Report on a Bull Trout Expert Panel Workshop Held July 2008 on "Assessing Potential Impacts of a Proposed Reintroduction of Bull Trout on ESA-Listed Salmon and Steelhead in the Clackamas River"

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EXECUTIVE SUMMARY OF FINDINGS

On July 21-23, 2008, an expert panel workshop was held in Vancouver, Washington, to help determine the potential impact of reintroducing bull trout into the Clackamas River system, on four existing ESA-listed salmonids: spring Chinook, fall Chinook, Coho, and winter steelhead. The panel consisted of five experts on bull trout and salmonid biology and ecology.

The workshop was rigorously structured using a modified Delphi process so that panelists could learn from other presenters and from each other, yet offer their knowledge individually. The panelists were asked to (1) score possible outcomes of the degree of impact of bull trout on salmonids' probabilities of extinction, among 7 categories ranging from very high impact to no impact; (2) suggest and prioritize possible topics for monitoring, should the proposed project be enacted, and (3) suggest possible management actions, should bull trout be found to have unacceptable adverse effects on salmonids. The panel also discussed related topics, such as the degree of reversibility of a bull trout reintroduction, and lessons learned from other river systems with and without bull trout and other desired fish species. The workshop was also attended by two facilitators and a note-taker, several selected biologists who presented summaries of topics pertinent to bull trout and salmonid biology and habitat ecology, and up to 10 observers consisting of other managers and biologists from a variety of agencies. All workshop participants, including the expert panelists, were specifically not asked to make or recommend policy decisions, as the purpose of the workshop was to provide technical, scientific information for later consideration by managers and decision-makers.

The results of the panelists' scoring of possible degree of impact of bull trout on salmonid probability of extinction ranged from moderately high impact to no impact. The variation in scores expressed the panelists' individual uncertainty, variability among the panelists, and expected differences among the salmonid species. The mode of overall score values suggested that impact was viewed by the panelists in general to be very low or moderately low for spring Chinook, Coho, and winter steelhead; and mostly none to very low for fall Chinook. However, again, some possible outcomes ranged into higher categories of impact but with far lower score levels.

The panelists identified 19 possible monitoring activities under four main objectives (environment, predator status, prey status, and trophic interactions). The highest priority monitoring categories pertained to determining predator (bull trout) abundance and reproduction, establishing baseline and periodic consumption rates, periodically determining size structure in bull trout populations, annually determining prey abundance and productivity, and determining baseline and periodic rates of trophic interactions. Other monitoring activities pertained to determining bull trout demography, habitat selection, abundance of salmonids, variation in fish distribution, and other topics.

The panelists identified 21 possible management activities that could be used to reduce adverse impacts of bull trout on salmonids, should any be discovered after reintroduction. The management activities fell under six main objectives (monitoring, offsetting impacts of bull trout, direct predator control, prey enhancement and management, public perception, and reservoir management) and pertained to a variety of types and degrees of possible impact.

Discussions by the panelists and observers of each of these scoring and listing tasks, and other topics pertinent to bull trout and salmonid biology and ecology, were recorded by the note taker and presented here in an appendix.

WORKSHOP PURPOSE AND OBJECTIVES

The following problem statement, overall goal, specific objectives, expected products, and agency roles were provided to the attendees (expert panelists, managers, and other observers) prior to the workshop, and again presented during the opening day of the workshop.

Workshop problem statement.--Based on findings from the *Clackamas River Bull Trout Reintroduction Feasibility Assessment* (2007), a proposal to reintroduce bull trout to the Clackamas River, Oregon, is being developed by the Fish and Wildlife Service (FWS) and Oregon Department of Fish and Wildlife (ODFW). Whereas a successful reintroduction of bull trout into the Clackamas would represent a major success for the species' recovery, there are concerns about the impacts of this effort on other ESA-listed species (Chinook and Coho salmon, steelhead trout). In particular, predation on salmon and steelhead by bull trout has been identified as an area of uncertainty.

Overall workshop goal.--Provide a scientific assessment of potential impacts to salmon and steelhead from a reintroduction of bull trout to the Clackamas River and outline monitoring and management strategies that could be implemented to reduce uncertainty and risk following a possible reintroduction.

Specific workshop objectives.--

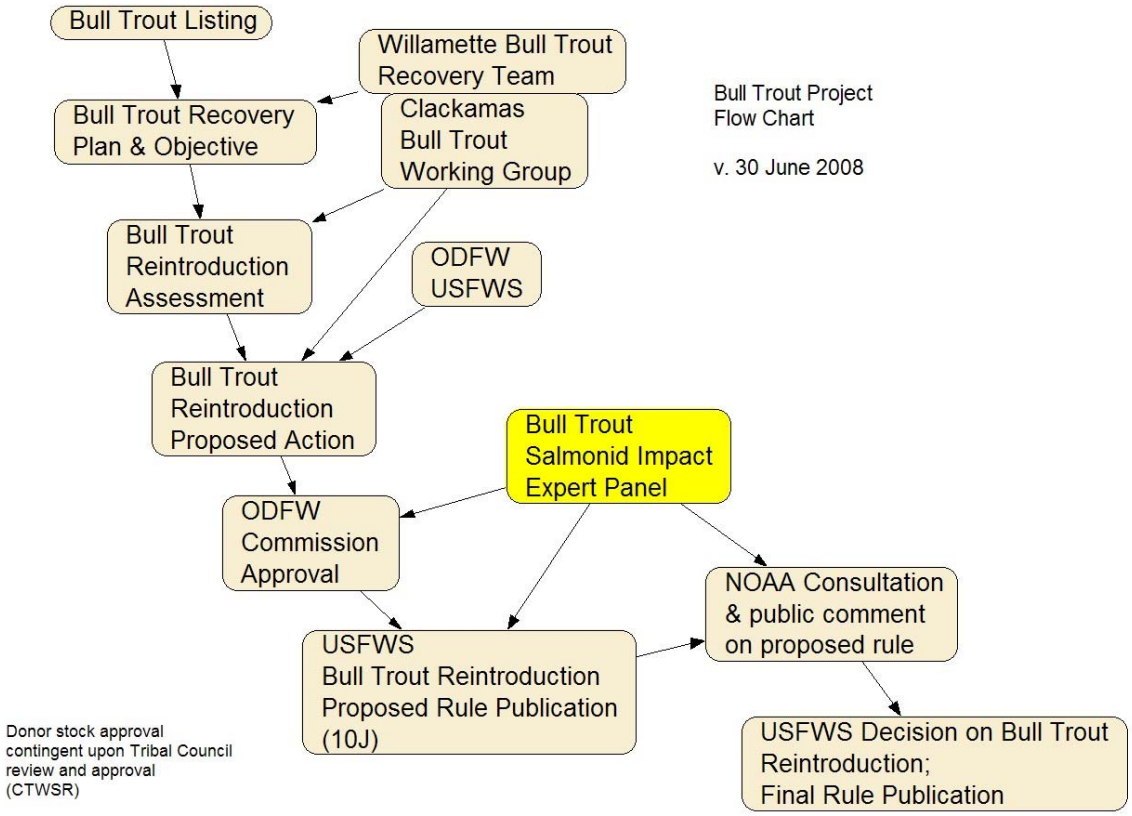
- An evaluation of potential interaction effects between reintroduced bull trout and existing anadromous salmonids in the Clackamas River system
- Suggestions for priority monitoring activities
- Suggestions for possible ameliorative management activities that could reduce undesirable species interactions.

Products derived from the workshop.--

- Provide a scientific assessment of potential risks and uncertainties under the proposed management scenario (i.e., a self-sustaining population of 200 to 500 adult bull trout by 2030 or sooner) and associated actions for bull trout reintroduction.
- Evaluate alternative activities for minimizing risk and uncertainty around the issue of impacts by bull trout on ESA-listed salmon and steelhead trout in the Clackamas River.
- Produce a summary report (this report) that describes the results of the assessment with reference to a potential reintroduction of bull trout into the Clackamas River

Agency roles.--FWS and ODFW are the lead agencies in the development of a reintroduction proposal. The U.S. Forest Service - Mt. Hood National Forest (USFS), National Marine Fisheries Service (NMFS), and the Confederated Tribes of the Warm Springs Reservation (CTWSR) are cooperating agencies. U.S. Geological Survey (USGS) is providing scientific support.

Also presented during the opening section of the workshop was the following flowchart for the Bull Trout Reintroduction Project, specifically to illustrate the context, role, and expected use of the workshop results.



WORKSHOP AGENDA, ATTENDEES, AND METHODS

The agenda for the workshop is presented in Appendix 1.

Pre-workshop materials.--Prior to the workshop, each expert panelist was sent a letter of invitation that explained the purpose, methods, and expected outcome of the workshop (Appendix 2) along with a set of pre-workshop reading materials (Appendix 3) and a list of questions and answers further explaining the overall project (Appendix 4).

Workshop attendees.—The workshop was attended by 5 expert panelists: Dave Beauchamp (University of Washington and USGS), Jason Dunham (USGS), Kathryn Kostow (ODFW), Paul McElhany (NMFS), and Michael Meeuwig (Montana State University). Workshop facilitators, planning team members, and other observers are listed in Appendix 5. The 5 expert panelists were chosen based on their individual expertise in bull trout and salmonid biology and ecology.

Opening presentations.--The workshop was structured with an opening series of presentations (see Appendix 1) to ensure that all expert panelists were equally informed on the following topics:

- the bull trout reintroduction program feasibility assessment and draft proposed action;
- the status and distribution of ESA-listed anadromous fish species in the Clackamas River and current recovery planning efforts;
- Portland General Electric's (PGE) hydro projects, reservoirs, and fish bypass systems in the Clackamas River system; and
- bull trout trophic interactions and food webs.

Model and discussion on trophic interactions and food web dynamics.--Also presented was a preliminary Bayesian network model depicting potential food web and species interaction dynamics relevant to relationships between bull trout, anadromous salmonids, and other predators and prey species in the river system. The model (Appendix 6) was presented to help prompt panel discussion on trophic and food web dynamics, including identifying key areas of uncertainty related to bull trout-salmonid interactions. The Bayesian network model was not used *per se* further in the workshop although the resulting discussions of trophic structure and food web dynamics were recounted and continued throughout the rest of the workshop.

Panel scoring of degree of impact of bull trout on salmonids.--On day 2 of the workshop, the expert panelists were engaged in a structured scoring of potential effects of bull trout on the extinction probability of each of the 4 ESA-listed salmon and steelhead populations of interest in the Clackamas River system: spring Chinook, fall Chinook, Coho, and winter steelhead. The instructions given to the panelists included that they were to (1) assume that bull trout reintroduction objectives would be met, that is, with at least 200-500 adult bull trout sustainable in the Clackamas River system by 2030, and (2) score the relative influence of bull trout on whatever absolute extinction probability might pertain to each salmon and steelhead population. Selection of this particular scoring approach is described in Appendix 7.

The scoring was conducted by using a modified Delphi paneling procedure (Appendix 7). In brief, this procedure involved the panelists scoring how a bull trout reintroduction might influence each salmonid species, by each panelist spreading 100 points (thought of as probabilities) among one or more outcome categories of potential impacts (see Appendix 8 for worksheet used). Spreading points would be an expression of uncertainty of outcomes and a means of displaying potential differences in outcomes among the salmonid species.

The Delphi paneling process entailed the panelists first individually and silently recording an initial set of outcome scores; then the panelists individually disclosing and explaining their scores to each other in a structured discussion, including an opportunity to engage with other observers and experts in the room; and then individually and silently rescoring outcomes based on new knowledge or insights gained from the shared disclosure and open discussion. The disclosure and discussion portion of the panel

ensured that each panelist had equal time to present their ideas, seek clarification, and ask questions. The scores and discussion comments were recorded anonymously using letter codes (A-E) for each panelist. The scoring session encouraged the panelists to synthesize their own expert experience, the pre-workshop readings (Appendix 3), the workshop presentations (Appendix 1, 6), and their shared interpretations and rationale.

The panelists were prompted to score the *degree of impact that bull trout would have on the extinction probability of each salmonid species over 100 years from the start of the reintroduction project*. The panel discussed an initially-presented 5 class system, did a first round of scoring, and then refined the classes and collectively agreed to use the following 7 categories and definitions for scoring potential bull trout impacts:

- **Very High** = bull trout influence contributes to 100% of the extinction probability
- **High** = bull trout influence contributes to about 95% of the extinction probability
- **Moderately High** = bull trout influence contributes to about 75% of the extinction probability
- **Moderate** = bull trout influence contributes to about 50% of the extinction probability
- **Moderately Low** = bull trout influence contributes to about 25% of the extinction probability
- **Very Low** = bull trout influence contributes to about 5% of the extinction probability
- **None** = bull trout influence has no contribution to the extinction probability

It was clarified to the panelists that they were to score only that portion of salmon and steelhead population extinction probabilities that would be caused by bull trout; they were not asked to score overall extinction probabilities. In this way, the relative impact contributed specifically by bull trout would be represented.

The panelists were also asked to provide written documentation of the basis for their scores. After their second (and final) round of scoring, the meeting facilitators displayed the score results on screen, summarizing mean and ranges of score values among the panelists. The panel provided further explanation and discussion of their scores, which was captured in meeting notes.

Identification of possible monitoring and management activities.--After scoring potential degree of impact of bull trout on salmonids, the panelists were then led through two structured brainstorming sessions (see Appendix 7 for further details of methods) in which they were prompted to list possible monitoring and management objectives and specific activities, without regard to the likely cost of each effort, and under the presumption that the bull trout reintroduction project would be enacted.

The list of possible monitoring activities was displayed on screen. After discussing and refining the list, the panelists were given hard copies of the list and asked to individually rank each monitoring activity by three priority levels: (1) essential to conduct, (2) important but not necessarily essential, and (3) worthwhile but of lower importance. The

individual panelists' priority scores were recorded and the monitoring activities were sorted by mean and range of the priority scores, and by overall monitoring objectives. Discussion within the panel and observers ensued and caveats and ideas were recorded in the written meeting notes.

In the final panel task, also in a structured brainstorming procedure, the panelists listed possible management activities to reduce or eliminate effects of bull trout on the four ESA-listed salmon and steelhead populations, assuming that the bull trout reintroduction project would be enacted and that it might be found that bull trout have an unacceptably high adverse impact on the salmonid species. The list of possible management activities, along with type and degree of impact and overall management themes, were displayed on screen. The expert panel and observers then engaged in open discussions as to the feasibility or expected result of the various management activities; discussions were recorded in the written meeting notes.

RESULTS AND DISCUSSION

Opening presentations.--The opening day talks (see Appendix 1) were made with PowerPoint presentations.[1]

Scoring of impacts of bull trout on salmonids.—The individual panelist scores are presented in Appendix 9 along with score sums, means, and ranges. The means of all 5 panelist scores were distributed among the species in Figure 1:

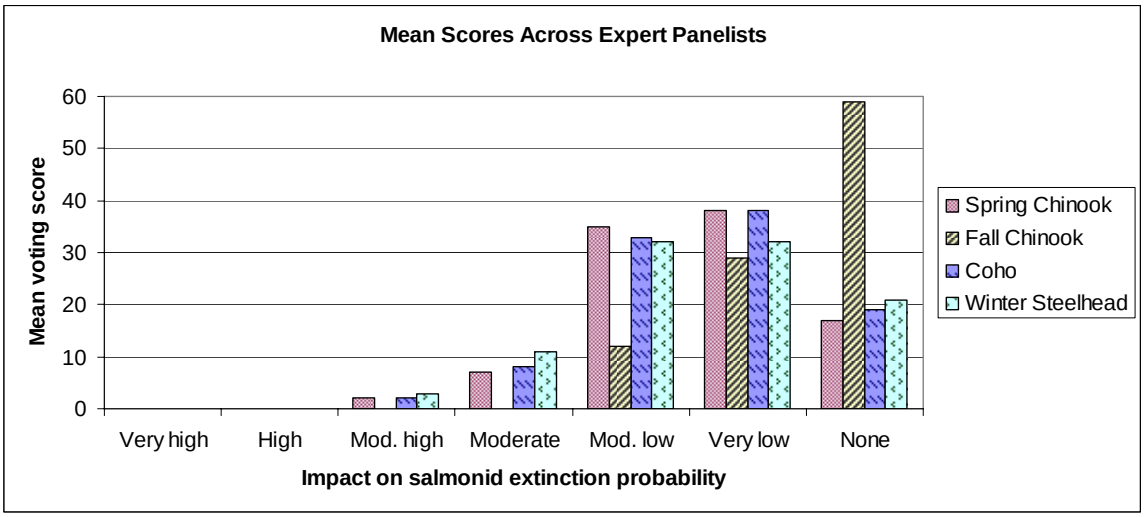


Figure 1. Mean scores of the potential impact of bull trout on salmon and steelhead population extinction probability.

Figure 1 suggests that the panelists generally rated bull trout impacts on extinction probabilities of salmon and steelhead populations as "moderately low," "very low," or

[1] The PowerPoint files are available from the U.S. Fish and Wildlife Service, upon request (Chris Allen, 503.231.6179, chris_allen@fws.gov).

even "none." Also, the mean scores suggested that the panelists in general considered bull trout impacts on salmon and steelhead extinction probability to be lower for fall Chinook than for the other three populations. However, there were non-zero scores suggested even at the "moderately high" and "moderate" degrees of impact for three of the populations; these ratings should not be ignored.

A different way to visualize these patterns is by summing the panelists' scores by salmonid species (Fig. 2):

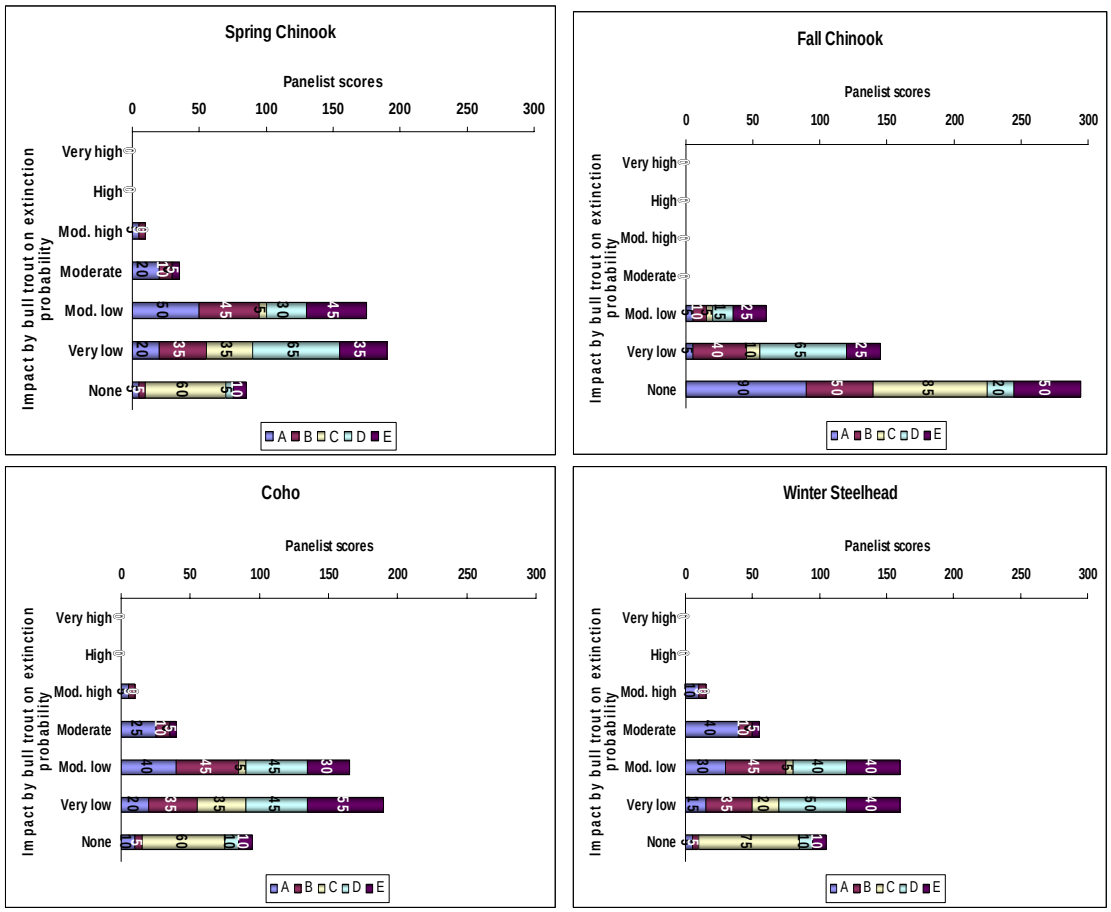


Figure 2. Sum of scores of the potential impact of bull trout on salmon and steelhead population extinction probability, across the 5 panelists (A-E) and by salmonid species.

Summarized in this way (Fig. 2), it is more apparent that the panel generally expected lesser impacts from Bull Trout on Fall Chinook than on the other 3 salmon and steelhead populations. The panel as a whole allocated most of their scores to "None" and "Very low" outcomes for Fall Chinook, and most of their scores to "Very Low" and "Moderately Low" for the other 3 salmon and steelhead populations, with lower score levels allocated to "None," "Moderate," and "Moderately high."

These distributions of composite scores across the outcome categories for each species can be interpreted as expected probability distributions. Outcomes that scored with few points are still possible, according to at least some of the panelists, even if the probability

is low. Whether such expected outcomes as "Moderately high" that scored with few outcome points still trigger concern for the species will be the purview of the decision-makers.

It should be clarified that we did not ask the panelists to reach consensus on their scoring. Thus, it is also instructive to view the individual panelists' degrees of uncertainty and variation among the salmon and steelhead populations considered, across the various outcome categories, and among the individual panelists, as shown in Figure 3.

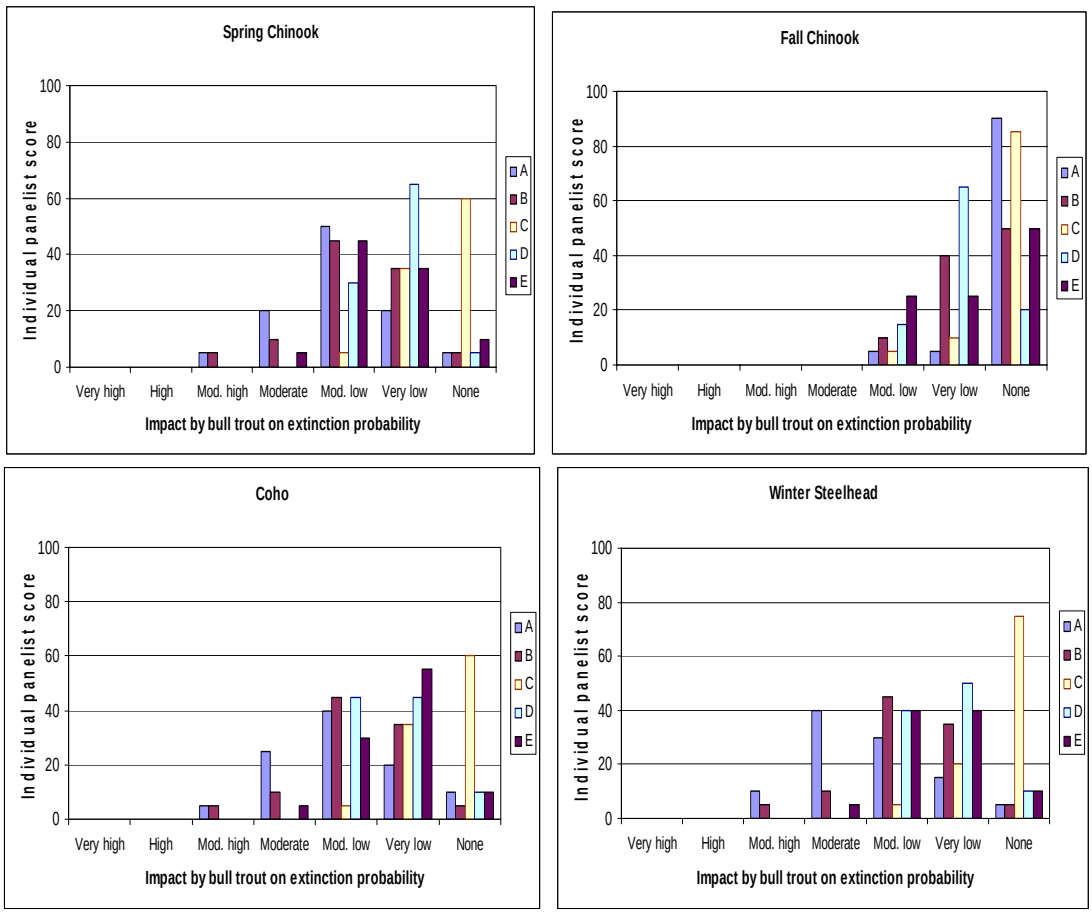


Figure 3. Individual panelist scores of bull trout impact on salmon and steelhead populations after 100 years of bull trout reintroduction. Legend: A-E represents the individual panelists.

Figure 3 suggest that (1) each panelist expressed some degree of uncertainty over the possible impact of bull trout on extinction probability of each salmon and steelhead population, suggested by the spread of scores across multiple outcomes; and (2) although the panelists differed in their specific score values, they concurred by not scoring bull trout impact on any population as "very high" or "high," with modes mostly in the categories of "moderately low" to "none."

Identification of possible monitoring activities.—The expert panel identified a collective set of 19 possible monitoring activities that could follow bull trout reintroduction, without regard to cost. The activities variously pertain to general

objectives for monitoring the overall aquatic environment, predator (bull trout) status, prey (salmon and steelhead population) status, and trophic interactions; and would address various aspects of predator age and growth, angler catch of bull trout, bull trout movement, bull trout size structure, food web and predator consumption dynamics, predator and prey demography, predator and prey habitat selection and reservoir use by prey, predator and prey abundance and productivity, reservoir limnology, and other topics.

The full list of all 19 monitoring activities is presented in Appendix 10. The top activities ranked as essential to conduct by at least 4 of the 5 panelists pertained to monitoring of:

- bull trout reproduction and recruitment, e.g., spawning surveys, age, and size (annual)
- rates of consumption of food by bull trout (baseline and periodic)
- size structure of bull trout in reservoir and river environments (periodic)
- smolt and adult abundance, size, and age of the 3 listed salmon and steelhead species at North Fork Dam (annual)
- juvenile and adult abundance and size structure of the 3 listed salmon and steelhead species above North Fork Reservoir (annual)
- diet and stable isotopes of fish and key invertebrates to identify major predators (fish & others) of salmonids and other fishes (that is, to determine the food web) (baseline and periodic)

Much discussion was held regarding interpretation and qualification of the impact scores and the monitoring activities (Appendix 11).

Identification of possible management activities.—The expert panelists collectively identified some 21 possible management activities that could be pursued, should bull trout be found to have unacceptable impacts on the 4 ESA-listed salmon and steelhead populations if a reintroduction were occur (Appendix 12). The management activities were not prioritized because the type and degree of bull trout impact might vary considerably. Thus, the management activities were categorized by type and degree of impact and by overall management theme, as noted above.

As examples, if the type and degree of impact was found to be high to very high impact from bull trout on the other listed salmonids, one possible management activity pertaining to predator (bull trout) control was identified as complete removal of the bull trout population or maintenance of the bull trout population at a specified lower level. If the type and degree of impact was predation by bull trout on juvenile salmonids in tributaries, one possible management activity pertaining to prey (salmonid) management was identified as adding refuge cover in tributary habitat and other habitat enhancements to reduce predation levels.

Additional comments and discussions.—During the workshop, we recorded a great deal of the discussions and comments made by the expert panelists and observers.[2]

ACKNOWLEDGMENTS

Success of the workshop was largely due to the contributions and participation of the five expert panelists -- Dave Beauchamp, Jason Dunham, Kathryn Kostow, Paul McElhany, and Michael Meeuwig – and from the management support by Chris Wheaton of ODFW, Paul Henson and Miel Corbett of USFWS, and Gary Larson of USFS.

Agencies and institutions that sponsored and contributed to the success of this workshop included USDI Fish and Wildlife Service, USDA Forest Service, Oregon Department of Fish and Wildlife, Portland General Electric, NOAA Fisheries, Confederated Tribes of the Warm Springs Reservation (CTWSRO), and USDI Geological Survey.

We also extend our thanks to the following invited speakers for their presentations: Chris Allen, Todd Alsbury, Doug Cramer, Dave Beauchamp, and Jason Dunham.

[2] These notes are available from the U.S. Fish and Wildlife Service, upon request (Chris Allen, 503.231.6179, chris_allen@fws.gov).

APPENDICES

1. Workshop agenda.

2. Letter of invitation sent to each invited expert panelist.

3. List of pre-workshop reading materials sent to each expert panelist.

4. Project question and answer sheet, sent to each expert panelist prior to the workshop.

5. List of workshop attendees: invited expert panelists, meeting facilitators, workshop planning team, and observers.

6. Bull trout food web model presented at the workshop by Jason Dunham and Bruce Marcot.

7. Detail of expert panel methods used during the workshop.

8. Worksheet used by the expert panelists to score potential impacts from bull trout on each of the 4 ESA-listed salmonids in the Clackamas River system.

9. Results of the expert panel scoring of degree of impact of bull trout on ESA-listed salmon and steelhead populations.

10. Potential monitoring activities identified by the expert panel.

11. Written explanatory notes and discussion comments from the five expert panel participants, recorded from their scoring of bull trout impacts and listing of potential monitoring activities.

12. Potential management activities identified by the expert panel, for reducing or eliminating unacceptable impacts of bull trout on salmon and steelhead populations, sorted by management theme.

APPENDIX 1 - Agenda - Bull Trout Expert Panel Meeting June 21-23, 2008: "Assessing Potential Impacts of a Proposed Reintroduction of Bull Trout on ESA-Listed Salmon and Steelhead in the Clackamas River"

Location: City of Vancouver's Water Resources Education Center
Vancouver, Washington

Prework for Bull Trout Expert Panel:

- Review items sent out in advance – Binder with feasibility study, selected publications

DAY 1 - MONDAY, July 21, 2008

Time	Topic	Main messages	Lead	Objective
1:00-1:20p	**WELCOME** • Roster Check In, introductions (BT Expert Panel; Workshop Facilitators & Advisors; BT Biologist Observers; Manager Observers; Note-taker) • Overall workshop goal • What you should have received/brought • Agenda review • WELCOME by ODFW and USFWS Managers	Introductions to the workshop. No decisions to be made. No major changes to the agenda.	Dan Shively Chris Wheaton with Paul Henson or Rollie White	*Expectations for the workshop:* To provide objective technical information on potential effects of bull trout on salmonids in the Clackamas River system, for informing ODFW, USFWS, NOAA, and other stakeholders.
1:20-1:30p	**OVERVIEW OF METHODS** • Roles of bull trout expert panel, facilitators, and observers – clarify how workshop fits overall project proposed action • Summarize specific workshop objectives • Grounding in terminology: define key terms and concepts to be addressed	Information sharing. Scoring and written info will be anonymous.	Dan Shively, Bruce Marcot	*Present flow chart diagram* of overall project, and how this workshop fits in *Specific workshop objectives*: • Evaluate potential interaction effects between reintroduced Bull Trout and existing salmonids in the Clackamas River system. • Suggest priority monitoring activities. • Suggest possible ameliorative management activities that could reduce undesirable species interactions.

Time	Topic	Main messages	Lead	Objective
	BACKGROUND PRESENTATIONS (each 20 min, with 10 min Q&A)			
1:30-2:00p	• Brief Synopsis of Feasibility Assessment Conclusions and Draft Proposed Action	Presentation	Chris Allen	The purpose of all presentations is to ensure that all panelists are equally up to speed on each presented topic and have a chance to ask questions of each speaker (i.e., leveling and elevating playing field).
2:00-2:40p	• Overview of Status and Distribution of ESA-Listed Anadromous Species in the Clackamas River & Current Recovery Planning Efforts	Presentation	Todd Alsbury	
2:40-3:00p	**BREAK**			
3:00-3:30	• Overview of PGE's Hydro Projects, Reservoirs, and Fish Bypass Systems	Presentation	Doug Cramer	Sharing of information (continued)
3:30-4:00p	• Review of Bull Trout Trophic Interactions	Presentation	Dave Beauchamp	
	PANEL DISCUSSION OF FOOD WEB DIAGRAM AND MODEL			
3:50-4:10p	• Review of Bull Trout Food Web	Presentation	Jason Dunham	Present current thinking on how bull trout fit into the river ecosystem food web.
4:10-4:25p	• Introduction to Food Web Bayesian Network Model	Presentation, model demonstration	Bruce Marcot	Present working hypothesis model that depicts the dynamics of how food web dynamics interact. Engage expert panel in discussion of food web model.
4:25-4:55p	Guided discussion on bull trout/anadromous salmonid interactions (results will provided as a handout tomorrow) • Structural uncertainty • Dynamic uncertainty	Expert panel discussion (Note-taker will capture panel's key discussion points)	Dan Shively with Bruce Marcot	Engage the expert panel in a discussion of how the food web system may be functioning
4:55-5:00	**WRAP-UP OF DAY 1** Briefly review work done today, mention tomorrow's expert panel exercises coming up; address any logistics needs for the evening • Optional Social @ McMenamin's 5:30p	Summary	Dan Shively	Summary, wrap-up, preparation for tomorrow

DAY 2 - TUESDAY, July 22, 2008

Time	Topic	Main messages	Lead	Objective
8:00-8:10a	**WELCOME** • Today's objectives, agenda, and expected products • Any logistics needs	Housekeeping	Dan Shively	Welcome, orientation to the day's upcoming work
8:10-8:20a	**BRIEF REVIEW OF PREVIOUS DAY** • Quick reminder of workshop objectives • Quick reminder of the themes of yesterday's presentations • Handout or display results of yesterday afternoon's revision of the food web diagram and/or model	Review, reminders, and handout on interactions list	Dan Shively Bruce Marcot	Recap and address any new ideas or thoughts on food web since Day 1
8:20-10:00a	**TASK 1: EXPERT PANEL EVALUATION OF SPECIES INTERACTIONS** **INTRODUCTION** • Objectives, expected products • Review methods - modified Delphi paneling process entailing individual scoring; structured disclosure, discussion, and Q&A; individual rescoring • Ground rules for conduct **FIRST SCORING SESSION** • Individual silent scoring of questions (handout to be provided) **STRUCTURED DISCLOSURE, DISCUSSION, Q&A** **SECOND SCORING SESSION**		Bruce Marcot Bruce Marcot Bruce Marcot	The expert paneling is intended to meet the first of the workshop objectives, that is, to provide an evaluation of potential interaction effects between reintroduced Bull Trout and existing salmonids in the Clackamas River system.
10:00-10:30a	**BREAK**	Entry of scores into spreadsheet by Marcot et al.	(Marcot, Allen)	

Time	Topic	Main messages	Lead	Objective
10:30-11:30a	**BRIEF PRESENTATION OF SCORING RESULTS** **GUIDED PANEL DISCUSSION ON OVERALL EXTINCTION RISK AND CONTRIBUTION BY BULL TROUT** **OPEN FLOOR FOR MANAGERS AND OTHER OBSERVERS TO ASK CLARIFYING QUESTIONS OF PANELISTS**	Presentation Facilitated discussion	Bruce Marcot Dan Shively	Ensure panel has opportunity to see the distribution of their scores, and at least to briefly discuss meaning and implications; and for the note-taker to capture key points.
11:30a-12:30p	**LUNCH**			
12:30-2:30p	**TASK 2: SUGGESTIONS FOR MONITORING ACTIVITIES** • Guided panel brainstorming exercise to identify monitoring themes and activities	Facilitated discussion	Dan Shively & Bruce Marcot	Develop a list of potential monitoring themes, objectives, and activities presuming that the proposed action will take place.
2:30-2:50p	**BREAK**			
2:50-4:50p	**SUGGESTIONS FOR MONITORING ACTIVITIES (CONTINUED)** • Guided panel brainstorming exercise • Summary of results **OPEN FLOOR FOR MANAGERS AND OTHER OBSERVERS TO ASK CLARIFYING QUESTIONS OF PANELISTS**	Facilitated discussion	Dan Shively & Bruce Marcot	(as above)
4:50-5:00p	**WRAP-UP OF DAY 2** Briefly review work done today, mention tomorrow's activities; address any logistics needs for the evening	Summary	Dan Shively	Summary, wrap-up, preparation for tomorrow

DAY 3 - WEDNESDAY, July 23, 2008

Time	Topic	Main messages	Lead	Objective
8:00-8:10a	**WELCOME** • Today's objectives, agenda, and expected products • Any logistics needs	Housekeeping	Dan Shively	Welcome, orientation to the day's upcoming work
8:10-10:00a	**TASK 3: SUGGESTIONS FOR POTENTIAL AMELIORATIVE MANAGEMENT ACTIVITIES TO REDUCE ADVERSE SPECIES INTERACTIONS** • Guided panel brainstorming exercise to identify potential management actions, pertinent not only to food web interactions but also to other factors. • Is the assumption valid that bull trout introduction is reversible? • Could the bull trout population be managed at a particular size(s)?	Facilitated discussion	Dan Shively & Bruce Marcot	Develop a list of potential mitigating or ameliorative management activities to address potential adverse effects on anadromous salmonids, presuming that the proposed action will take place.
10:00-10:20a	**BREAK**			
10:20-11:00a	**SUGGESTIONS FOR POTENTIAL AMELIORATIVE MANAGEMENT ACTIVITIES (CONTINUED)** • Guided panel brainstorming exercise • Summary of results **OPEN FLOOR FOR MANAGERS AND OTHER OBSERVERS TO ASK CLARIFYING QUESTIONS OF PANELISTS**	Facilitated discussion	Dan Shively & Bruce Marcot	(as above)
11:00-11:30a	**WORKSHOP WRAP-UP AND CONCLUSION**	Wrap-up	Dan Shively, Rollie White	Summary of workshop accomplishments; return to overall flowchart of project; next steps in process

Appendix 2. Letter of invitation sent to each invited expert panelist.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oregon Fish and Wildlife Office
2600 SE 98th Avenue, Suite 100
Portland, Oregon 97266
Phone: (503) 231-6179 FAX: (503) 231-6195

Reply To: 8183.5304A
File Name: Workshop Invite D Beauchamp.doc
TS Number: 08-865

[name, address of invited expert panelist]

Subject: Clackamas River Bull Trout Reintroduction Expert Panel Meeting

Dear _____:

Thank you for agreeing to participate in the July 21-23, 2008, expert panel workshop to assess impacts of a proposed reintroduction of bull trout on federally listed salmon and steelhead in the Clackamas River, Oregon. The results of this workshop will support various decision making processes associated with a reintroduction of bull trout to the Clackamas River. The workshop will be held in Vancouver, Washington, at the Water Resources Education Center (map and directions enclosed) beginning at 1 pm July 21, ending at 12 pm July 23.

We will follow this letter with a packet of background materials that will include a draft workshop agenda, relevant sections from the Clackamas River Bull Trout Reintroduction Feasibility Assessment, a USGS publication on the Feasibility Assessment, Q&A for the project, and relevant literature. Although we intend to cover some of these items in presentations at the front end of the workshop we ask that you familiarize yourself with these materials ahead of time.

Dan Shively, Fisheries Program Leader for the Mt. Hood National Forest, will facilitate the workshop, and Dr. Bruce Marcot, research wildlife ecologist with Region 1, U.S. Forest Service will serve as a technical facilitator for all exercises involving quantitative scores or estimates. Dr. Jason Dunham, U.S. Geological Survey, who previously contacted you about the workshop, will participate on the panel and continue to serve as one of the workshop contacts for panel members.

The general format for the workshop will be as follows: Day 1 will begin with an overview of workshop goals, objectives, and methods, followed by a series of short background presentations for the panel, and end with a discussion of ecological interactions. Day 2 will focus on expert panel evaluations of species interactions using a modified Delphi paneling process entailing individual scoring, structured disclosure, discussion, Q&A and individual rescoring. The end of day 2 and most of day 3 will focus on a structured brainstorming session and panel discussion of potential monitoring activities to address uncertainty and risk associated with a reintroduction of bull trout, and suggestions for potential ameliorative activities to reduce adverse species interactions.

Per diem (food, lodging, travel) for the workshop is available from the FWS to panel members that require funding assistance. If you are not from the Portland/Vancouver area and will need accommodations, the closest hotel to the Education Center is Homewood Suites, 701 SE Columbia Shores Boulevard, Vancouver, 1-360-750-1100. In order to provide per diem we will need participants to complete several forms prior to the workshop. If you plan to seek per diem please contact our administrative assistant Diana Acosta as soon as possible at 503.231.6179. Please note that in order to accommodate air travel cost, our office will need to process your reservations.

Thank you again for agreeing to participate in the expert panel workshop. If we can be of any assistance or if you wish to discuss any aspect of the panel process, please feel free to call me at (503) 231-6179 or contact Chris Allen of my staff at the same number.

Sincerely,

Miel Corbett
Acting State Supervisor

Appendix 3. List of pre-workshop reading materials sent to each expert panelist.

A. Workshop Statement of Work (see text)

B. Draft Workshop Agenda (see Appendix 1)

C. Directions to Workshop

D. Project Question and Answer Sheet (see Appendix 4)

E. Publications

1. Shively et al. 2007. Clackamas River Bull Trout Reintroduction Feasibility Assessment (select sections most pertinent to workshop goals and objectives)
2. Dunham & Gallo, 2008. Assessing the Feasibility of Native Fish Reintroductions: A Framework and Example Applied to Bull Trout in the Clackamas River, Oregon
3. Beauchamp & Van Tassell, 2001. Modeling Seasonal Trophic Interactions of Adfluvial Bull Trout in Lake Billy Chinook, Oregon.
4. Seddon et al. 2007. Developing the Science of Reintroduction Biology

Appendix 4. Project question and answer sheet, sent to each expert panelist prior to the workshop.

Commonly Asked Questions and Answers

Possible Proposal to Reintroduce Bull Trout to the Clackamas River

Q. What action is being considered?

A. Agencies are considering whether to propose reintroducing a "nonessential experimental population" of bull trout into the Clackamas River, where they were once abundant and widely distributed.

Q. Who is working on this proposal?

A. The U.S. Fish and Wildlife Service and the Oregon Department of Fish and Wildlife in cooperation with the U.S. Forest Service. The U.S. Geological Survey is providing scientific support. Coordination on the proposal is occurring with the Confederated Tribes of the Warm Springs Reservation of Oregon.

Q. Why would this reintroduction be proposed?

A. Bull trout are a species listed as "threatened" under the federal Endangered Species Act, and the goal of that law is to recover species from being threatened or endangered to the point that they no longer need its protection. Their reintroduction into the Clackamas River is under consideration because it would meet objectives of the current Fish and Wildlife Service recovery strategy for the species in the Willamette Basin, as well as other agencies' goals to restore native fish communities.

Q. Why choose the Clackamas River for this proposal?

A. The Clackamas was considered for reintroduction even before the bull trout was listed as threatened, in years of discussion between the Forest Service and Oregon Department of Fish and Wildlife. With these two key partners already exploring the possibility, and the need expressed in the bull trout recovery plan, it was logical to continue exploring the idea. There are other appropriate locations for bull trout reintroduction, and examination of this possible reintroduction will gain knowledge and experience that can be applied elsewhere. From the bull trout's perspective, the Clackamas is a good candidate because bull trout haven't been documented there since about 1963; the factors which caused them to disappear have been remedied, and about 70 miles of the upper river and tributaries contain suitable habitat for bull trout spawning and rearing.

Q. How can a "nonessential" population contribute to recovery?

A. A nonessential experimental population would contribute to the recovery of the bull trout in the Willamette Basin, but it is not essential to the survival of the species in the wild. The designation allows for greater flexibility in managing other land uses and human activities, without the usual level of protections being given to individuals of the reintroduced species. The designation of nonessential experimental

populations [through Section 10(j)] was added to the Endangered Species Act in 1982 by Congress in order to increase the public's tolerance for putting a protected species back into an area where it had been previously.

Q. Would the agencies later want to change the nonessential population to an "essential" designation?

A. It is not likely that the Fish and Wildlife Service would propose to change the nonessential experimental population classification. Any changes that might become necessary would occur in cooperation with the State of Oregon and other affected parties and would require another federal rule-making process. The only likely change would be if the species recovers and is removed from the list of threatened and endangered species, in which case the "nonessential experimental population" designation would be eliminated as part of the delisting.

Q. What will bull trout do to salmon and steelhead in the Clackamas River?

A. Like many other native fish in the Clackamas River, bull trout will eat juvenile salmon and steelhead. They also will eat other fish which would have eaten juvenile salmon and steelhead. These predator/prey dynamics are complex, and despite the fact that these species evolved together, it is uncertain whether bull trout would have a negative, positive, or neutral effect on today's salmon and steelhead populations. Because of this, the agencies are seeking to understand the potential impacts before making the decision to propose the reintroduction. A panel of expert scientists will meet in July 2008 to answer the questions about potential bull trout effects on salmon and steelhead in the Clackamas River.

Q. How is this proposed reintroduction affected by the recent completion of the 5-year status review of bull trout?

A. The U.S. Fish and Wildlife Service completed its 5-year status review of the bull trout with two recommendations: retain threatened status for the species as currently listed throughout its range, and evaluate whether distinct population segments (DPSs) exist and merit protection under the Endangered Species Act. The first recommendation validates the science and decisions underlying this proposal. Any change resulting from the second recommendation will be well in the future, and meanwhile the reasons to continue studying this proposal remain.

Q. Would the presence of a protected species in the Clackamas River affect land management activities, like timber harvest?

A. The proposal under consideration would be to designate a "nonessential experimental population," under the authority of Section 10(j) of the Endangered Species Act, specifically to avoid restricting land management and recreational activities. Throughout the entire nonessential experimental population area, no federal agency or its contractors would be in violation of the Endangered Species Act for harming or killing bull trout as a result of any authorized agency action.

Q. What about impacts of this protected species on recreational river uses?

A. The reintroduction will not conflict with recreational uses of the river. For example, since it would be within a nonessential experimental population area, a person

fishing in accordance with Oregon angling regulations would not be in trouble for inadvertently harming a bull trout.

Q. What activities will be prohibited because of this nonessential experimental population area?

A. It remains illegal to deliberately "take" (harm or kill) bull trout, which generally would occur if they are taken or possessed in violation of state fish and wildlife laws or regulations. In other words: fishing in violation of state regulations which results in catching these fish, or polluting the waters in violation of state or federal law, could result in additional penalties for harming the fish. Fishing and other activities conducted legally will not result in penalties if they happen to result in catching or otherwise harming the fish.

Q. Is it even biologically possible to reintroduce this threatened species here?

A. A report published in 2007 by the agencies concluded that the proposal would be feasible, given what was found on habitat quality and availability, suitable donor stocks, nonnative species interactions, available prey species and threats.

Q. Where in the Clackamas River would the fish be reintroduced?

A. They would be released into historical bull trout habitat in the upper Clackamas River above the confluence with the Collawash River. This reach contains the most suitable habitat for reintroductions.

Q. When might these fish be put into the Clackamas?

A. The reintroduction could begin in the spring of 2009 and continue through the fall depending on whether the fish being moved are juvenile, subadult or adult fish. Transfer would continue annually for ten years in the first phase of the reintroduction. Transfer of fish in phase two (years 11 through 20) would be contingent on the success of phase one.

Q. How would this reintroduced population contribute to recovery of the species?

A. The reestablishment of bull trout in the Clackamas River would reduce the risk of elimination of bull trout from the greater Willamette Basin, and contribute to stabilizing bull trout populations in the lower Columbia River. The specific recovery objectives that would be supported by this action are:

- Maintain current distribution of bull trout and restore distribution where recommended in recovery unit chapters.
- Maintain stable or increasing trend in abundance of bull trout.
- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.
- Conserve genetic diversity and provide opportunity for genetic exchange.

Q. Where would the fish come from?

A. The most appropriate donor stock for the reintroduction has been determined to be from the Metolius River, in the Deschutes River Basin, a tributary of the lower Columbia River in north central Oregon.

Q. How many bull trout would be moved?

A. The potential proposed action includes the direct transfer of adult, subadult and juvenile bull trout from the Metolius River to the Clackamas River. For the first few years we anticipate transferring annually approximately 100 adults, 100 subadults, and several thousand juveniles and fry. The numbers and life stages of fish transferred annually will be linked strongly to the annual population size of the donor stock, as well as to information derived from monitoring and evaluating the success of the various life stages over the initial few years of the project.

Q. What happens after the bull trout are released in the river?

A. The Fish and Wildlife Service and partner agencies will monitor them to document survival, movement, spawning and natural recruitment. Reports will document the stocking rates and monitoring activities that took place during the previous year. Periodic progress reports will be released, and the agency will fully evaluate this reintroduction effort after phase one (ten years) is complete to determine whether to continue the project.

Q. Will the bull trout leave the area where they are released?

A. Bull trout do tend to migrate within large river systems, and some of the reintroduced fish are expected to move out of the release area on the upper Clackamas. To ensure that any reintroduced bull trout that may move are covered by the nonessential experimental population designations, the area's boundaries will extend downstream from the release areas the entire length of the Clackamas River, and include the Willamette river downstream to where it meets the Columbia River (including Multnomah Channel) and upstream to Willamette Falls. It is expected that the majority of reintroduced fish and future offspring of these fish will remain within the area boundaries. If bull trout move outside the boundaries, the Fish and Wildlife Service could propose to extend the boundaries to include the entire range of the expanded population.

Appendix 5. List of workshop attendees: invited expert panelists, meeting facilitators, workshop planning team, and observers.

Expert Panel Participants: Dave Beauchamp (UofW/USGS BRD), Jason Dunham (USGS FRESC), Kathryn Kostow (ODFW), Paul McElhany (NMFS Science Center), and Michael Meeuwig (Montana State University).

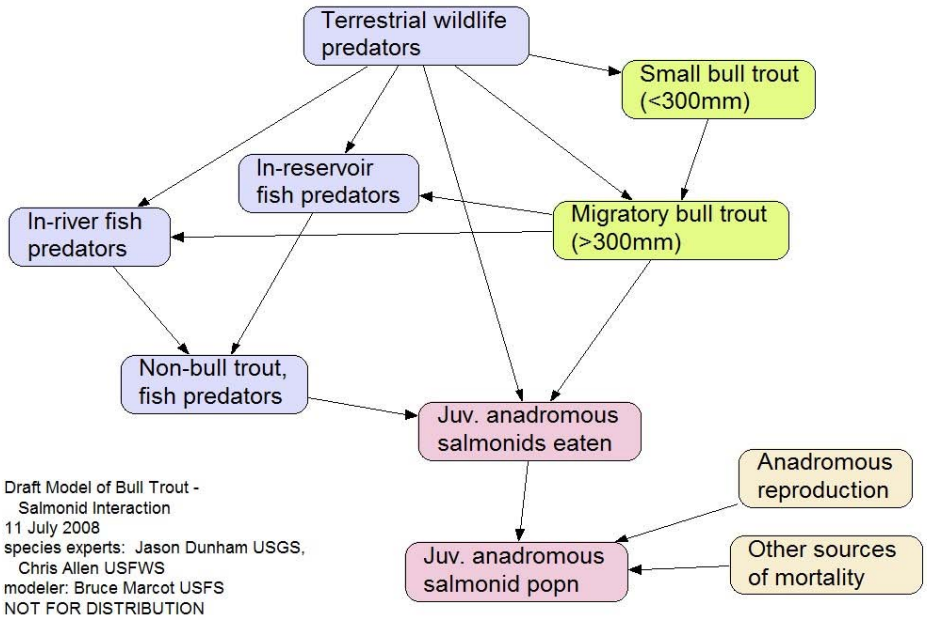
Facilitator: Dan Shively (USFS) with assistance by Bruce Marcot (USFS)

Workshop Planning Team: Dan Shively and Bruce Marcot (USFS); Rollie White, Chris Allen, and Steve Morey (USFWS); Jason Dunham (USGS)

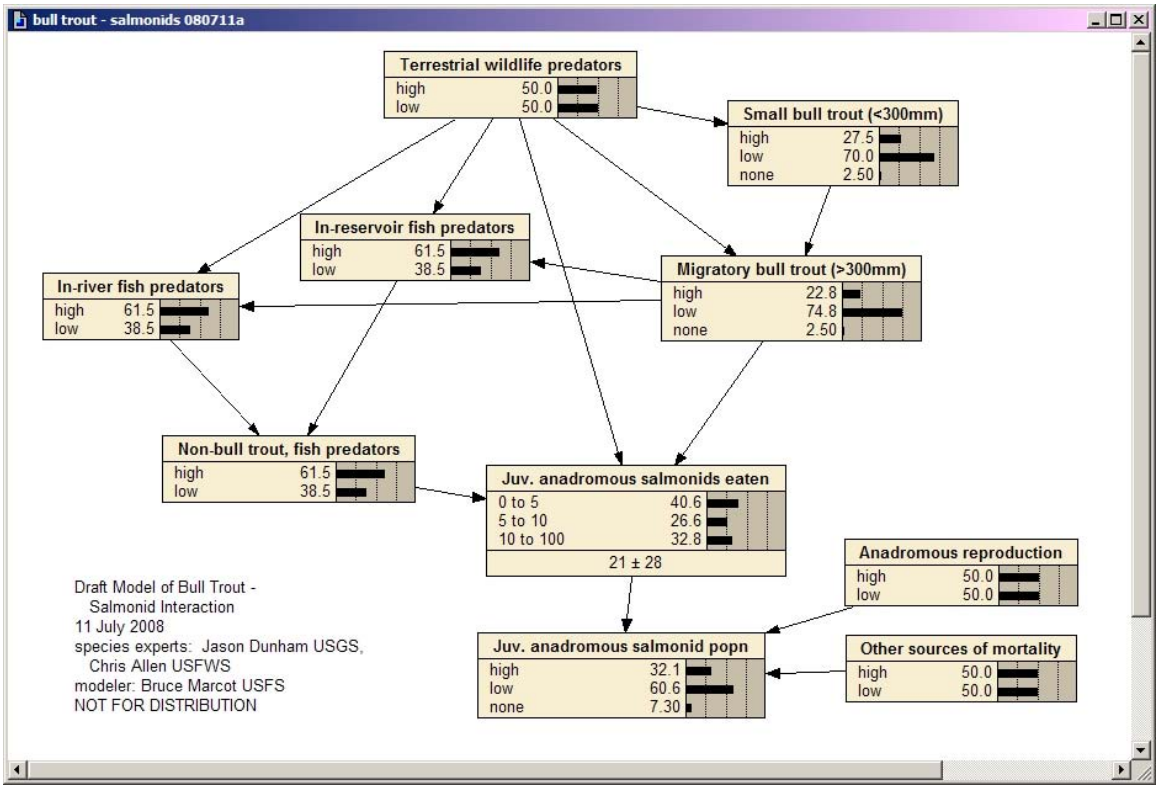
Manager Observers:
Paul Henson (FWS, State Supervisor, Oregon Fish and Wildlife Office), Miel Corbett (FWS OFWO), John Esler (PGE), Gary Larson (USFS, Mt. Hood Forest Supervisor), Chris Wheaten (ODFW, NW Regional Supervisor)

Additional Observers:
Nick Ackerman (PGE), Chris Allen (FWS OFWO), Todd Alsbury (ODFW), Jeff Boechler (ODFW), Doug Cramer (PGE), Brad Goerhring (FWS OFWO), Jen Graham (CTWSRO), Erin Lowery (UW), Rick Swart (ODFW), Rebecca Toland (FWS OFWO), Richard Turner (NOAA Fisheries), Garth Wyett (PGE), Bob Progulske (FWS OFWO).

Appendix 6. Bull trout food web model presented at the workshop by Jason Dunham and Bruce Marcot.



Influence diagram.



Bayesian network model developed from the influence diagram.

Appendix 7. Detail of expert panel methods used during the workshop.

Author: Bruce G. Marcot

This appendix provides a brief overview of concepts of expert paneling and the specific paneling methods used in the Bull Trout Expert Panel Meeting of July 2008.

On Expert Paneling

Expert judgment is often used as a source of information in the absence of, or to supplement, empirical research and statistically-sound studies. In ecology, expert judgment has always been sought for interpreting difficult or otherwise intractable problems in modeling, management, planning, and scientific understanding. Some examples include using expert opinion to evaluate an elk habitat model (Holthausen et al. 1994), to develop general faunal distribution models (Pearce et al. 2001), modeling rare species (Marcot 2006), evaluating adaptive management options (Failing et al. 2004), and many applications.

For many years, experts in particular fields of study have provided knowledge and experience that have been represented in computer expert systems. For example, Cheung et al. (2005) incorporated expert knowledge in an expert system to predict extinction probabilities of marine fishes, Crist et al. (2000) used an expert systems tool to evaluate effects of land use on biodiversity, and O'Keefe et al. (1987) developed an expert system approach to evaluating the conservation status of rivers. Many other examples are found in the literature.

One critical step in all of these examples is the soliciting and representing of expert knowledge in a reliable, repeatable, and unbiased fashion, especially from more than one expert for a particular problem. One major method for this is the conducting of panels of multiple experts in such as way as to ensure that individual and collective expertise is appropriately solicited and summarized.

Expert panels have been used extensively by natural resource and land management agencies for a wide variety of problems. Some examples include evaluating potential effects on species viability from an array of forest and land management planning options (FEMAT 1993, Lehmkuhl et al. 1997), determining the appropriate conservation status for a wide variety of potentially at-risk species under the Northwest Forest Plan (Marcot et al. 2006), developing a management plan for a national forest in Alaska (Shaw 1999), and other programs and projects.

An important consideration in seeking expert judgment from an expert panel is to clarify if consensus among all panelists is desired, or if individual judgment among the panelists is desired. Each of these objectives entails different paneling methods, results, and cautions. For example, to reach consensus among a group of individuals with disparate opinions and preferences, Hajkowicz (2008) and Bojórquez-Tapia et al. (2005) tested and

suggested use of multiple criteria analysis. To provide individual expert judgments, I have used a modified Delphi technique (Marcot 2006, Marcot et al. 2006), described in more detail below. Consensus might entail potential bias from group-think and excluding outlier opinions. Providing individual judgments might entail bias from different, individual motivations.

Reaching consensus is typically the objective of expert panels convened by the National Research Council's programs for developing criteria for contract requests for proposals. Weisberg et al. (2008) found that consensus was possible for evaluating the condition of communities of benthic substrates. However, a consensus outcome of an expert panel does not provide information on the variation in expert judgment among the individual expert panelists. Nor does it provide for "outlier" opinions from experts that might not concur with the majority views.

For the project objectives at hand, it was decided by the workshop planning team that individual expertise, not consensus, was sought as the objective of the paneling process, in large part because (1) the expert panel was to provide technical and scientific information to be later considered by decision-makers, and not specific consensus recommendations for management or a management decision per se, and (2) it was deemed of interest to determine the type and degree of variation *among* selected experts for the difficult questions posed.

Bull Trout Expert Panel Methods

Overall paneling approach

The Bull Trout Expert Panel procedure was structured as a modified Delphi paneling process. The Delphi paneling process entails a structured querying, disclosure, discussion, and revisiting of expert judgment on some focused problem of interest (e.g., see MacMillan and Marshall 2006). In addition to some of the above-cited expert paneling projects, the Delphi process has been used to assess status of wildlife species (Clark et al. 2006), to prioritize urban improvement strategies in India (Gokhale 2001), to develop habitat suitability index curves (Crance 1987), and for other ecological projects.

The standard Delphi process entails eventually reaching consensus among a panel of experts, but the modification used here (and in many previous expert panels) omits the consensus step because it was desired to obtain individual experts' input, in part to discover the range of judgment and interpretation among the experts on the panel. A consensus approach would not provide this.

Scoring of potential bull trout impacts

The specific Delphi method we used in the Bull Trout Expert Panel for scoring of potential impacts of bull trout on ESA-listed salmonids was as follows (also see Appendix 1):

1. Prior to the workshop, each expert panelist was sent a letter of explanation (Appendix 2) along with pre-meeting reading material (see Appendix 3 for list).

The purpose was to ensure that the panelists understood the nature of the questions and the general paneling methods to be used in the meeting, and would all come prepared with having studied the same background material.

2. At the workshop, a series of focused presentations was provided by various experts (some of the presentations by some of the panelists) on various key topics of the Clackamas River system, its dam management structure, and biology and ecology of salmonids (see Appendix 1 for presentation topics).

The purpose of these presentations, as with the pre-meeting reading material, was to ensure that all expert panelists were brought up to the same, common level of understanding of these key topics, that is, bring them to parity, so when they score outcomes they have all been equally informed on the major background information.

3. In preparation for the panel scoring exercise, during the workshop the scoring worksheet format and key terms and definitions were reviewed so that all panelists would understand and interpret the intent and terminology in the same ways.

The overall purpose of steps 1-3 is to reduce or eliminate bias from variation in their understanding of the ecological and environmental context and terminology, and of scoring methodology. The aim is to ensure that whatever variation may result among the panelists' scores and contributions would be principally from their individual ecological interpretations and expertise.

4. The panelists were then asked to provide initial scores of the potential degree of impact of bull trout on the 4 ESA-listed salmonids in the Clackamas River system. See Appendix 8 for the score sheet used.

The scoring was explicitly to be made on the assumption that bull trout reintroduction objectives are met (that is, at least 200-500 adult bull trout would be sustainably present in the Clackamas River system by 2030). The scoring was done by having each panelist spreading 100 points among one or more possible impact outcome categories (ranging None to Very High), for each of the four salmonids (Spring Chinook, Fall Chinook, Coho, and Winter Steelhead). This first round of scoring was done individually, in silence, without interaction and discussion.

5. Next, the panelists engaged in structured disclosure and discussion.

One by one, each panelist was asked to disclose their scoring for each salmonid and explain why they scored as they did. After this structured disclosure, they engaged in more open discussion on their rationale, including how they considered and weighed various factors in their scores. The discussion was followed by then allowing the panelists to ask questions of the observers and other experts in the room. The overall purpose of structured disclosure and discussion was to allow each panelist to learn from reach other, to bring out their best efforts and broadest judgments of all information and considerations.

6. The panelists then engaged in a second, final round of silent scoring, which constituted their final expert contribution on degree of impact. The panelists were also asked to describe, in words on their score sheet, their rationale for why they scored as they did, that is, to denote and describe which main environmental, biological, or ecological factors they considered and weighed in their scoring decisions.

Note that, between steps 4 and 6, the panelists suggested expanding the initial 5-category classification of impact to a 7-category classification, as follows:

Very High = bull trout influence contributes to 100% of the extinction probability
High = bull trout influence contributes to about 95% of the extinction probability
Moderately High = bull trout influence contributes to about 75% of the extinction probability
Moderate = bull trout influence contributes to about 50% of the extinction probability
Moderately Low = bull trout influence contributes to about 25% of the extinction probability
Very Low = bull trout influence contributes to about 5% of the extinction probability
None = bull trout influence has no contribution to the extinction probability

The panelists wanted to be able to more precisely denote possible impacts in the range between None and Moderate; this modification permitted this, and all panelists concurred with this change and felt more comfortable using it for their second round of scoring.

7. Results of the final scores were then presented back to the panelists (Appendix 9) for their information and interpretation (using Excel on a laptop computer projected to a screen).

Potential monitoring activities

The panelists were then quizzed, using a structured brainstorming paneling method, to provide ideas on potential monitoring activities and metrics, again presuming that the bull trout reintroduction program would go forward. The structured brainstorming approach took the form of individually asking each panelist in turn to suggest their "top two" monitoring topics and metrics, without repeating or critiquing what a previous panelist might have suggested; and going around the panel as many times as they felt necessary to provide ideas. Panelists were allowed to "pass" after the first round if they felt that their main ideas had already been suggested and added to the list, which was presented on screen.

The panelists then engaged in an open discussion to refine their list of potential monitoring activities, that is, to exclude, combine, or split out some suggestions. They also provided information on each monitoring activity's overall objective, theme, and duration or frequency (see Appendix 10).

The panelists were then given printouts of the final list of monitoring activities, and asked to score each activity on a 3-class priority scale: 1 = essential to conduct, 2 = important

but not necessarily essential, and 3 = worthwhile but of lower importance. They provided these scores individually in silence (just as they had done the scoring of potential bull trout impact on each salmonid, in the previous exercise).

Their scores were then entered into the spreadsheet; sums, means, and ranges of their scores were calculated; and the monitoring activities were then sorted by on increasing sum scores and then increasing mean scores. This resulted in a final list of suggested monitoring activities sorted by decreasing priority (Appendix 10).

Potential management activities

The expert panelists were then asked to provide ideas on potential management activities that could be considered, should the bull trout reintroduction program go forward *and* it be found that there was unacceptably adverse effects on the salmon and steelhead populations. The panelists provided ideas on such potential management activities again in a structured brainstorming process as described above. The panelists also specified the type and degree of adverse impact and the overall management theme to which potential management activity pertained.

The panel then was asked to engage in an open discussion to revise and refine their list of potential management activities, that is, to exclude, combine, or split out some suggestions. The final list was then sorted by management theme (Appendix 12).

Additional panel activities

The workshop agenda also provided, at the end of the sessions, each panelist to offer any comments of interpretation, caution, recommendation, or any other statement, and to interact more freely with all observers and managers in the room.

The expert panelists were also given an opportunity to review the content of the note taker's summary of each of their main comments (see Appendix 11) to ensure that what is presented in this report correctly captured their statements during the workshop.

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Appendix 8. Worksheet used by the expert panelists to score potential impacts from bull trout on each of the 4 ESA-listed salmonids in the Clackamas River system.

Panelist code: _____
Date: _____

TASK 1: DEGREE OF IMPACT

Assume that bull trout reintroduction objectives are met (that is, at least 200-500 adult bull trout sustainable by 2030). Now, **what are the impacts from bull trout on ESA-listed salmon and steelhead populations?**

Spread 100 points among one or more cells in each column (the spread of points represents your degree of predictability for each species); score each species independently.

Key: Round 1 / Round 2

Degree of impact	Spring Chinook	Fall Chinook	Coho	Winter Steelhead
Very High	/	/	/	/
High	/	/	/	/
Moderately High	/	/	/	/
Moderate	/	/	/	/
Moderately Low	/	/	/	/
Very Low	/	/	/	/
None	/	/	/	/
Total	100 / 100	100 / 100	100 / 100	100 / 100

Very High = bull trout influence contributes to 100% of the extinction probability
High = bull trout influence contributes to about 95% of the extinction probability
Moderately High = bull trout influence contributes to about 75% of the extinction probability
Moderate = bull trout influence contributes to about 50% of the extinction probability
Moderately Low = bull trout influence contributes to about 25% of the extinction probability
Very Low = bull trout influence contributes to about 5% of the extinction probability
None = bull trout influence has no contribution to the extinction probability

Overall rationale for your scoring across all species – *denote only for Round 2*
Check all that apply to your scoring:

- Refer to food web diagram
- Role of reservoirs in juvenile rearing of salmonids
- Migratory timing of salmonids
- Spatial and temporal habitat use by predatory bull trout
- Predator aggregations caused by in-stream structures
- Current abundance and recent trend of each salmonid species
- Other: _____

Appendix 9. Results of the expert panel scoring of degree of impact of bull trout on extinction probabilities of ESA-listed salmon and steelhead populations. See Appendix 8 for worksheet used.

Panelist A

Degree of impact	Spring Chinook	Fall Chinook	Coho	Winter Steelhead
Very high	0	0	0	0
High	0	0	0	0
Mod. high	5	0	5	10
Moderate	20	0	25	40
Mod. low	50	5	40	30
Very low	20	5	20	15
None	5	90	10	5

Panelist B

Degree of impact	Spring Chinook	Fall Chinook	Coho	Winter Steelhead
Very high	0	0	0	0
High	0	0	0	0
Mod. high	5	0	5	5
Moderate	10	0	10	10
Mod. low	45	10	45	45
Very low	35	40	35	35
None	5	50	5	5

Panelist C

Degree of impact	Spring Chinook	Fall Chinook	Coho	Winter Steelhead
Very high	0	0	0	0
High	0	0	0	0
Mod. high	0	0	0	0
Moderate	0	0	0	0
Mod. low	5	5	5	5
Very low	35	10	35	20
None	60	85	60	75

Panelist D

Degree of impact	Spring Chinook	Fall Chinook	Coho	Winter Steelhead
Very high	0	0	0	0
High	0	0	0	0
Mod. high	0	0	0	0
Moderate	0	0	0	0
Mod. low	30	15	45	40
Very low	65	65	45	50
None	5	20	10	10

Panelist E

Degree of impact	Spring Chinook	Fall Chinook	Coho	Winter Steelhead
Very high	0	0	0	0
High	0	0	0	0
Mod. high	0	0	0	0
Moderate	5	0	5	5
Mod. low	45	25	30	40
Very low	35	25	55	40
None	10	50	10	10

SUM OF ALL PANELIST SCORES

Degree of impact	Spring Chinook	Fall Chinook	Coho	Winter Steelhead
Very high	0	0	0	0
High	0	0	0	0
Mod. high	10	0	10	15
Moderate	35	0	40	55
Mod. low	175	60	165	160
Very low	190	145	190	160
None	85	295	95	105

No. of panelists: 5

MEAN SCORES

Degree of impact	Spring Chinook	Fall Chinook	Coho	Winter Steelhead
Very high	0	0	0	0
High	0	0	0	0
Mod. high	2	0	2	3
Moderate	7	0	8	11
Mod. low	35	12	33	32
Very low	38	29	38	32
None	17	59	19	21

RANGE OF SCORES (MAX-MIN)

Degree of impact	Spring Chinook	Fall Chinook	Coho	Winter Steelhead
Very high	0	0	0	0
High	0	0	0	0
Mod. high	5	0	5	10
Moderate	20	0	25	40
Mod. low	45	20	40	40
Very low	45	60	35	35
None	55	70	55	70

Appendix 10. Potential monitoring activities identified by the expert panel, listed in decreasing order of mean priority. \1

					Panelist								
	Objective	**Monitoring theme**	**When**	**Brief description, metric**	**A**	**B**	**C**	**D**	**E**	**Sum**	**Mean**	**Range**	**Comment**
1	predator status	predator abundance & reproduction	annual	bull trout reproduction and recruitment, e.g., spawning surveys, age, and size	1	1	1	1	1	5	1	0	
2	trophic interactions	consumption	baseline & periodic	estimate rates of consumption of food by bull trout	1	1	1	1	1	5	1	0	tied with item 6
3	predator status	bull trout size structure	periodic	monitor size structure of bull trout in reservoir and river environments	1	1	1	2	1	6	1.2	1	
4	prey status	prey abundance & productivity	annual	smolt and adult abundance, size, and age of the 3 listed species at North Fork Dam	1	1	2	1	1	6	1.2	1	some redundancy re: adults w/ 5
5	prey status	prey abundance & productivity	annual	juvenile and adult abundance & size structure of the 3 listed species above the North Fork Reservoir	1	1	1	1	2	6	1.2	1	some redundancy re: adults w/ 4
6	trophic interactions	trophic interactions	baseline & periodic	monitor diet & stable isotopes of fish and key invertebrates to identify major predators (fish & others) of salmonines and other fishes (determine food web)	1	1	1	1	2	6	1.2	1	tied with item 2
7	predator status	demography	baseline & periodic	life stage and habitat-specific survival estimation of bull trout	1	1	2	2	2	8	1.6	1	
8	predator status	fish habitat selection	baseline & periodic	habitat selection by predator, probability of habitat use	2	2	1	2	1	8	1.6	1	
9	prey status	species abundance	baseline & annual	monitor Coho, Chinook, & winter steelhead abundance in nearby, adjacent basins, for reference both marine and other common freshwater effects	2	2	2	1	1	8	1.6	1	

	Objective	Monitoring theme	When	Brief description, metric	Panelist A	B	C	D	E	Sum	Mean	Range	Comment
10	trophic interactions	spatial and temporal variation in distribution of species	baseline & periodic	general surveys; over time for temporal variation; seasonally; all aquatic species	1	2	2	1	2	8	1.6	1	"all aquatic species" includes inverts & other taxa; contributes to 6
11	environment	reservoir limnology	~monthly	monitor temp & zooplankton	1	2	3	1	2	9	1.8	2	
12	predator status	age and growth	baseline & periodic	age and growth of all predators	1	1	2	2	3	9	1.8	2	
13	prey status	demography	baseline & periodic	life stage and habitat-specific survival estimation of all prey species	1	2	2	2	2	9	1.8	1	
14	prey status	fish habitat selection	baseline & periodic	habitat selection by prey, probability of habitat use	3	2	2	2	1	10	2	2	
15	prey status	fish use of reservoir	annual or periodic	hydroacoustic survey in reservoir to determine fish species abundance and distribution	2	2	2	3	1	10	2	2	this item is a subset of 10
16	trophic interactions	bull trout movement	periodic	tracking of bull trout movement through the basin, esp. if below the dam, to better understand interaction with prey species	2	2	2	3	1	10	2	2	
17	environment	habitat	baseline & periodic	monitor habitat to determine environmental correlates to better understand potential species interaction	3	2	3	2	3	13	2.6	1	
18	prey status	prey behavior	periodic	monitor of behavior of prey species, microhabitat selection diel activity	3	2	3	2	3	13	2.6	1	
19	predator status	angler catch of bull trout	annual or periodic	monitor angler catch of bull trout	3	3	3	3	3	15	3	0	

\1 Priority scoring: 1 = essential to conduct; 2 = important but not necessarily essential; 3 = worthwhile but of lower importance.

Appendix 11. Written explanatory notes and discussion comments from the five expert panel participants, recorded from their scoring of bull trout impacts and listing of potential monitoring activities.

These notes include any hand written notations, clarifications, comments, justifications etc.. made by individual panelists on their scoring forms.

Task #1 refers to the panelists scoring the potential effect of reintroduced bull trout on the four existing ESA-listed salmonid species in the Clackamas River system. Task #2 refers to potential monitoring activities. (See Appendix 7 for explanation of how these panel tasks were conducted.)

Panel Member A

Task #1 Notes:

Panelist A noted that for this exercise he/she assumed a population of 500 adult bull trout in the Clackamas River (this is the top end of our 200 to 500 fish goal as stated in background presentations from day 1 of the workshop).

Overall Rationale: Panelist A circled all bullets on score sheet and included additional information in italics below:

Refer to food web diagram: *all species*
Role of reservoirs in juvenile rearing of salmonids: *zooplankton during fall and late spring, insects during winter & early spring. Spring Chinook & Coho reportedly immigrate into the reservoir in fall and remain until outmigration in late spring*
Migratory timing of salmonids: *Spring Chinook & Coho vulnerable during migration into reservoir & chronic exposure in reservoir.*
Spatial and temporal habitat use by predatory bull trout: *fraction of subadult and adult bull trout use reservoir during fall through spring, adults move into river in summer, subadults stay in reservoir or go upstream.*
Predator aggregations caused by in-stream structures:
Current abundance and recent trend of each salmonids species:
Other: *Temporal patterns in thermal regime in both stream and reservoir (include vertical profile) will determine the degree of spatial-temporal overlap between predatory bull trout and juvenile salmonids. A cooler and less stratified reservoir will increase predation due to increased spatial-temporal overlap of predators and prey.*
Other: *Relative availability of juvenile salmon and steelhead compared to other forage fish among seasons & between river & reservoir habitat. If juvenile salmonids are the predominant fishes in the reservoir, they will absorb nearly all of the predatory impact by bull trout.*

Task #2 Notes:

In the 3rd row of the scoring sheet, under the column header "Brief description, metric", Panelist A crossed out "…all predators" and replaced with "bull trout".

The same thing was done 3 cells below the previous edit. The panelist crossed out "all predator species" and replaced with "bull trout".

Panel Member B

Task #1 Notes:

Panelist B provided the following rationale for his/her scoring:

- Spring Chinook, Coho & winter steelhead all scored the same because all share time and space with bull trout. No compelling data to conclude one species more vulnerable than another.
- Fall Chinook most likely no impact on risk, little likelihood of significant overlap in time and space.
- For spring Chinook, Coho & steelhead, most likely moderate-low, or low. Bull trout likely to prey on salmon and have some impact but not high relative to other threats. Bull trout part of historical ecosystem; should be able to coexist.
- A few points allocated to moderate & moderate-high risk category because there is possibility of worst case scenario of large artificially high bull trout population in reservoir that eat lots of salmon (analogous to terns in the Columbia). Species translocations have a history of going awry.

Task #2 Notes:

Panelist B noted the following:

- All his/her priority 1 tasks are needed for crisis monitoring
- All his/her priority 2 tasks are needed to understand and manage interactions (e.g. if you want to try to change the environment to reduce interactions). Also priority 2 tasks are generally needed to estimate food webs.
- Circled items are needed to estimate consumption rates (panelist circled 6 rows associated with monitoring activities – rows 3, 5, 6, 13, 17& 19).

Panel Member C

Task #1 Notes:

On the scoring sheet where the "Degree of impact" definitions were provided, Panelist C suggested inserting "biologically significant" into the definition of "None" so that it reads "bull trout influence has no *biologically significant* contribution to the extinction probability.

Panelist C also inserted 2 footnotes in the "Very High" definition. One footnote read: "Relative not absolute extinction probability, threats." The other footnote read: "Consider entire life cycle"

Panelist C provided the following rationale for his/her scoring: "I considered bull trout in the context of 1) the entire Clackamas River and threats therein, and 2) in the context of threats to salmon throughout their life cycle from freshwater to marine habitats and back. In this view I see "moderate" (50% of the risk) to represent a huge fraction of the risk that is not likely to be accounted for by any single variable. The category of "None" was not interpreted as zero, but rather, not biologically significant. Overall given the wide array of known problems with anadromous species & existing threats, the latter seem to loom much larger than I could easily imagine coming from bull trout alone. I erred on the side of caution in according more of the extinction risk to bull trout. Furthermore, I did not consider potential positive effects of bull trout on salmon (e.g. consumption of other predators) that are possible."
Task #2 Notes:

Panelist C provided only one note on the Task #2 scoring sheet and that was to cross out "all predators" and replace with "bull trout" in row 17 under the column header "brief description, metric".

Panel Member D

Task #1 Notes:

Under the "Rationale" portion of the scoring sheet, Panelist D circled the following categories (from the task #1 scoring sheet) that applied to his/her scoring:

Refer to food web diagram:
Role of reservoirs in juvenile rearing of salmonids:
Migratory timing of salmonids:
Spatial and temporal habitat use by predatory bull trout:
Current abundance and recent trend of each salmonids species:

Panelist D provided the following additional rationale:

"Ocean conditions, as well as other factors including passage and non-bull trout predators, likely contribute to population abundance of the anadromous salmonids in question. These topics were outlined in the feasibility assessment. The reintroduction of bull trout would likely result in some added mortality to anadromous salmon, specifically small size-class individuals; however, the variety of other factors influencing population extinction probability of these anadromous salmonids outweigh the influence of an introduced bull trout population, in my opinion. Data suggest that bull trout are opportunistic predators; therefore bull trout may key-in on a certain salmonid prey species when abundant, but may favor other prey sources in the system (e.g. sucker species) in years of low salmon abundance. That is, bull trout will likely not select for anadromous salmonids in years that they are of low abundance (they will likely switch to other prey species)."

Panelist D provided additional rationale for scoring across species:

- Food web diagram: Abundant linkages, prey items, and predators other than bull trout should spread predation risk across many components of the food web, especially for an opportunistic predator.
- Role of reservoir: Bull trout will likely use the reservoir and prey on anadromous salmon but other species (e.g. sucker) may provide a forage base for bull trout.
- Migratory timing: The spatial and temporal overlap of piscivorous bull trout and potential anadromous salmonid prey is a very important question that should be addressed, variability in this overlap added to a large degree in the uncertainty of my scoring.
- Recent trends of salmonids species: Trends in anadromous salmonids are often tied to ocean conditions. This is likely a large contributor to the extinction probability of the species in question and in my opinion outweigh the potential influence of an introduced predator with a shared evolutionary history.

Task #2 Notes:

Panelist D stated that "tracking of bull trout movement through the basin, especially if below the dam, to better understand interaction with prey species" was ranked low (he/she ranked it a 1) because this activity was redundant, although at a finer resolution, with the activity "general surveys; over time for temporal variation; seasonally; all aquatic species" (he/she ranked this a 3). The two activities referred to in Panelist D's notes are from rows 16 and 18 from the Task #2 scoring sheet.

Panel Member E

Task #1 Notes:

Panelist E provided the following scoring rationale that they termed "Contributing Factors" by species on the back of Task #1 score sheet. He/she also provided scoring by percentages by species on the back of the sheet but these numbers correspond to the scoring in the table on the front of the score sheet.

- Spring Chinook: smaller size; higher spatial overlap; yearling/sub yearling duration of vulnerability; relatively abundant now
- Fall Chinook: very small; lower river, no spatial overlap unless bull trout move down river; subyearling short duration of vulnerability; very low abundance now.
- Coho: moderately small; may be preferred; modest spatial overlap; yearlings, but maybe some 2-year olds?; relatively abundant now.
- Winter Steelhead: small to large; modest spatial overlap, but may increase as fish rear; long period of vulnerability (2-3 years); modest abundance now.

Task #2 Notes:

Panelist E provided the following statement at the bottom of the score sheet: "Having problems with "all predators" versus "bull trout". "Some of these are higher priority for bull trout then for all predators or all aquatic species". "Agree with changes to bull trout – use those scores".

For several rows (6 & 17), it appeared Panelist E provided two scores; one score if considering just bull trout, and another if considering all predator species.

Panelist E scored row 18 as a 2 but penciled in the following comment in the margin: "might be higher for some species".

Appendix 12. Potential management activities identified by the expert panel, for reducing or eliminating unacceptable impacts of bull trout on salmon and steelhead populations, sorted by management theme.

Type, degree of impact	**Management theme**	**Brief description of activity**
High to very high impact from bull trout on other listed salmonids	Monitoring	Confirm type and degree of impact by collecting better data; improved or more intensive monitoring; to determine if indeed there is an impact so stated
Other threats	Offset impacts of bull trout	Deal with the lower river; mitigate threats to anadromous salmonids in Lower Clack River
All impact levels of bull trout predation on salmonids	Offset impacts of bull trout	Put more management emphasis to address other H and non-native fish species impacts on listed salmon on the Clack. River to offset possible bull trout predation effects
High to very high impact from bull trout on other listed salmonids	Predator control	Bull trout removal in toto, or maintain bull trout population at lower specified level
Moderate to high bull trout predation on salmonids	Predator control	Targeted eradication of bull trout on particular size classes; through public angling or fisheries managers
Moderate to high bull trout predation on salmonids	Predator control	Targeted eradication of bull trout redds to reduce the population
Predation on fall Chinook and chum on lower river	Predator control	Control downstream movement of bull trout at North Fork Dam
Moderate to high bull trout predation on salmonids	Predator control	Stop introducing bull trout; observe effects (passive)
All impact levels of bull trout predation on salmonids	Prey enhancement	Enhance 3 listed prey populations by increasing habitat capacity throughout the range of the populations (including areas below North Fork Dam), and increasing survival of prey populations
All impact levels of bull trout predation on salmonids	Prey enhancement	Ensure healthy mountain whitefish populations and other native resident fish species by increasing habitat capacity throughout the range of the populations and increasing their survival; the purpose is to provide a stable alternative prey base for bull trout
Predation by bull trout on juvenile salmonids in tributary habitats	Prey management	Add refuge cover in tributary habitat; habitat enhancements to reduce predation
Predation in reservoir	Prey management	Trap outmigrating smolts and physically move them below the reservoir
All impact levels of bull trout predation on salmonids	Prey management	Reservoir management to increase populations of other non-salmonid prey items

All impact levels of bull trout predation on salmonids	Prey management	Hatchery rainbow trout management in North Fork Reservoir: increase or decrease stocking levels or sizes of fish dependent on results of the baseline food web monitoring
All impact levels of bull trout predation on salmonids	Prey management	Focused supplementation of salmon carcasses in areas known to be forage hot spots if determined
All impact levels of bull trout predation on salmonids	Prey management	Facilitate upstream lamprey passage at North Fork Dam
All impact levels of bull trout predation on salmonids	Prey management	Add wood or structure to the reservoir and inlet channel as refuge habitat for prey species
Noncompliance with fishing regulations	Public management	Enhance law enforcement controls on enforcing fishing regulations in upper basin
Social impact	Public perception	Public conservation education about bull trout reintroduction objectives
Time and area of acute predation	Reservoir management	Adjust flow regime, or engineering to guide smolts to bypass system more quickly
Thermal impacts on trophic interactions	Reservoir management	Water management to adjust the thermal structure/productivity of reservoirs