

6. Bycatch mortality of native fishes is a continuing concern. Can the proponents demonstrate that the numbers of native fishes expected to be killed as bycatch will be acceptably small relative to population sizes?

7. The reward program for northern pike heads may be modified to provide another monitoring index. When heads are returned, anglers may be asked to specify the number of hours fished for northern pike, total number of northern pike caught, and number of anglers in the group who fished for northern pike. This information on effort expended by anglers to catch the northern pike may provide an additional metric (i.e., northern pike CPUE by anglers) to assess temporal trends in abundance.

8. The ISRP continues to strongly recommend inclusion of a northern pike diet study and bioenergetics modeling as part of the project. A primary reason for northern pike suppression in Lake Roosevelt is the assumption that northern pike are having or will have a significant impact on focal species (redband trout, kokanee). This assumption

needs to be confirmed in order to justify continuing suppression efforts. Another reason for a diet study and bioenergetics modeling is to determine if northern pike consume non-native predators (walleye, smallmouth bass) and thereby reduce overall predation on the focal species. An alternative is that the proponents may collaborate with another organization (i.e., university, agency, or consulting firm) with appropriate expertise to design a diet study and bioenergetics modeling effort with the proponents doing the field work to obtain diet, water temperature, and other needed data.

9. Annual reports should document progress towards each project objective in addition to describing the overall suppression effort. Changes in the program should be identified and discussed, as needed.

ISRP Point-by-point Responses to Lake Roosevelt Co-Managers' March 9, 2018 Responses to ISRP 2018-1

The ISRP's current comments are in green font below.

Co-Managers Intro: The Colville Confederated Tribes, Spokane Tribe of Indians, and the Washington Department of Fish and Wildlife (co-managers of Lake Roosevelt) appreciate the Independent Scientific Review Panel's (ISRP) review of the Northern Pike Suppression and Monitoring proposal (#2017-004- 00). As detailed in Memorandum 2018-1, the ISRP determined that "…*substantially more detailed information is needed for a full assessment of the proposal by the ISRP, particularly in regard to the monitoring program and adaptive management.*" As such, the ISRP outlined seven comments to which they requested responses prior to completing their review of the proposal. Please find the co-manager's responses below and the attached document "Northern Pike Suppression Plan 2018-2022" that was developed to clearly outline the co-managers monitoring and suppression plans and address ISRP's questions. We recommend reviewing the Suppression Plan document first, then reviewing the responses. Collectively, we addressed the comments, concerns, and suggestions of the ISRP to the best of our ability. If additional follow-up is required, we request an opportunity to meet with the ISRP in-person to discuss their concerns. Thank you for your consideration and support.

ISRP JANUARY 2018 COMMENT #1

A detailed description of the suppression efforts planned to begin in 2018. For each type of gear mentioned in the proposal (i.e., gill nets, boat electrofishers, fyke nets, and seines), describe: (a) the gear to be used, (b) how the gear will be deployed, (c) the locations where the gear will be used, (d) when the gear will be used and how long it will be in use at each location, (e) the field data that will be obtained with each gear (i.e., total length, weight, sex, maturity, etc.), (f) database management, and (g) the descriptive statistics (i.e., metrics, e.g. CPUE) that will be computed from the data. Also, explain the timing and spatial distributions of suppression efforts with each gear relative to changing water temperature and reservoir elevations. The data and process used to determine the proposed lengths of gill net sets also need to be described.

Response: Please reference Northern Pike Suppression Plan 2018-2022 section 2.0 (Suppression) for details related to questions a-g listed above.

ISRP April 2018 Comment:

The response is a big step forward in covering the ISRP's question. It was good to see that the descriptions of suppression efforts for each gear type followed the outline (i.e., [a] to [g] in Comment #1).

Attention needs to be given to the quantitative Interim Targets (page 5), which are related to Northern Pike Population Monitoring (Section 1.1) and the quantitative Goals for each of the

four gear types to be used in Mechanical Suppression (Section 2.1) efforts. It is good that the proponents have attempted to develop quantitative objectives, but further consideration of the objectives and the data (i.e., metrics) to be used to assess them is needed. Several more metrics can be computed from the monitoring data with quantitative objectives associated with them. Further, the precision of estimates from monitoring data need to be determined to assure that the data can be used to effectively assess progress toward objectives. Evaluation of project objectives must be based on data and metrics from the monitoring program. Interim Targets are stated on page 5, but there is no description as to how these targets will be assessed using data from the Northern Pike Population Monitoring (Section 1.1). Further consideration of analytical methods and explanation of them are needed.

In Section 2.1, Mechanical Removal, a quantitative goals statement (page 35) is included that refers to CPUE of northern pike per hour. It is unclear if this goal refers to population monitoring with gill nets (Section 1.1) or to the suppression efforts with gill nets. Given the structure of the following sections describing the other gears to be used for suppression, it appears that the goals at the beginning of Section 2.1 apply to the gill net suppression data, but it is not clear. Assuming that the goals apply to gill net suppression data, it will be very difficult to develop a meaningful CPUE metric given the six different kinds of gill nets being used. Thought should be given as to the specific definition of the CPUE metrics to be applied to the gill net suppression data.

Assuming that the goals on page 35 apply to the gill net suppression efforts, and considering the stated goals for boat electrofishing, fyke nets, and seines, a caution is provided. Frequently, CPUE data from a fishery does not yield accurate information regarding the density of fish being harvested. Fishers often become more efficient in harvesting fish as they gain experience in when, where, and how to use a particular gear. Often, CPUE data from the fishery can remain high as the population declines. While CPUE from the fishery (i.e., suppression efforts) can provide insight, the independent Northern Pike Population Monitoring (Section 1.1) plan is likely to yield more accurate data on population trends. Project objectives should not be set based on data and metrics using various gears during the suppression efforts, but on data and metrics from the monitoring program.

The ISRP appreciates that detailed responses to our concerns are highlighted in the cover letter for ease of review, as well as documented in the new Northern Pike Suppression Plan for more general availability. Notable exceptions are the lack of detail in the Suppression Plan about catch rates and by-catch mortality from 4-h versus 23-h sets, and about the reservoir operations research component.

Section 2 of the new Plan largely addresses the ISRP concerns. However, it was surprising that the plan concluded that there were insufficient data and analysis to evaluate gillnet mesh sizes that effectively target northern pike (P. 35) given the number of northern pike suppression efforts in the Columbia River Basin and elsewhere. However, the response provides some important selectivity information that justifies the importance of the 2-inch mesh. Is there information available on northern pike capture in the 1-inch and 1.5-inch panels of the FWIN nets? If northern pike are not captured in these small-mesh panels, the suppression effort should avoid using the FWIN nets. It was not clear why the FWIN net was included in Table 4.

ISRP January 2018 Specific questions include:

(1) Will standardized gillnets be used by all co-managers throughout the suppression effort?

Response: Up until this point, the suppression gear used by the co-managers has not been standardized. This has been the case for two reasons. One, the co-managers identified six different nets that could be used to maximize Northern Pike catch while reducing bycatch (listed in Northern Pike Suppression Plan 2018-2011 Section 2.0). Without specific data to support the use of one net over the other, the co-managers used all of them during the 2017 suppression effort with a plan to analyze the data to identify the net(s) that maximize Northern Pike catch and minimize harm to native fish. In addition, without dedicated funding for this project the agencies utilized the gill nets that were on hand and each agency had an inventory of different nets.

Preliminary analysis of data collected in 2017 indicated the majority (81%) of all Northern Pike were captured in two mesh sizes (stretch measure): 5.1 cm (31%) and 6.4 cm (50%). Mesh sizes 7.6 and 8.9 cm captured less Northern Pike (14%), but the captured fish were larger in size.

Multi-filament gill nets used by the White Sturgeon crews also captured Northern Pike and had very little bycatch. Northern Pike were captured both by gilling and tangling their teeth. The successful Northern Pike catch and the lack of bycatch in the multi-filament nets suggested the NPTT should further investigate their utility.

Using the above information, the 2018 suppression net plan will be:

The CCT will primarily use the CCT Predator nets for suppression. In May (spawning period) and again in September (fall growing period), the CCT will compare catch between multi-filament nets (#1; same dimensions as the CCT Predator net but only 5.1 cm stretch mesh) and CCT Predator nets in the Kettle Falls area. The plan consists of setting 50 additional multi-filament nets during each season.

The STI will primarily use SPIN nets for suppression. In May (spawning period) and again in September (fall growing period), the STI will compare catch between SPIN nets and multi-filament nets (#2; same dimensions and mesh size configuration as the SPIN net) set in the Kettle Falls area. The plan consists of setting 50 additional multi-filament nets during each season.

The WDFW will use SPIN nets for suppression.

These data will be analyzed and discussed at the NPTT meetings. Net configuration use will be discussed and a plan agreed upon by the NPTT for use in 2019 and beyond.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question; however, it should be conducted within a

formal adaptive management process.

It is not evident in the Suppression and Monitoring Plan that further analyses of data will occur with consideration of possible modifications of gill nets used in 2019 and beyond. This evaluation of results from 2018 should be identified as a specific adaptive management activity.

Standardization will be essential for future monitoring and should be resolved as quickly as possible. For 2018, it seems both practical and reasonable to experiment with different nets to help resolve uncertainty about the best choices for suppression and/or monitoring of northern pike abundance. However, the Plan for 2018 does not take advantage of possible comparisons among agencies to maximize opportunities for learning. For example, a more complete comparison of net effects could be achieved if WDFW deployed either multifilament #1 or CCT predator nets in addition to the SPIN nets. The present design allows for separate estimation of CCT predator net versus multifilament #1 net effects (both used by CCT which controls for agency effect), and for multifilament #2 net versus SPIN net effects (both used by STI), and for any STI versus WDFW agency effect (both using SPIN nets), but it does not allow for controlled comparisons among agencies or net types.

Comparing CPUE and northern pike length among gillnet types is an important task. Ideally the nets to be compared should be "paired" in specific habitats so that the effect of fishing location can be controlled. To the extent possible, CPUE and northern pike length in the CCT nets should be compared with the STI nets. A statistician should be consulted about these tests prior to the field season. The findings should be part of the adaptive management process that provides guidance to a more efficient suppression effort.

ISRP specific question: (2) What time of the day will gillnets be set and what is the duration of gillnet sets? What were the data and process used to determine the proposed timing and duration of gillnet sets?

Response: Gill nets will typically be set in the morning and pulled the following day. The average duration of overnight gill net sets completed during the 2017 suppression was 23 hours.

Gill net set duration was determined by comparing catch-per-unit-effort (CPUE) of Northern Pike, total catch of non-target species, and proportion of non-target fish released alive in gill nets fished overnight (approximately 23 hr in duration) with those in gill nets fished for four hours. During the 2017 sampling year, CCT/STI/WDFW completed a total of 1,113 gill net sets, of which 794 were overnight and 310 four-hr daytime sets. The CPUE (Northern Pike/set) in overnight sets was 3.4 (n=2,709 Pike) and in four-hr sets was 0.7 (n=117 Pike).

A total of 1,612 native fish were captured in gill nets with 68% being released alive – they swam away when removed from the net and returned to the reservoir. The majority (78%) of the native catch consisted of four species (Burbot n=491, Northern Pikeminnow n=402; Largescale Sucker n=212; and Redband Trout n=153).

In 2017, mortality was low for Burbot (23%), Largescale Suckers (21%), and Northern

Pikeminnow (39%); however mortality was 54% for wild Rainbow Trout *(CCT, STI, and WDFW unpublished data).*

The relatively high survival of native fish support the use of overnight gill net sets which maximize Northern Pike catch. A bycatch protocol, with catch thresholds, has been established to address instances when there is high catch of native fish.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question with one exception. Bycatch rates and associated mortality are not compared between the 4-h and 23-h sets. Mortality rates between 21% and 39% do not seem "low" as stated (although much higher rates might have been expected). It remains unclear whether the expected level of bycatch mortality (i.e., burbot) can be deemed acceptable from a population perspective. Can the proponents demonstrate that the numbers expected to be killed as bycatch will be small compared to population sizes?

ISRP specific question (3) Will similar boat electrofishing gear be used throughout the suppression effort?

Response: Yes, all electrofishing boats are setup similarly. See the protocol in the Northern Pike Suppression Plan 2018-2022 section 2.0 (Suppression) for description.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question. The ISRP appreciates the more detailed information in the Plan.

ISRP specific question (4) What standardized methods will be used for recording field data?

Response: The co-managers agreed upon and implemented standardized field protocols in 2017. See the Northern Pike Suppression Plan Appendix A. Standard datasheets and codes attached.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question. The ISRP appreciates the more detailed information in the Plan.

The data form shown in the Appendix is reasonable for the northern pike data, assuming every northern pike is measured. An addition to the form is needed to document bycatch numbers and environmental conditions such as water temperature and reservoir level.

ISRP specific question (5) How will field data be pooled into a common database for analysis?

Response: Each agency will enter their data in a standardized Excel spreadsheet. Each agency is responsible for the quality control of their data. Data is sent to CCT by December 15th; CCT will combine the data and re-distribute the data no later than January 15th.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question. The ISRP appreciates the more detailed information in the plan.

ISRP specific question (6) What techniques will be used to maximize viability of native bycatch species (i.e., redband trout, wild kokanee, and wild sturgeon) that will be released?

Response: Special care is always taken by Lake Roosevelt co-manager staff to protect and ensure native fish viability. Standard practices for all surveys include:

- Handling native fish with care and as little as possible
- Return all live bycatch to the water immediately
- If fish have symptoms of barotrauma, they will be fizzed.
- Viability of net selection, trying not to catch them.

Bycatch thresholds are set low for native fish, ensuring that staff stop netting certain areas before harm is caused to native fish populations. Specific examples of where this is important include the Redband Trout and Burbot spawning runs in the Colville and Kettle rivers.

ISRP April 2018 Comment:

The response partially covers the ISRP's question. Questions remain on how native fish will be handled to minimize mortality. How can a native fish be handled with care (and as little as possible) when being removed from a gill net? If there is evidence of barotrauma, then it is likely that nets were set at depths greater than 30 feet. How often does this happen? This might indicate a problem in the deployment of gill nets. How could such a deployment issue be avoided? It is indicated that native fishes showing symptoms of barotrauma will be "fizzed." What is the specific technique (i.e., fizzed) that will be used? Effectiveness of such a measure must vary among species and sizes of fish. Has its effectiveness been evaluated?

ISRP COMMENT #2

A science-based justification for bycatch limits for native and non-native fishes is requested. The bycatch limits described in the proposal appear to give a priority to fishes valued by anglers, but the proposal does not provide science-based reasoning for limiting their bycatch. The inclusion of bycatch limits for non-native fishes is inconsistent with project goals and Fish and Wildlife Program goals.

Response: The co-managers of Lake Roosevelt strive for consensus on issues related to the fishery in Lake Roosevelt and we are most often successful. Nonetheless, there are the rare instances when consensus is not achieved. The co-managers could not reach consensus on a response to the question of bycatch thresholds, as the justification for acceptance of bycatch thresholds was different for the Tribes and WDFW. Therefore, two responses are provided – one from the Tribes and one from WDFW.

Colville Confederated Tribes and the Spokane Tribe of Indians Response: The Colville Confederated Tribes and Spokane Tribe of Indians (referred to as Tribes' for the remainder of this response) agreed to the Northern Pike bycatch thresholds for four reasons: 1) native fish conservation, 2) to ensure program efficiency (i.e. spend time killing Northern Pike not dealing with bycatch), 3) to maintain the support of the local angling communities, and 4) belief that the thresholds for non-native fish are high enough that they would rarely be met.

There was limited information available to determine the levels of bycatch mortality that could be sustained by each native fish species, thus the Tribes' agreed to the levels using best professional judgement informed by available life history, seasonal distribution and relative abundance data (Blake et al 2017; Schmuck 2017; Hildebrand and Parsley 2013). Resources are not available to develop and implement a more rigorous scientific approach for determining the specific levels of mortality that could be sustained by each native fish population.

The Tribes' would prefer not to have bycatch limits on any non-native species, but we recognize the value in maintaining the support of the local angler communities. To that end, the Tribes' have agreed to the bycatch thresholds.

The Tribes' view the thresholds for non-native fish as high. This view was supported during the 2017 suppression effort when the Walleye threshold was reached on only one occasion. Further, bycatch of Walleye and Smallmouth Bass that are within the proximity of these threshold values reduce our Northern Pike suppression gillnetting efficiency. The goal of the project is to suppress Northern Pike and it is inefficient to expend effort dealing with large amounts of bycatch in nets. Regardless of the thresholds, crews have been and will continue to be directed to adjust fishing locations in the event of high bycatch to improve suppression efficiency. Based on results of previous Northern Pike suppression netting, the Tribes do not anticipate that adhering to the bycatch thresholds for non-native fish will adversely affect suppression of Northern Pike.

The Tribes' are in partial agreement with the ISRP's assertion that the bycatch thresholds are inconsistent with the project and Fish and Wildlife Program goals. Bycatch thresholds for native fish conservation are consistent with the goals of both this project and the Fish and Wildlife Program. The thresholds for non-native species provide for social acceptance of the program. Releasing Walleye and Smallmouth Bass that are still alive upon net retrieval is inconsistent with Fish and Wildlife Program goals, but the Tribes must balance the social implications associated with a visible, large scale mechanical suppression project and the potential impacts to the Northern Pike suppression effort from lack of public support.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question.

The Tribes provide a cogent response and explain that the proposed limits of bycatch of non-native walleye and smallmouth bass are a consequence of public engagement. The proponents express confidence that the limits are set high enough to avoid compromising the effectiveness of efforts to suppress northern pike. It is appropriate to recognize that scientific data to support the bycatch thresholds are not available. It is assumed that the bycatch thresholds and relocation of suppression efforts upon achieving bycatch thresholds described in the Suppression and Management Plan will not pose a threat to native fish populations in Lake Roosevelt or substantially impact northern pike suppression, but this assumption is not supported by scientific data. Continued assessment of bycatch and bycatch mortality with each gear should be an element of adaptive management activities.

It is reasonable to avoid high bycatch level of non-native fishes especially when few northern pike are captured because fish processing requires time. However, it is conceivable that high numbers of northern pike could be caught along with many non-native fishes. In such situations, while likely rare, it may be worthwhile to consider the ratio of northern pike per non-native species. It is informative that the project rarely met the thresholds for the non-native species.

WDFW Response: The Washington Department of Fish and Wildlife (WDFW) does not view the bycatch thresholds agreed to by the co-managers as a scientific issue; rather, these thresholds were established to address social issues (perceived loss of angling opportunity and general public concern regarding lethal removal of non-target species). Bycatch thresholds do give priority to certain fish species valued by anglers, as well as all native fish species.

The current Lake Roosevelt fish community is a direct result of construction of Grand Coulee Dam by the US Bureau of Reclamation (1933-1942) and illegal introduction of walleye in the 1950's. Conditions created by impoundment of Lake Roosevelt have fostered success of non-native fish. Consequently, non-native sport fisheries (e.g., Walleye and Smallmouth bass) have developed a large following. While the co-managers have implemented management actions aimed at reducing Walleye and Smallmouth bass abundance that are palatable to the angling public (e.g., liberal harvest limits), it is not realistic to ignore the social implications of a perceived attack on established warmwater sport fisheries if bycatch was not a consideration. Management actions beyond the scope of sport fishing regulations to address Walleye and Smallmouth bass abundance will require extensive public outreach in order to gain public acceptance. To be clear, the focus of the proposed project is to address Northern Pike population expansion early in order to prevent population establishment and continued downstream movement, which could lead to establishment of a popular Northern Pike fishery. Based on results of 2017 Northern Pike suppression netting, the co-managers do not anticipate that adhering to bycatch thresholds will adversely affect our ability to suppress Northern Pike.

In the last review of this project (2017-004-00), the ISRP noted the importance of social consequences of the Colville Confederated Tribes' (CCT) Northern Pike reward program. However, there is no acknowledgement of the social consequences of lethal removal of popular and established non-native sport fish. Prior to and during Northern Pike suppression efforts in 2017, sport anglers voiced concerns regarding lethal removal of Walleye and other sport fish (e.g., Rainbow Trout). To address the rising concern, the co-managers attended and presented the Northern Pike Suppression Plan to various angler groups. However, despite outreach efforts, angler concerns regarding bycatch persist. It is in the interest of neither the co- managers, nor the NPCC to alienate anglers, as they play a key role in limiting Northern Pike population growth and spread within the Columbia Basin.

Fish Species	Weekly Threshold	Origin
Redband Trout	10	Native
Wild Kokanee	10	Native
Burbot	50	Native
Mountain Whitefish	15	Native
Sucker species	50	Native
White Sturgeon (wild)	1	Native
White Sturgeon (hatchery; wild larvae origin 2010-2016)	10	Native
White Sturgeon (hatchery; direct gamete take 2001-2009)	No limit	Native
Hatchery Rainbow Trout	50	Non-Native
Walleye	100	Non-Native
Smallmouth Bass	100	Non-Native
Lake Whitefish	No limit	Non-Native
All other non-native fish species	No limit	Non-Native

ISRP April 2018 Comment:

WDFW provided a reasonable response to the ISRP comment. However, there is a need to clarify threshold definitions in the Plan, i.e., do thresholds refer to a single net in a specific area or all nets in an area?

As mentioned in regard to the response by the Tribes, continued assessment of bycatch and bycatch mortality with each gear should be an element of adaptive management activities.

ISRP COMMENT #3

A detailed description of northern pike population monitoring and assessment protocols as part of an adaptive management process is requested. Please include a full description of the design of the population monitoring plan, the sampling gear to be used, sampling locations, data to be obtained, and analyses of the data. The ISRP emphasizes the need to develop quantitative objectives for each task described in the proposal and incorporate these objectives into an

adaptive management process. Description of a process that uses monitoring and suppression data to assess the level of suppression effort being applied and progress toward quantitative objectives is a critical part of an adaptive management plan. We ask the proponents to: (1) provide quantitative objectives with timelines for each task in the proposal, (2) explain how metrics developed from monitoring and(or) suppression data will be used to assess progress toward the stated objectives, and (3) describe the process to be used for making decisions regarding modification of the suppression program. As described in the proposal, the proposed suppression effort will occur regardless of northern pike catch rates or response of the population during the next 5 years. However, the suppression plan should consider the possibility of changes in effort based on catch rates, monitoring data, and quantitative objectives that are part of an adaptive management process.

WDFW Response: See the Northern Pike Suppression Plan 2018-2022 (Section 1.1 Northern Pike Monitoring).

ISRP April 2018 Comment:

Quantitative objectives for northern pike suppression and a time table are included in the current draft (see page 12). Only two metrics (i.e., percent reduction in CPUE of northern pike and proportion of nets with northern pike from 2018 baseline survey) are to be used. An array of additional metrics could be included based on data to be obtained through the monitoring plan.

It is not clearly stated if data from the Spring or Fall survey (or both) will be used, but a decision as to the season(s) in which monitoring needs to be made. Figure 1 indicates that data from both Spring and Fall surveys will be utilized independently and that a decision will be made as to which survey may be used for monitoring in the future. Figure 1 also indicates that several additional metrics will be used in assessment of suppression efforts based on length structure, age structure, sex ratio, and relative weight data, but the metrics to be computed are not described.

Figure 1 provides an outline of a framework for an adaptive management process for the northern pike suppression program. However, quantitative objectives not mentioned in the text are indicated in Figure 1 (i.e., “reduce >600mm 50% by 2021”). Quantitative objectives should be developed for each of the metrics that are computed and described in detail within the Suppression and Monitoring Plan. Overall, Figure 1 indicates that substantial thought has gone into development of an adaptive management process, but that process is not well described within the text of the Suppression and Monitoring Plan. Consequently, a substantial review of the adaptive management process by the ISRP was not possible at this time. Upon completion of a detailed adaptive management process, a focused review should be conducted by the ISRP.

To what extent will data from the suppression nets also be used to evaluate the time-specific objectives and the long-term goal of < 1 northern pike per 100 gillnet sets (page 5) given that the suppression nets will be targeting habitats most likely to support northern pike? Will the monitoring effort evaluate and report the effectiveness of the overall effort, including objectives for the suppression effort on page 35? In other words, considerable time and effort

may be required to reach the long-term goal of less than one northern pike per 100 gillnet sets.

The sampling strategy should describe whether or not specific habitat types are excluded, so that more effort can be expended in habitats where northern pike are less common. It is clear that the effort will focus on shallower water with gentle slope and that the initial effort will focus on upper reach areas where northern pike are more abundant. To what extent is water velocity considered given that northern pike tend to prefer water without current?

WDFW should consult with a biometrician as soon as possible in order to maximize effectiveness of site selection and the overall monitoring strategy. Monitoring will only occur during one month in Spring and/or one month in the Fall. However, the overall effort and effort within specific habitats remains unclear. How many nets need to be fished each day in each habitat to obtain reasonable precision of computed metrics?

The response is much less detailed for the reservoir operations research component. In particular, the proposal does not mention or rule out possible adverse consequences for other species. This should be addressed before significant effort is directed at a feasibility study.

The budget request for reservoir operations research in 2018 is $100,000, which seems high given the planning efforts to be completed. A more detailed explanation of the work to be conducted in 2018 is needed.

ISRP COMMENT #4

A detailed study plan is requested for three research elements described as Monitoring Actions in the proposal:

(a) Northern Pike natal origin: **CCT Response:** Please see section 1.2 Northern Pike Natal Origin Monitoring in the Northern Pike Suppression Program SOW

(b) Early Detection (eDNA): **CCT Response:** Please see section 1.3 Northern Pike Early Detection Monitoring (eDNA) in the Northern Pike Suppression Program SOW.

(c) Reservoir Operations: **CCT Response:** Please see section 1.4 Reservoir Operations Study in the Northern Pike Suppression Program SOW.

ISRP: For each of these studies, the study plan should describe the research objectives, research hypotheses, experimental design, methods, data analysis, and how this information will inform the adaptive management framework.

a) Specific questions regarding the northern pike natal origin study include:
   (1) Why is the otolith microchemistry approach better than active sampling of habitat types preferred for spawning?

   Response: Active sampling will occur within the Lake Roosevelt watershed, however the area of potential entrainment from upstream water bodies in Canada, the Pend Oreille, and the Spokane River is too vast for comprehensive sampling. Analyzing Northern Pike collected near these locations will assist us with determining if entrainment is a significant source of population growth. This

information will assist the NPTT with adapting the suppression program to include more effort in these areas. More importantly, this information can be provided to regional managers of those waterbodies. Managing Northern Pike is an ongoing issue and suppression is not the currently management technique in some of these locations.

ISRP April 2018 Comment:

(a) Natal origin: The isotope concentrations presented in Figure 4 differ little between the Canadian Columbia River Basin and Lake Roosevelt, so this method (alone) appears to be inadequate to identify northern pike originating from the Canadian Columbia River Basin, i.e., one of three key areas of interest. The Plan should clearly state how it will identify northern pike originating from the Canadian Columbia. When examining isotope transitions along the otolith axis, the age at which the transition occurs should be estimated (see Fig. 5).

(b) eDNA: This seems to be an inexpensive technique that is worth exploring. The Plan noted that eDNA breaks down rapidly such that the probability of a fish being detected declined to 10.8% just 40 m downstream from the test fish carcass. Although this finding suggests that a false positive is unlikely when sampling downstream areas, it also suggests that northern pike densities may need to be fairly high in order to be detected. Presumably the size of the watershed (dilution) is also a significant factor.

(c) Reservoir Operations: The proposed effort is to develop a study plan. The response has little detail despite a $100,000 budget. While the proposed project may have merit for interfering with northern pike reproduction in Lake Roosevelt, a key task should be to discuss with reservoir operators the extent to which reservoir levels may be regulated as a means to control northern pike reproduction. The proposal does not mention or rule out possible adverse consequences for other species. This should be addressed before significant effort is directed at a feasibility study.

(2) Which tributaries to Lake Roosevelt have been sampled for water chemistry?

Response: Seasonal water (spring, summer, fall) samples have been analyzed at 45 locations in the Upper Columbia watershed (Figure 1). See map below and maps within the NP Suppression Plan 2018-2022 document. This includes all major tributaries (Kettle River, Colville River, Spokane River, Pend Oreille River, and the Columbia River in Canada, and the Kootenay River).

ISRP April 2018 Comment:

The response adequately covers the ISRP's question. The ISRP appreciates the map and the data presented in Figure 4 in the Plan (Figure 2 here).

(3) Is water chemistry at sampling sites sufficiently unique to allow delineation of northern pike origins using otoliths?

Response: The mean water chemistry, specifically $^{87}Sr/^{86}Sr$ values from the six major tributaries (Kettle River, Colville River, Sanpoil River, Pend Oreille, Coeur d Alene

Lake, Spokane River) vary widely (Figure 1). These rivers drain geologic formations of widely differing age and composition (Cascade and Rocky Mountains, respectively), which resulted in a general pattern of lower $^{87}Sr/^{86}Sr$ in watersheds west of Lake Roosevelt and higher $^{87}Sr/^{86}Sr$ in watersheds to the east.

However, the mainsteam Columbia River values only vary slightly from upstream to downstream (Figure 2). Consequently, microchemistry is useful for understanding if and when Northern Pike enter Lake Roosevelts from tributaries, but not useful for understanding movements within the Columbia River itself.

A Northern Pike population does exist upstream of the Teck smelter (Trail, British Columbia) and may be contributing to the Lake Roosevelt population. Utilizing other elements such as zinc, lead, and cadmium may assist with understanding if Northern Pike originated in Canada.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question.

(4) Are otoliths from only 50 northern pike per year a sufficient sample size?

Response: The 2016-2017 study utilized 80 otoliths total (40 adults and 40 juveniles). This sample size was adequate to confirm spawning locations and identify new mainstem spawning locations.

Reducing the sample size to 50 with focused sampling zones (see Section 1.2 of the Norther Pike Suppression Plan 2018-2022) kept the project on budget and should enable adequate information to assist with adapting the suppression plan. However, if funding permits the sample size will be increased back to 80.

ISRP April 2018 Comment:

It is not clear how the proponents can assert that a sample of 40 adult and 40 juveniles was "adequate" to confirm spawning locations and identify new mainstem spawning locations given the very large size of Lake Roosevelt. This appears to be a judgment by the proponents that is not based on an analytical or statistical process. The proponents should conduct a quantitative analysis, perhaps based on spatial statistics.

(5) What sizes and ages of northern pike are to be targeted for otolith sampling?

Response: The 2016-2017 study targeted equal numbers of juvenile and adult Northern Pike to confirm hypothesized spawning locations. The 2018-22 study will focus on determining where new populations originated. Target size varies between the three targeted zones.

Target zone 1: Upstream of China Bend, primarily near the Canadian border. All fish collected in this section will be prioritized for analysis. This is currently not a sampling zone; therefore data will be collected from bycatch during White Sturgeon sampling periods. Both adults and juveniles will be tested.

Target zone 2: In 2017, Northern Pike expanded their range downstream between Gifford (RKM = 1088) and Wilmont Creek (RKM = 1048). It is unclear if these fish are from the known spawning locations in the Kettle and Colville rivers, or if they are from mainstem spawning locations. Juveniles (< 250 mm TL) will be kept for analysis.

Target zone 3: Downstream new areas. In 2017, a lone Northern Pike was collected in the Spokane River. It is unclear if this fish came from populations upstream in the Spokane River (Long Lake) or Coeur d'Alene Lake, or if it came from the population near Kettle Falls. All fish (all sizes) collected in new areas will be prioritized for analysis. This information is critical to adapting the suppression plan as well as informing area fisheries managers of any new expansion issues from other water bodies.

ISRP April 2018 Comment:

For the northern pike sampled in Target Zone 1 near the Canadian border, please confirm that otoliths and water chemistry will be analyzed for metals that might originate from the smelter. Metal concentrations (i.e., zinc, lead, and cadmium) would need to be compared with metal concentrations collected from water and northern pike in Lake Roosevelt and other sampled tributaries. Without some kind of additional information, it seems doubtful that the microchemistry analysis could distinguish between northern pike originating from Canada and Lake Roosevelt.

(6) How will data on northern pike natal origin be used to assess suppression efforts?

Response: This information will be provided to regional managers to support Northern Pike suppression efforts. Specifically, to determine if suppression activities need to expand to include upstream areas from China Bend to the Canadian border, the Spokane Arm of Lake Roosevelt, and/or any other new locations. This information will be provided to regional managers if it is discovered that Northern Pike are entraining into Lake Roosevelt from upstream waters bodies including the Columbia River in Canada, Pend Oreille, Spokane River, or Coeur d'Alene Lake.

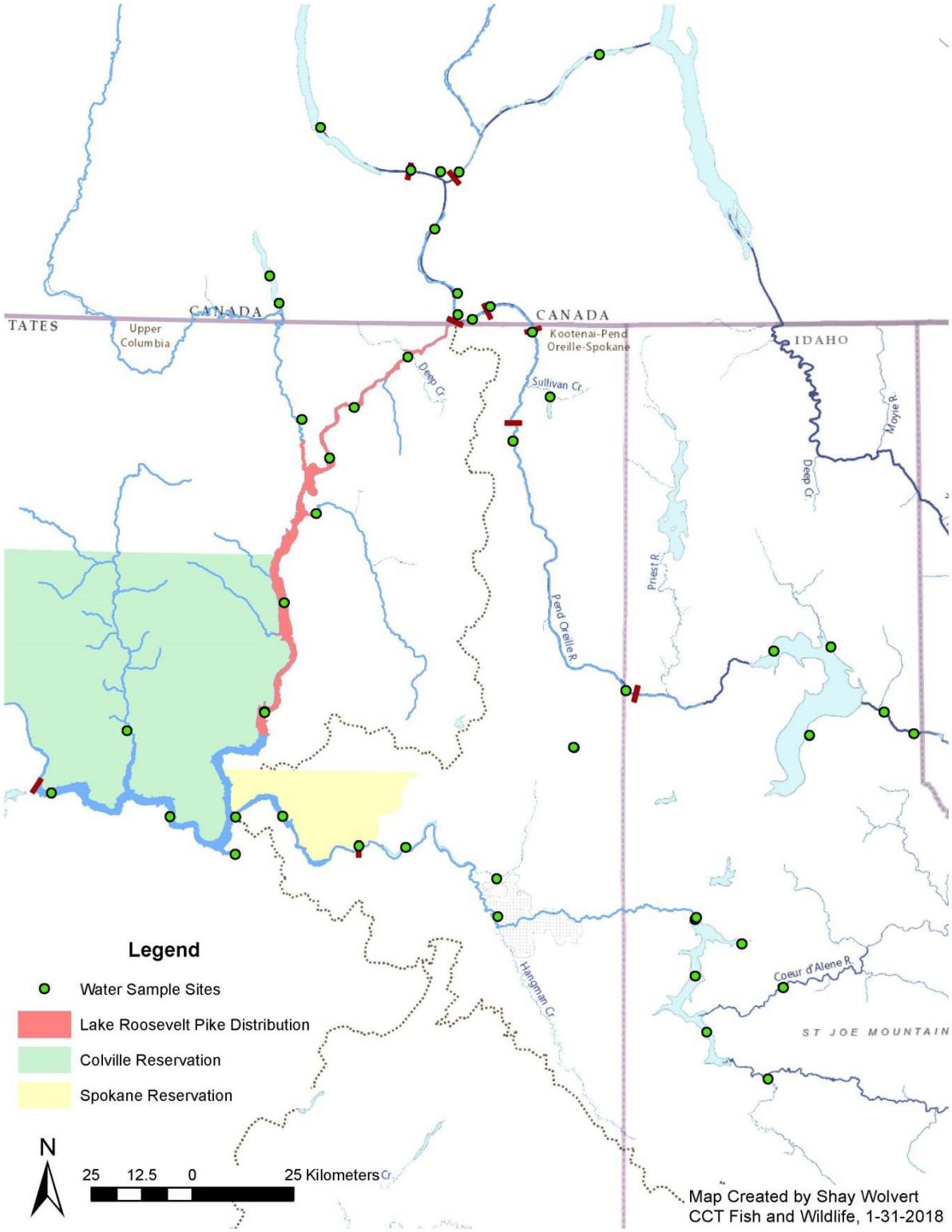

Figure 1. Water sample locations in the Lake Roosevelt watershed used in the Northern Pike microchemistry study.

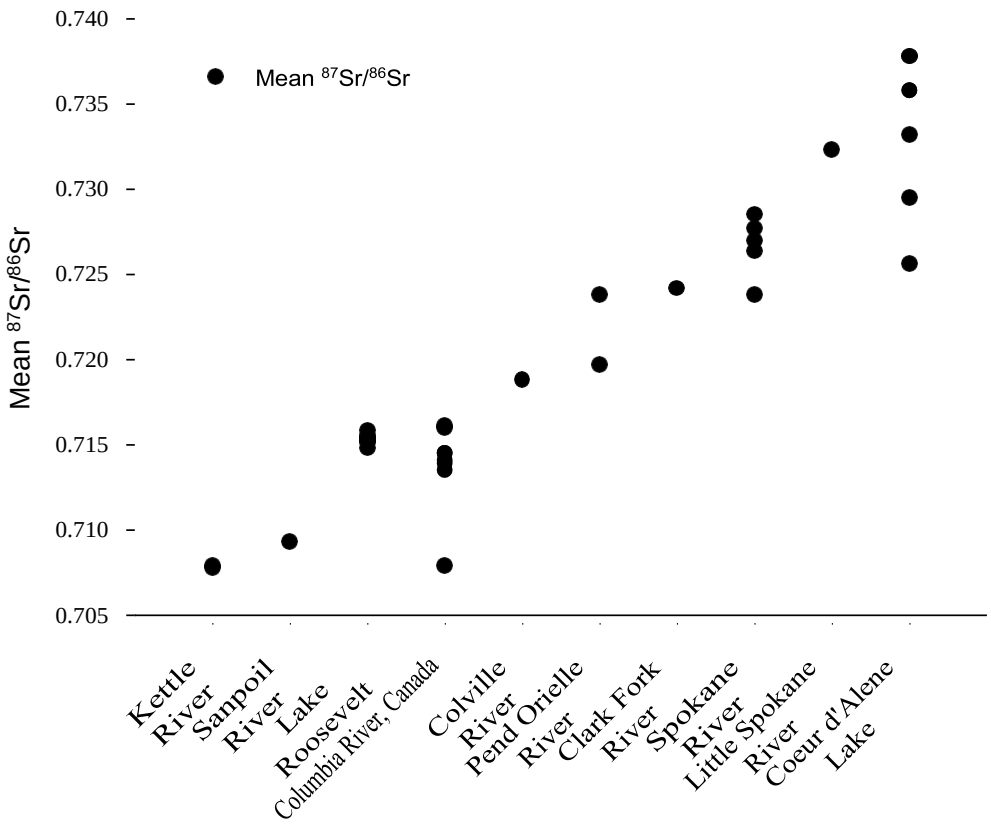

Figure 2. Mean 87Sr/86Sr isotope values between the major waterbodies in the Upper Columbia River drainage.

ISRP April 2018 Comment:

It is stated that information on natal origin will be provided to regional managers. This does not identify how the data will be used by co-managers to inform and possibly alter northern pike suppression efforts. Explanation of how data on natal origin will be included in an adaptive management process should be included in the Suppression and Monitoring Plan. The process should be explained in a detailed adaptive management plan. A coordinated effort throughout the upper Columbia River Basin is needed. Coordination of responsibilities and timelines for various activities with other agencies should be described in the Plan.

b) Specific questions regarding early detection monitoring (eDNA) include:
   (1) How can eDNA be used to detect northern pike dispersal into new downstream areas?

   Response: Environmental DNA (eDNA) is DNA that have been released by an organism into its environment and can be detected in the air, water, or soil. In aquatic systems, eDNA has been shown to provide a sampling approach that is sensitive enough to detect species presence or absence and can be performed

rapidly and efficiently (Laramie et al. 2015; Carmin et al 2016).

Environmental DNA has recently emerged as a powerful tool for detecting aquatic animals in low abundance (Dunker et al. 2016). Monitoring sites have been setup downstream of the current known distribution in Lake Roosevelt. Downstream sites were selected based on habitat characteristics in each water body. Site selection included shallow, weedy areas, typically on a bench. Areas with slower water velocity were selected, but areas of back water or eddies were avoided. Sample timing has been proposed to occur during May (the spawning period) and September (low flows) as a way to increase the probably of detecting the presence of Northern Pike in new areas.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question, but questions remain regarding the effectiveness of eDNA in detecting northern pike. It seems that eDNA may be an inexpensive technique that is worth exploring. The Plan noted that eDNA breaks down rapidly such that the probability of a fish being detected declined to 10.8% just 40m downstream from the test fish carcass. Although this suggests that a false positive is unlikely when sampling downstream areas, this finding also suggests that northern pike densities may need to be fairly high in order to enable detection. Given the very large watersheds in the northern pike suppression region, it may be worthwhile to test this issue. For example, fresh northern pike carcasses could be transported to a large river where northern pike presence is highly unlikely, then sample eDNA at multiple distances downstream. What minimum concentration of northern pike eDNA is needed for detection in a sample of water?

The eDNA plan states that agencies will be notified about positive detections. To what extent does the Plan allow for field verification of positive eDNA findings, as noted in the proponents' response?

(2) What is the likelihood of not detecting northern pike in new areas when in fact they are present?

Response: We have no calculated probability of detection for Northern Pike in large river systems, however we are working on strategies to address this question. Pilot data collected by the USFWS and Colville Tribes in areas with known occupancy of Northern Pike and Lamprey in larger river bodies suggest that population level densities are detectable with sampling on both river banks. The minimum density of fish required for reliable detection varies depending on the size of the waterbody and distance to the fish. Published literature has reliable detection dialed in for small streams <3 CFS, but we are now beginning to understand reliable detection in larger lakes, reservoirs, and rivers. Pilot studies have been useful in characterizing detection limits, but a formal study would be preferable.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question.

(3) To what extent might northern pike eDNA from the upper mainstem areas (where they currently occur) contaminate or confound interpretation of eDNA samples from lower mainstem areas?

Response (provided by Dr. Carmin): The distance that Northern Pike eDNA will be detectable downstream will depend on fish density (more fish means more DNA, resulting in further detection downstream) and environmental conditions (sunlight, water temperature, etc.). With samples from our Bull Trout Inventory, we have found that it is unlikely a population level density of fish will be detected 2 km downstream. Because eDNA is not a perfect science, positive detections are followed up with additional sampling to ground truth or corroborate observed patterns of detections.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question.

(4) Can more than one reference area be included to assure that false positives are not occurring in the dataset?
Response: Yes, we will add four more reference locations for a total of 5 per year.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question.

a) Specific questions regarding the reservoir operations data gap studies include:
Response: The CCT agrees with the ISRP in that this study needs to be fully developed and wasn't completely ready for ISRP review. We request time to develop this study with the assistance of consultants and experts in this field, as described in section 1.4 of the Northern Pike Suppression Plan.

ISRP April 2018 Comment:

The proposed effort is to develop a study plan. The response has little detail. The budget request for reservoir operations research in 2018 is $100,000 which seems high given the vagueness of the work (e.g., literature review to develop a study plan?) to be completed. While the proposed project may have merit for interfering with northern pike reproduction in Lake Roosevelt, a key task should be to discuss with reservoir operators the extent to which reservoir levels may be regulated as a means to control northern pike reproduction. The proposal does not mention or rule out possible adverse consequences for other species. This should be addressed before significant effort is directed at a feasibility study. The ISRP should review the reservoir operations study plan when it is completed.

Project Plan:

2018-2019: Develop a study plan for a reservoir operations study.

- Solicit a subcontractor to assist with study design.

2020-2022

- Fill data gaps identified in the study design.
- Implement prescribed analysis, if feasible.

We attempted to answer the specific questions even though we plan to solicit assistance with project development.

(1) Will egg counts be associated with species and size of plants?
Response: Northern Pike egg counts will be associated with water depth, dominant submergent vegetation, percent vegetation cover, and vegetation height.
plant species.

ISRP April 2018 Comment:

It is anticipated that this question may be addressed in the upcoming reservoir operations study plan. The ISRP should review the reservoir operations study plan when it is completed.

(2) Will there be controls that involve egg counts in adjacent un-vegetated substrate?
Response: Yes, if un-vegetated areas exist in the study area (Kettle River bay) traps will be set there.

ISRP April 2018 Comment:

It is anticipated that this question may be addressed in the upcoming reservoir operations study plan. The ISRP should review the reservoir operations study plan when it is completed.

(3) When and for how long do northern pike eggs need to be dewatered at varying temperatures to effectively kill them?
Response: We could not find a specific study that determined this for Northern Pike, Muskellunge, or Walleye. This may require a controlled study.

ISRP April 2018 Comment:

It is anticipated that this question may be addressed in the upcoming reservoir operations study plan. The ISRP should review the reservoir operations study plan when it is completed.

(4) When and for how long do northern pike larvae require vegetative cover to survive?
Response: After hatching, Northern Pike use an adhesive organ, located on the front of the head for 4 to 10 days. The adhesive organ secretes mucous that attaches larval Pike to aquatic vegetation or other material, suspending that larval fish off the bottom and presumably keeping them out of the bottom silt and camouflaged from predators (Frost and Kipling 1967; Pierce 2012). Pike larvae start to feed 5 to 10 days

after hatching. It appears Northern Pike require vegetation for the egg incubation period (two weeks) and at least 5 days post-hatch prior to first feeding.

ISRP April 2018 Comment:

It is anticipated that this question may be addressed in the upcoming reservoir operations study plan. The ISRP should review the reservoir operations study plan when it is completed.

Questions pertinent to the logistic-regression modeling phase of the reservoir operation study are:

(1) What sampling strategy and data (metrics) will be used to describe year class strength of northern pike?
Response: Abundance (changes in CPUE) of age-1 Northern Pike collected via the monitoring study will be used to determine changes in year class strength.

ISRP April 2018 Comment:

It is anticipated that this question may be addressed in the upcoming reservoir operations study plan. The ISRP should review the reservoir operations study plan when it is completed.

(2) Given the types and quantity of data collected will there be enough statistical power to detect changes in year class strength?
Response: At this time that is unknown. If there is a lack of accurate year class strength data this metric will not be included in the model.

ISRP April 2018 Comment:

It is anticipated that this question may be addressed in the upcoming reservoir operations study plan. The ISRP should review the reservoir operations study plan when it is completed.

The ISRP encourages the proponents to consult with a biometrician as soon as possible so that sampling locations, habitat types, and effort can be evaluated to ensure project success.

(3) Will year class strength be based on mainstem spawners, tributary spawners, or both?
Response: Both because the monitoring surveys will include the lower section of the Kettle (inundated area) as well as the lower section of the Colville River (inundated area).

ISRP April 2018 Comment:

It is anticipated that this question may be addressed in the upcoming reservoir operations study plan. The ISRP should review the reservoir operations study plan when it is completed.

(4) To what extent might drawdown in the mainstem affect northern pike spawning in tributaries?
Response: During the spawning period, the reservoir has partially refilled the inundated areas of the Kettle and Colville rivers. A reservoir drawdown during the spawning period may dewater the inundated areas where Northern Pike are presumed to be spawning. Collecting data confirming spawning locations is a

priority. Conducting eDNA surveys in the free-flowing sections of these reservoir may help to determine if Northern Pike are using that habitat as well. If Northern Pike are using free-flowing sections for spawning, a drawdown would have less effect. However, a drawdown in the mainstem would reduce Pike survival along the shoreline where vegetation has grown.

ISRP April 2018 Comment:

It is anticipated that this question may be addressed in the upcoming reservoir operations study plan. The ISRP should review the reservoir operations study plan when it is completed.

Identification of specific spawning habitats is an important task. Reservoir drawdown could impact the quality of habitat or it may dewater habitats where northern pike have already spawned.

(5) How are low, moderate, and high drawdown years defined?
Response: Using the 10 year average lowest point the reservoir was draw down during the spring runoff from the DART website:

- A shallow drawdown = the lowest water level was ≤ 384 msl
- Average drawdown = the lowest water level was between 385 m and 371 msl
- Deep drawdown = the lowest water level was ≥ 372 msl.

ISRP April 2018 Comment:

It is anticipated that this question may be addressed in the upcoming reservoir operations study plan. The ISRP should review the reservoir operations study plan when it is completed.

It appears that the >, < symbols in the bullet statements have been reversed. Is this correct? Expansion and clarification of the drawdown classes are needed.

ISRP COMMENT #5

Justification for exclusion of northern pike diet monitoring or a plan for monitoring northern pike diet is requested. The ISRP previously recommended continued diet monitoring to evaluate the extent to which northern pike consume salmon and trout compared to other non- native predators (i.e., walleye and smallmouth bass), but monitoring of northern pike diet was not included in the current proposal.

Co-Manager Response: A large body of literature is available describing the impacts of Northern Pike introductions, most of which describe similar results; Northern Pike prefer soft-rayed, fusiform fishes such as cyprinids, clupeids, catostomids, and salmonids in comparison to compressiform fish such as centrarchids and percids (Beyerle 1971; Mauck and Coble 1971; Wolfert and Miller 1978; Wahl and Stein 1988). Diet analysis in conducted in Box Canyon Reservoir, Pend Oreille River, Washington identified Mountain Whitefish *Prosopium williamsoni* and Peamouth *Mylocheilus caurinus* were the only species with positive electivity values, suggesting Northern Pike selected for soft-rayed fishes over more abundant spiny-rayed fishes (Bean et al. 2011). In the upper Columbia River (B.C.), Baxter and Doutaz (2016)

concluded that 60% of Northern Pike diet consisted of native salmonids. Lee and King (2015) found that salmonids and catostomids were primary diet items and were observed in 58% and 42% of Northern Pike stomachs, respectively. Although bioenergetics modeling and a rigorous diet study would provide a quantitative assessment of the impacts of Northern Pike predation on the Lake Roosevelt fish community, implementation would require immense effort and cost and would not provide co-managers new information that other researchers have already concluded locally (Bean et al. 2011, Harvey 2011, Lee and King 2015, Baxter and Doutaz 2016). The co-managers believe that resources would be better allocated toward monitoring and suppression efforts to reduce the eminent threat that Northern Pike pose to native species in Lake Roosevelt. If the sponsors believe that a rigorous diet study is still necessary, the proponents will provide a study design and line item budget upon request.

Additionally relevant studies diet studies include the following:

Muhlfeld, C. C., Bennett, D. H., Steinhorst, R. K., Marotz, B., & Boyer, M. (2008). Using bioenergetics modeling to estimate consumption of native juvenile salmonids by nonnative northern pike in the upper Flathead River system, Montana. *North American Journal of Fisheries Management*, *28*(3), 636-648.

Walrath, J. D., Quist, M. C., & Firehammer, J. A. (2015). Trophic Ecology of Nonnative Northern Pike and their Effect on Conservation of Native Westslope Cutthroat Trout. *North American journal of fisheries management*, *35*(1), 158-177.

Sepulveda, A. J., Rutz, D. S., Dupuis, A. W., Shields, P. A., & Dunker, K. J. (2015). Introduced northern pike consumption of salmonids in Southcentral Alaska. *Ecology of freshwater fish*, *24*(4), 519-531.

Sepulveda, A. J., Rutz, D. S., Ivey, S. S., Dunker, K. J., & Gross, J. A. (2013). Introduced northern pike predation on salmonids in southcentral Alaska. *Ecology of Freshwater Fish*, *22*(2), 268-279.

Scheibel, N. C., Dembkowski, D. J., Davis, J. L., & Chipps, S. R. (2016). Impacts of northern pike on stocked rainbow trout in Pactola Reservoir, south Dakota. *North American Journal of Fisheries Management*, *36*(2), 230-240.

ISRP April 2018 Comment:

A primary reason for northern pike suppression in Lake Roosevelt is the assumption that northern pike are having or will have a significant impact on focal species such as redband trout and kokanee. This assumption needs to be confirmed in order to justify continuing suppression efforts. Another reason for a diet study is to determine if northern pike consume non-native predators such as walleye and bass and therefore reduce overall predation on the focal species. A diet study for northern pike in Lake Roosevelt does not need to be comprehensive. It could be

designed to take only a bit more time within this very large study.

The ISRP believes that a comparative diet study of northern pike, walleye, and smallmouth bass is a key component to justify northern pike suppression efforts in the Columbia River Basin. An alternative is that the project proponents collaborate with another organization (i.e., university, agency, consultant) to design and conduct a diet study and bioenergetics modeling effort with the project proponents doing the field work to obtain diet data. Perhaps a proposal for a separate study that would include both diets and stable isotope analyses to determine relative trophic levels among the three species is needed.

ISRP COMMENT # 6

A detailed description of the northern pike reward program with assessment of both biological effects and social consequences of the program is requested. The potential for the reward program to contribute to suppression of the northern pike population needs to be addressed in a quantitative manner. The social consequences and potential for illegal activities associated with the reward program need to be evaluated and included in the description.

Response: Please reference the Northern Pike Suppression Plan 2018-2022 (Section 2.2) for specific details.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question. Thank you for more detailed information on the reward program. This section is greatly improved. However, assessment of the effectiveness of the Reward Program in contributing to Northern Pike suppression should become part of the adaptive management process.

While not specific to the ISRP question, it should be pointed out that there is a discrepancy between the rules from the website and the description of the Reward Program in the Monitoring and Suppression Plan. The website states a $10,000 limit on total rewards, whereas the Plan states a $15,000 limit.

Would it be possible to obtain information on effort used to catch the northern pike so that an additional metric (i.e., northern pike CPUE by anglers) could be used to assess temporal trends? For example, when heads are returned, fishermen may be asked to specify the number of hours fished for northern pike, total number of northern pike caught, and number of anglers in the group who fished for northern pike?

Specific questions regarding the rewards program include:

(1) Is the existing reward program cost-effective compared with other efforts proposed for the suppression of northern pike in Lake Roosevelt?

Response Yes, the reward program is extremely cost effective compared to the other proposed removal efforts. In 2017, 1,095 Northern Pike were removed via the Reward Program ($10/head). Including administrative costs, the program spent

approximately $13.78 per pike. During suppression, the majority of Northern Pike were collected via gillnetting in 2017 (n=2,841). During the mechanical removal efforts, staffing one boat for one 10 hr day typically cost the program approximately $780, plus fuel ($100 day). Staff sampled 84 days in 2017 (880 x 84 = $73,920), therefore, it costs the program approximately $26.02 per pike. This does not include supplies and equipment required to implement a gill net survey. In summary, yes, the Northern Pike Reward Program is cost-effective. In addition, the social value associated with having active angler participation with the conservation and protection of the Lake Roosevelt ecosystem has benefits that cannot be easily transferred to a dollar value.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question. The ISRP agrees that the rewards program provides public outreach, too. The information in the response should be included in the Suppression and Monitoring Plan for use in future assessments.

(2) What sizes of northern pike are turned in for rewards by anglers?

Response: The size of Northern Pike turned in from the reward program in 2017 is unknown. Nilsson and Bronmark (2000) published a paper that established a relationship between Northern Pike gape width and total length (gape = 0.098 TL - 0.339, r2 = 0987, P < 0.001, n= 49). In 2018, CCT staff will ground truth this equation by measuring 100 Northern Pike for total length (mm) and gape width (mm)(see section 2.1 of the Suppression and Monitoring Plan).

The Pike will be divided into 4 length bins with 25 fish from each (Bin #1 = ≤ 249 mm TL; Bin #2 = 250 – 499 mm TL; Bin #3 500 – 750 mm; and Bib #4 ≥750 mm TL). We will develop a Lake Roosevelt specific regression and compare this with the one developed by Nilsson and Bronmark using ANCOVA analysis.

Craig, J.F. (1996) published a relationship between Northern Pike cleithra length and total length of the fish (anterior cleithra radius x 10 is approximately equal to the body length of a Pike). Unfortunately, the majority of heads returned had the cleithra cut in half making it impossible to estimate length using this technique.
However, the Craig, J. F. (1996) method may be another option if the Nilsson and Bronmark (200) gape measurement technique does not meet our needs.
A literature search could not find a citation that described a relationship between total length and eye-to-snout length.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question. This approach should provide valuable information even if the estimated pike length is not highly precise. The information should be documented in the Suppression and Monitoring Plan for use in future assessments.

(3) Is it possible that the rewards program could encourage anglers to illegally stock northern pike?

Response: Yes, this was considered. The total annual payout that each angler can receive was kept low ($590) to discourage unlawful translocation of Northern Pike to benefit illegally from the reward (i.e., unlikely that anyone could make a living fishing for Northern Pike).

ISRP April 2018 Comment:

The response adequately covers the ISRP's question.

(4) Why does the Colville Tribe reserve the right to suspend this program at any time?

Response: The Colville Tribe reserves the right to suspend the reward program at any time for two reasons. 1). During the development of the reward program, it was not clear how the public would respond to the monetary reward. The CCT had secured three years of funding ($15,000 a year) and wanted to ensure the program did not go over budget. Therefore, if the budget was met and CCT could not secure additional funds, the program would need to be shut down until the end of the year when the new funding would be available.

Secondly, if it is deemed that the program is not cost-effective and not meeting the CCT's goals for Northern Pike suppression, the CCT would terminate it. Therefore, to address this internal concern, the CCT reserved the right to terminate the program.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question.

(5) What are the issues that could lead to the program's suspension?

Response: During the early phases of the programs design, a variety of concerns were raised by CCT managers. These included concerns related to funding, illegal angler activity (planting fish in new waters, committing fraud, vandalism), lack of participation, administrative burden, and CCT's fisheries staff requirements (maintenance of drop off stations, etc).

Strategies were developed to address each concern. The funding level issues were addressed by enabling CCT to suspend the program at any time. The illegal angler activities were addressed by keeping the reward limit low, below a level that would enable someone to earn a living wage. The potential lack of participation was addressed with a a wait and see attitude, internal protocols were developed to streamline the payout process, and protocols were developed for CCT's fisheries staff to ensure proper handling and processing of returned fish. If the CCT managers decided that the program was not meeting expectations, then the program could be suspended at any time.

The limit of $590 was established to address the above issues related to illegal movement and keeping within planned budgets. In addition, the CCT would be required to file a 1099 for every individual and business that is paid $600 or more

(https://www.irs.gov/pub/irs-pdf/i1099msc.pdf).

The CCT was concerned with the added administrative duty of filing 1099's if numerous anglers exceeded the $600 value. Additional administrative costs were not included in the original $15,000 funding pool. Due to the uncertainly surrounding angler participation, the program opted to keep the payout value low. If the program was deemed successful and additional funds could be found, the CCT would consider increasing the payout limit per person. This decision would be made on an annual basis. Additional funds have not been found and therefore the payout will remain $10 a head up to $590 for the 2018 calendar year.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question. It is good to see that the proponents considered all of these issues. Assessment of the issues that could lead to suspension of the Reward Program should become part of the adaptive management process for the overall suppression effort.

ISRP COMMENT #7

A more detailed description of the public outreach plan including of quantitative objectives and monitoring and assessment protocols is requested.

Response: The proponents attempted to address the ISRPs request for a quantifiable public awareness survey without adding any additional costs to the project. The proponents will leverage the creel clerks that are located throughout the reservoir and already interact with the public. While the clerks process angler's fish, they will ask them to fill out a short survey. Please reference Northern Pike Suppression Plan Section 3.0 Public Outreach for specific details.

Brief Summary: The co-managers of Lake Roosevelt have collaborated with regional stake holders to educate the public on the adverse effects Northern Pike introductions can have on an ecosystem and regional economies.

In 2017, the proponents and regional stakeholders collaborated to install Invasive Northern Pike Signs at 27 National Park Boat Launch sites, 2 Spokane Tribal boat launch sites, and 6 Colville Tribal boat launch/fishing locations.

In 2017, the co-managers have presented the Northern Pike Suppression and Monitoring plan at Walleye Club meetings, Trout Unlimited meetings, and provided information to local newspapers and regional news radio stations.

2018-2022 annual actions include

- Upkeep of the current 35 signage locations around Lake Roosevelt.
- Expansion of the current signage to Rufus Woods (3 locations) and Banks Lake (3 locations).
- Present results and plans to the local communities through fishing clubs (1

presentation), radio stations (2 interviews), and newspaper articles (2 articles), as well as presenting at regional fisheries conferences (1 conference). These presentations and press releases will remind the public of the prohibited status of Northern Pike in Washington State, of the threats posed to the entirety of the Columbia River system, and promote the $10 reward program.

- The proponents and regional stakeholders will collaborate to develop an informational Northern Pike brochure and will print 1,000 copies annually. The brochure will describe the prohibited status and threats posed by Northern Pike to Washington State and downstream waters. The brochure will be made available to the public at the CCT Northern Pike reward drop off locations, at specific high-use angler access sites, and will be distributed by the Lake Roosevelt angler creel survey clerks.
- The proponents will implement a Public Awareness Survey to characterize angler awareness regarding Northern Pike in Lake Roosevelt over time. The proponents developed a short, post card sized questionnaire that will be distributed to 50 angler parties per season in each of the three creel survey areas. The questionnaire will ask four yes or no questions:

1. Are you aware Northern Pike are present in Lake Roosevelt?
   ϒ Yes □ No
2. Are you aware Northern Pike are an aquatic invasive species in Washington State?
   ϒ Yes □ No
3. Are you aware that the co-managers of Lake Roosevelt are implementing a suppression program to eliminate Northern Pike?
   ϒ Yes □ No
4. Are you aware of the $10 reward for each Northern Pike turned in at drop off stations?
   ϒ Yes □ No
5. Comments: _____
   _____

The responses to the questions will be summarized by STI and results reported annually in the Lake Roosevelt Northern Pike Annual Report. The information will be used to establish a baseline regarding angler awareness of Northern Pike.

The proponents will coordinate with the National Park Service to include an informational page on the Lake Roosevelt website which will provide information on the threats of Northern Pike and other aquatic invasive species. There will also be links to the co-managers websites that provide additional information.

ISRP April 2018 Comment:

The response adequately covers the ISRP's question. However, the ISRP suggests that the proponents consult with experts in survey design prior to initiating the Public Awareness Survey.

Literature Cited by the ISRP in this review

Beaudoin, C.P., W.M. Tonn, E.E. Prepas and L.I. Wassenaar. 1999. Individual Specialization and Trophic Adaptability of Northern Pike (Esox lucius): An Isotope and Dietary Analysis. Oecologia 120: 3, 386-396.

Chapman, L.J., W.C. Mackay and C.W. Wilkonson. 1989. Feeding flexibility in northern pike Esox lucius): fish versus invertebrate prey. Canadian Journal of Fisheries and Aquatic Sciences 46: 666-669.

Chihuly, M. 1976. Biology of northern pike (Esox lucius) in the Wood River Lake system Bristol Bay, Alaska. Master's Thesis. University of Alaska, Fairbanks.

ISRP 2016-2. Review of Lake Roosevelt Northern Pike Suppression Proposal (1994-043-00).

ISRP 2016-6. Final Review of Lake Roosevelt Northern Pike Suppression Proposal (1994-043-00).

ISRP 2016-7. Review of Box Canyon Northern Pike Suppression Progress Report (2007-149-00).

ISRP 2017-6. Review of Expanded Proposal for Lake Roosevelt Northern Pike Suppression Project (1994-043-00).

ISRP 2018-1. Response Request for Northern Pike Suppression and Monitoring Proposal (2017-004-00).

Mauck, W.L. and D. W. Coble. 1971. Vulnerability of some fishes to northern pike predation. Journal of the Fisheries Research Board of Canada 28:957-969.

Rich, B.A. 1992. Population dynamics, food habits, movement and habitat use of northern pike in the Coeur D'Alene River system, Idaho. Idaho Department of Fish and Game, Fisheries Management Investigations. Completion Report, F-73-R-14, Subproject No.: VI Study No.: 3.

Sepulveda, A.J., Rutz, D.S., Ivey, S.S., Dunker, K.J. and Gross, J.A. 2013. Introduced northern pike predation on salmonids in southcentral Alaska. Ecology of Freshwater Fish 22: 268–279.

Scott, J.L. 2002. Investigations into the feeding habits of piscivorous fishes in Coeur D'Alene Lake, Idaho. Master's Thesis. Eastern Washington University, Cheney.

Wahl, D.H. and R.A. Stein. 1988. Selective predation by three esocids: the role of prey behavior and morphology. Transactions of the American Fisheries Society 117:142-151.

Walrath, J. D., M. C. Quist, and J. A. Firehammer. 2015. Trophic ecology of nonnative Northern Pike and their effect on conservation of native Westslope cutthroat trout. North American Journal of Fisheries Management 35:158-177.