

# Pacific Northwest Aquatic Monitoring Partnership (PNAMP)

## Management Question Survey Summary Report



## Pacific Northwest Aquatic Monitoring Partnership

April 2007

Pacific Northwest Aquatic Monitoring Partnership

## **Acknowledgements**

PNAMP would like to thank all those who were involved in the Management Question Survey, either in the planning and implementation process or in completing the survey for the regional entities: Greg Delwiche (BPA), Dave Johnson (NPT), Jay Hesse (NPT), Joe Peone (CCT), Bill Towey (CCT), Jerry Marco (CCT), Michael Newsom (USBR), Ken Dzinbal (WDE), Bruce Crawford (WIAC), G. Witt Anderson (USACE), Paul A. Ocker (USACE), Al Doelker (BLM), Scott Downie (CDFG), Kevin Shaffer (CDFG), Sharon Kiefer (IDFG), Steve Yundt (IDFG), Sam Sharr (IDFG), Greg Pettit (ODEQ), Paul Ward (YN), David Fast (YN), Charlie Corrarino (ODFW), Dave Ward (ODFW), George Nandor (ODFW), Jeff Rodgers (ODFW), Chris Drivdahl (WGSRO), Steve Leider (WGSRO), Jim Golden (USFS), Linda Goodman (USFS), Linda Ulmer (USFS), Ronald E. Kirby (USGS), Rob Walton (NOAAF), Mike Crouse (NOAAF), Russell Scranton (NOAAF), Cathy Tortorici (NOAAF), Kim Kratz (NOAAF), Chris Jordan (NOAAF), Dave Powers (EPA), and Gretchen Hayslip (EPA). PNAMP would especially like to acknowledge the significant contribution of Amy Braatz, USGS, to the completion of this report.

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## **Executive Summary**

The identification of key management questions and their associated information needs helps define the scope and priorities of Research, Monitoring and Evaluation (RM&E) programs and projects that support aquatic habitat and fish mitigation and restoration programs in the Pacific Northwest (PNW). This survey of management questions intended to obtain agency-specific confirmation that these are the key fish and aquatic habitat management questions of common interest to entities in the PNW region, and to identify the relative importance of these questions and the spatial scale of importance. One of the key objectives for the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) is to identify regional monitoring activities (projects and programs) for additional RM&E coordination and planning needs.

Eighteen responses were received by September 1, 2006. Of these, three agencies responded with comments or additional questions only and did not complete the questionnaire: US Geological Survey, Environmental Protection Agency and NOAA Fisheries. These three agencies indicated a support for this process and interest in the outcome, but that priorities were set outside the agency and that it was not appropriate for them to respond. Of the 15 entities that attempted the survey, not all management questions were assessed, as each individual entity has unique mandates and responsibilities that do not necessarily encompass all aspects of resource management. Thus, there are a number of “non-response” elements in the results.

Of the state, federal, tribal, and regional entities that received the survey, 51% responded, consisting of only federal, state, and tribal groups. Using the main questions, most respondents placed a high value of importance and funding for both anadromous and resident fish in the Tributary Habitat Management section. In contrast, the Predator Management section received the fewest high importance responses and the fewest funded responses for anadromous fish. For resident fish, Harvest Management and Predator Management received the least amount of high importance and the greatest amount of low importance. Due to the duplication of main question 20 regarding predators, no question referenced invasive species and therefore responses to question 21 were omitted and we reference the section as Predator Management from here forward. Several entities noted the importance of invasive species in their comments and we regret we did not address this issue in the survey.

Between anadromous and resident fish, anadromous fish garnered a higher frequency of high importance, funding, and number of entities who responded. Some entities that consistently indicated “high importance” and funding for anadromous fish are: US Army Corps of Engineers, Bonneville Power Administration, Colville Confederated Tribes, and Oregon Department of Environmental Quality. Between each agency however, the definition of resident fish varied and may have influenced the variability in responses. Overall, anadromous fish were ranked with a higher value of importance, were funded more often, and garnered more responses than resident fish in the survey. When examining the primary and secondary questions, few trends stood out. For both anadromous and resident fish, the responses to the secondary questions closely followed the trends of the response to the primary questions.

The survey intended to identify existing agreements to fund work related to these management questions. Presence of funding does not measure the effectiveness of money spent. We did not attempt to characterize if funding is inadequate (or insignificant) or if funding is exaggerated or overlapping. We do anticipate that the results of this survey will facilitate conversations to those ends. Survey responses regarding funding varied; at least one entity noted they responded with a “yes” in the funding column if they spent money on the specific subject, but noted most money came from other institutions (e.g. Bonneville Power Administration or grants).

PNAMP felt it was important to document resource management questions of interest to the Pacific Northwest and, specifically, receive input as to the relative importance of specific questions for different management entities. This survey of management questions, along with PNAMP’s efforts to identify shared monitoring principles, objectives, needs, and opportunities, was intended to ultimately lead to greater coordination of aquatic monitoring across the Pacific Northwest.

PNAMP anticipates the information from this survey will be used to facilitate and inform the coordination of ongoing regional efforts, prioritization of project funding, prioritization of technical efforts to develop RM&E approaches, and in the development of cost-sharing agreements for common RM&E needs. These activities directly and indirectly support various needs, including the state, federal, and tribal monitoring activities related to the ESA, the Columbia Basin Fish and Wildlife Program under the Power and Conservation Act, the

Northwest Forest Plan, and other monitoring programs under the purview of governmental and non-governmental organizations.

PNAMP looks forward to facilitating communication among its partners and others in the region so that the information gathered via this survey may be instrumental in improving aquatic resource monitoring in the Pacific Northwest.

## **Introduction and Background**

The identification of key management questions and their associated information needs helps define the scope and priorities of Research, Monitoring and Evaluation (RM&E) programs and projects that support aquatic habitat and fish mitigation and restoration programs in the Pacific Northwest (PNW). Identifying information needs jointly across multiple parties and regional programs can facilitate the integration and cost-sharing of these programs for more robust and cost-effective information targeting common needs. The Pacific Northwest Aquatic Monitoring Partnership (PNAMP), the Coordinated Systemwide Monitoring and Evaluation Project (CSMEP; a project within the Columbia River Basin Fish and Wildlife Program), and federal and state RM&E Programs, have all identified the development of management questions as a key first step for both designing and coordinating RM&E projects and programs. Key management questions have been developed under all of these ongoing efforts and have been reviewed by various technical and policy level groups. The result of this collaborative work is the list of Management Questions (Table 1) used for the PNAMP survey.

This survey of management questions intended to obtain agency-specific confirmation that these are the key fish and aquatic habitat management questions of common interest to entities in the PNW region, and to identify the relative importance of these questions and the spatial scale of importance. In addition, the survey asked if information specific to these questions is currently being funded. The information from this survey could be used by PNAMP partners and others to facilitate and inform the coordination of ongoing regional efforts, prioritization of project funding, prioritization of technical efforts to develop RM&E approaches, and in the development of cost-sharing agreements for common RM&E needs.

In November 2005, members of the same agencies and tribes may have participated in the CSMEP survey of management questions that was targeted at information needed to prioritize CSMEP work efforts. In order to fully capture information about management priorities, we asked for further participation in this similar survey. PNAMP goals are to identify regional monitoring activities (projects and programs) for additional RM&E coordination and planning needs. This additional more detailed monitoring survey was initiated in February 2006 and results received by September 1, 2006, are summarized in this report.

The PNAMP partners have agreed that these are critical pieces of information for the coordination and development of regional RM&E programs that support our common management goals and objectives. It is the intent of PNAMP to use the results of this survey to facilitate coordination and collaboration of RME activities desired by PNAMP partners.

Table 1.— List of Management Questions and Sub-questions included in 2006 PNAMP Management Question survey. This list is the result of collaborative work within PNAMP, the federal RME process, and other regional collaborative efforts.

- Q1. Are fish populations meeting population level objectives under federal or state mandates?
- a. What is the size of adult anadromous and resident fish populations?
  - b. What is the distribution of fish populations?
  - c. What is the population growth rate of fish populations?
  - d. What is the freshwater productivity of fish populations?
  - e. What is the age structure of fish populations?
  - f. What fraction of the spawners of fish populations is of hatchery origin?
  - g. How frequently do fish spawn?
  - h. What life history types make up different populations?
  - i. Are escapement or population size goals for ESU or DPS population groupings adequately defined and being met?
- Q2. Are aquatic, riparian, and upland ecosystems being degraded, restored or unchanged relative to desired conditions or objectives?
- a. What is the biological condition of spawning and rearing habitat for fish populations?
  - b. What is the physical condition of spawning and rearing habitat for fish populations?
  - c. What is the water quality in spawning and rearing habitats for fish populations?
- Q3. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives?
- a. Did all tributary habitat actions in aggregate for a fish population increase juvenile survival or adult abundance, compared to a similar fish population with few or no habitat actions?
  - b. What contribution did all tributary habitat actions for a fish population make toward increasing the population growth rate?
  - c. Did a single tributary habitat action increase local fish abundance or distribution, or improve local environmental conditions, compared to a similar control or reference site?
  - d. Did some classes of actions (e.g., riparian restoration actions) perform better than other classes (e.g., passage improvement actions) in improving localized conditions or sub-population juvenile survival rates?
- Q4. What are the limiting factors or threats preventing the achievement of desired habitat or fish performance objectives?
- a. What is the relationship of habitat processes and functions of upslope, riparian, and aquatic systems to biological and environmental habitat attributes?
  - b. What is the relationship of habitat attributes, processes, and/or functions to fish and wildlife abundance, productivity, and diversity?
  - c. Are there delayed mortality effects of tributary habitat conditions for migratory fish?

- Q5. Are salmon and steelhead meeting juvenile and adult hydro passage performance objectives?
- Are smolts achieving survival standards prescribed in the NOAA Biological Opinions?
  - Are adults achieving survival standards prescribed in the NOAA Biological Opinions?
- Q6. What is the magnitude of post release mortality or stress associated with transporting smolts?
- Under what conditions does in river passage yield higher Smolt to Adult Ratios (SAR) than transport?
  - Is transport appropriate for some locations and not others?
- Q7. Do fish migrating in-river through the hydro system incur delayed mortality?
- What is the magnitude of such effects?
  - What are the causes and can they be rectified?
- Q8. Are aquatic, riparian, and upland ecosystems of the estuary being degraded, restored or unchanged relative to desired conditions or objectives?
- To what quantitative extent are we avoiding further loss to existing shallow water wetland habitat and restoring degraded habitats?
  - What is the amount of habitat that is restored annually for each habitat type and for each reach of the estuary?
  - What is the index of habitat connectivity by reach and its status/trend?
- Q9. What are the status/trends in attributes of the estuary, plume, and ocean ecosystems?
- What are estuary habitat physical properties?
  - What are estuary fish population properties?
  - What are estuary hydrograph and water quality properties?
  - What are the environmental conditions and ecology in the plume and ocean relative to anadromous and resident fish production and survival?
- Q10. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives in the Estuary or Ocean?
- What is the cumulative effect of multiple habitat restoration or protection projects on the estuary ecosystem?
  - What are the effects of hydrologic reconnection projects (e.g., dike breaches, new tide gates and culverts) and revegetation projects on the estuary?
  - What possible changes to hydro power operations might improve habitat conditions in the estuary for salmonids?
- Q11. What are the limiting factors or threats in the estuary preventing the achievement of desired habitat or fish performance objectives?
- What is the ecological importance of the estuary and oceanic plume to the viability and recovery of fish populations?
  - What are the effects of toxics in the estuary on fish populations?
  - What are the causal mechanisms affecting survival of juvenile salmon during their first months in the ocean?
  - What is the survival rate by species of fish migrating downstream through the estuary?
- Q12. What effect do hatchery programs have on natural ecosystem and native fish health?
- What is the relative proportion of hatchery spawning fish compared to wild fish populations?
- Q13. To what extent can hatcheries be used to assist in meeting harvest management goals or maintain the viability or conserve the genetic legacy of natural fish populations?

- a. Can hatchery reforms and new programs reduce the deleterious effects of artificial production on listed populations, thereby contributing to increased viability and a reduction in extinction risk for affected natural populations?
  - b. Can properly designed intervention programs using artificial production make a net positive contribution to recovery of listed populations?
- Q14. What is the reproductive success of hatchery fish spawning in the wild relative to the reproductive success of wild fish?
- Q15. What are the harvest rates on wild and hatchery harvest management groups?
- a. What is the uncertainty around harvest point estimates?
  - b. What are the estimates of population size and escapement for each harvest management group?
  - c. What is the target and nontarget harvest and when is it projected to reach allowable levels?
- Q16. Are new selective gear types effective at harvesting?
- Q17. Are there delayed or incidental mortality effects associated with fish harvest?
- a. What is the post-release survival of fish caught in a selective fishery compared to fish that were not harvested?
- Q18. What is the impact of predators on juvenile fish?
- a. What are the nesting distribution, colony size, and colony productivity for avian predators?
  - b. What are the fish consumption rates of major avian predators?
  - c. What are the consumption rates of major piscivorous predators in the [Columbia River Basin]?
- Q19. What is the impact of predators on adult fish?
- a. What are the consumption rates of mammalian predators (marine)?
- Q20. What are the most effective management alternatives/actions that could be used to reduce the impact of predators?
- a. What is the effect of alternative management alternatives/actions used to reduce the impact of avian predators?
  - b. What is the effect of management alternatives/actions used to reduce the impact of piscivorous predators?
- Q21. What are the most effective management alternatives/actions that could be used to reduce the impact of predators?

## **Methods**

In February 2006, electronic surveys were emailed to PNAMP members and other entities responsible for aquatic resource management in the Pacific Northwest, including state (California Department of Fish and Game (CDFG), Idaho Department of Fish and Game (IDFG), Idaho Office of Species Conservation (OSC), Montana Fish, Wildlife, and Parks (MFWP), Oregon Department of Environmental Quality (ODEQ), Oregon Department of Fish and Wildlife (ODFW), Oregon Department of Forestry (ODF), Oregon Watershed Enhancement Board

(OWEB), Washington State Department of Ecology (WDE), Washington State Department of Fish and Wildlife (WDFW), Washington State Governor’s Salmon Recovery Office (WGSRO), Washington State Interagency Committee for Outdoor Recreation (WIAC)), federal (Bonneville Power Administration (BPA), Environmental Protection Agency (EPA), National Park Service (NPS), National Resources Conservation Service (NRCS), National Oceanic and Atmospheric Administration Fisheries Service (NOAAF), US Army Corps of Engineers (USACE), US Bureau of Land Management (USBLM), US Bureau of Reclamation (USBR), USDA Forest Service (USFS), US Geological Survey (USGS), US Fish and Wildlife Service (USFW)), tribal (Affiliated Tribes of Northwest Indians (ATNI), Columbia River Inter-Tribal Fish Commission (CRITFC), Colville Confederated Tribes (CCT), Northwest Indian Fisheries Commission (NIFC)) and regional entities (Bonneville Environmental Foundation (BEF), Columbia Basin Fish and Wildlife Authority (CBFWA), EcoTrust, Northwest Power and Conservation Council (NWPPCC), Pacific States Marine Fisheries Commission (PSMFC), The Nature Conservancy (TNC)). CRITFC forwarded the survey to their participating tribes who responded as individual tribes (Confederated Tribes and Bands of the Yakama Nation (YN), Nez Perce Tribe (NPT)).

Each agency was asked to provide a single policy-level response reflecting their perspective on importance of these particular resource management questions, spatial scale, and funding provided by their agency for tasks intended to help answer these questions. Respondents were also asked to provide any additional questions relevant to their agency, in order to fully capture regional needs.

Analysis and summary of returned questionnaires were completed in Microsoft Excel and Statistical Analysis Software (SAS). Responses are summarized by question and respondent in Tables 2 and 3 below and in Appendix Tables B1 and B2. Frequencies presented (of response categories and funding) reflect all responses received; that is, we did not attempt to identify and adjust for various reasons an entity chose not to respond (for example, whether or not the entity is responsible for a given topic or chose to not reply for other reasons).

## Results

Eighteen responses were received by September 1, 2006. Of these, three agencies responded with comments only and did not complete the questionnaire: USGS, EPA and NOAA Fisheries. The US Geological Survey stated that as a non-regulatory science agency, it is inappropriate to choose or prioritize natural resource management priorities. However, the USGS wanted to indicate that the agency's interests are congruent with the underlying premise of the questionnaire in that they wish to know the management priorities so they can use them to direct their science capabilities. Similarly, the EPA response indicated a support for this process and interest in the outcome, but that priorities were set outside the agency and that it was not appropriate for EPA to respond. NOAA Fisheries was not comfortable merging these specific questions with the agency's own list of specific questions, and thus offered a separate list of specific questions (Appendix C).

Responses are summarized in Figures 1 and 2, Tables 2 and 3 and Appendix Tables B1 and B2: (Figures 1 and 2 and Tables 2 and 3 are primary questions while Appendix Tables B1 and B2 show responses to all questions). Each respondent was asked to consider these questions relative to anadromous and resident fishes; results are presented in separate graphics (Figure 1, Table 2 and Appendix B1 are anadromous fish; Figure 2, Table 3 and Appendix B2 are resident fish.) Of the 13 entities that attempted the survey, not all management questions were assessed, as each individual entity has unique mandates and responsibilities. Thus, there are a number of "non-response" elements in the results.

Figure 1. — Importance rating of management questions for **anadromous fish** as percentage of agencies responding to the PNAMP Management Question Survey (2006)

N: The number of responses to the question (non-response to individual questions excluded).

Rating criteria:

High (H): Management Question and Information is: a) a direct responsibility of your agency or tribe through a legal mandate or other regional commitment; b) needed to plan, implement or adapt actions by your agency or tribe that are legally mandated; or c) are necessary for your agency or tribe to monitor or regulate legally mandated performance objectives or policies.

Medium (M): Management Question and Information has no legal or other binding performance commitments, but your agency or tribe thinks it is a critical monitoring information need for regional planning, policy development, implementation and/or management of actions for recovery or maintenance of a species and should be ranked high relative to other information needs for funding allocations.

Low (L): Management Question and Information has a low value to your agency or tribe for regional planning, policy development, and/or management of actions and should be ranked low relative to other information needs for funding allocations.

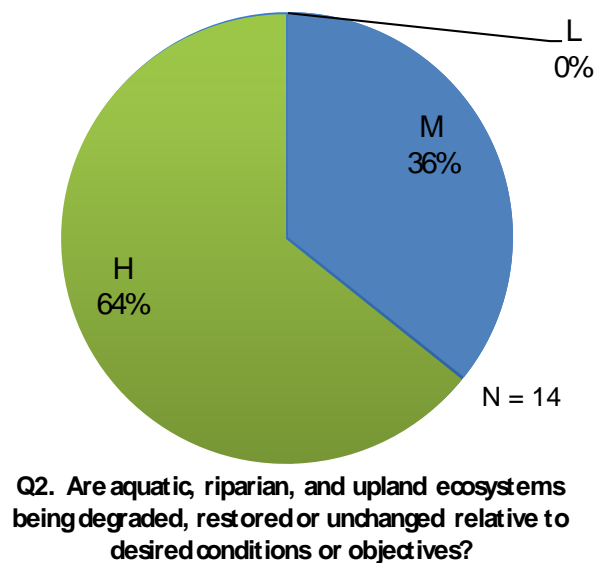
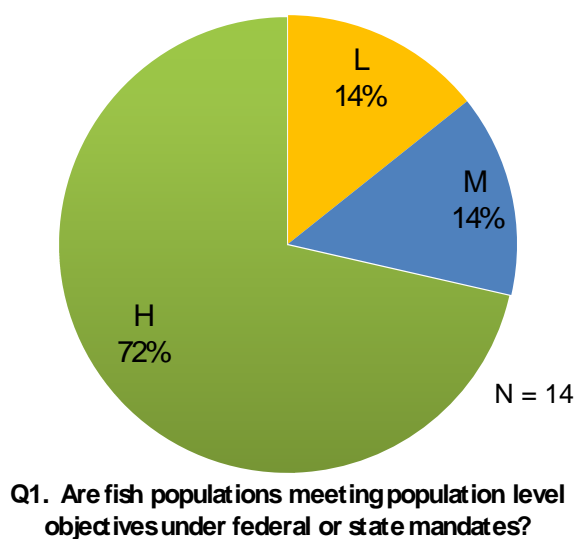
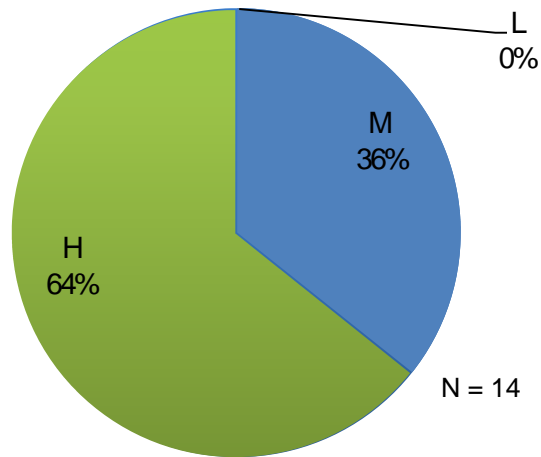
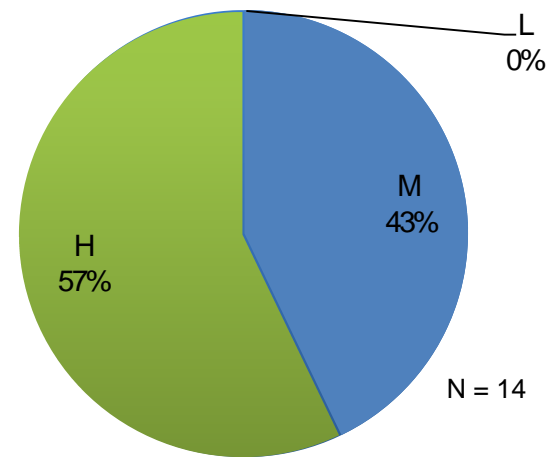


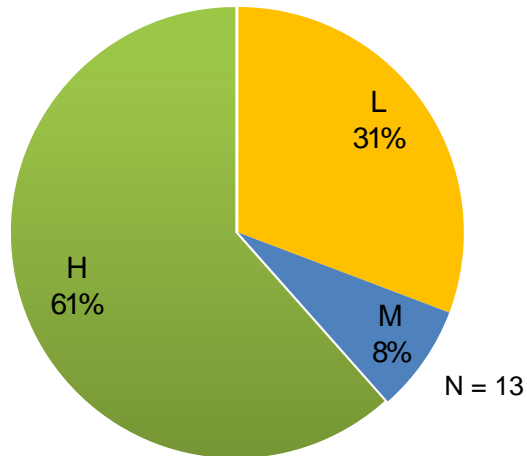
Figure 1. — Importance rating of management questions for **anadromous fish** (continued)



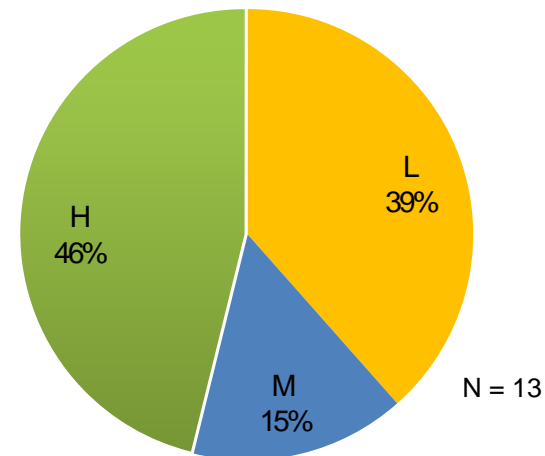
**Q3. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives?**



**Q4. What are the limiting factors or threats preventing the achievement of desired habitat or fish performance objectives?**

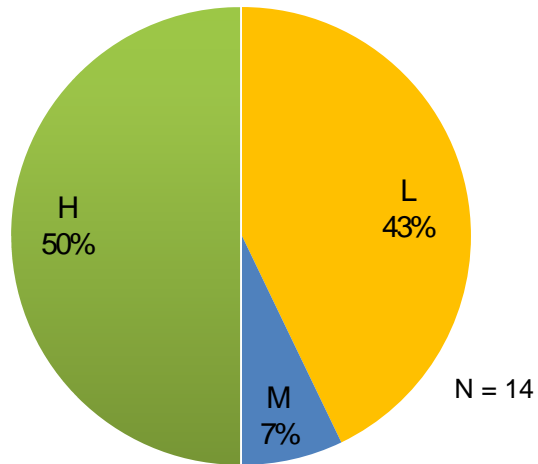


**Q5. Are salmon and steelhead meeting juvenile and adult hydro passage performance objectives?**

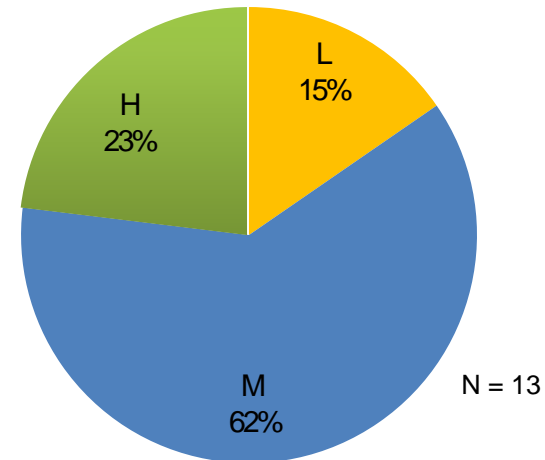


**Q6. What is the magnitude of post release mortality or stress associated with transporting smolts?**

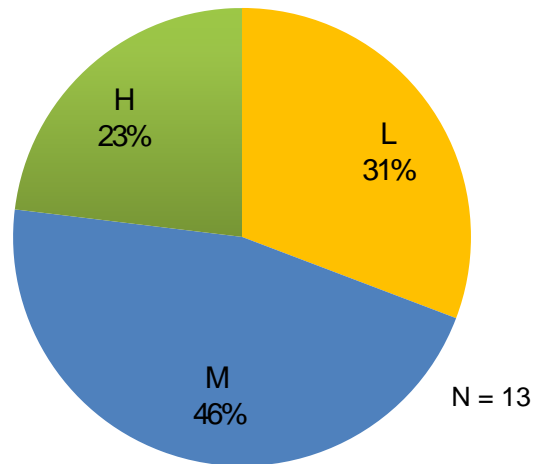
Figure 1. — Importance rating of management questions for **anadromous fish** (continued)



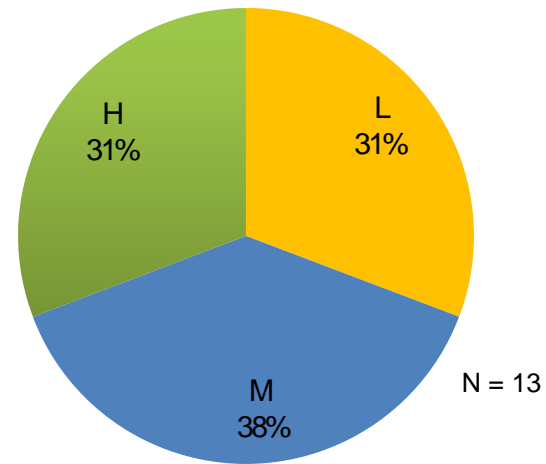
Q7. Do fish migrating in-river through the hydro system incur delayed mortality?



Q8. Are aquatic, riparian, and upland ecosystems of the estuary being degraded, restored or unchanged relative to desired conditions or objectives?

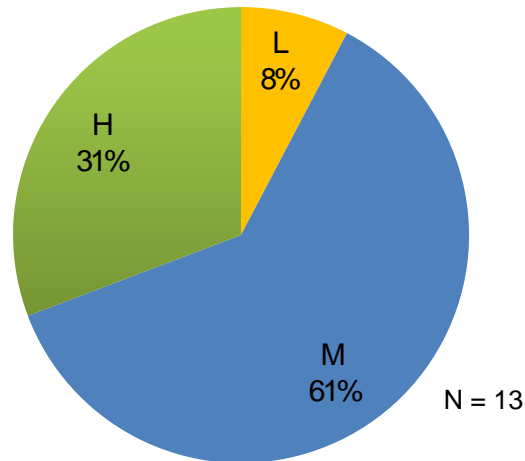


Q9. What are the status/ trends in attributes of the estuary, plume, and ocean ecosystems?

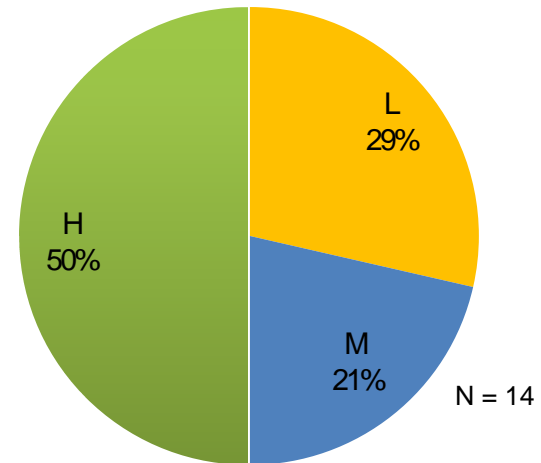


Q10. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives in the Estuary or Ocean?

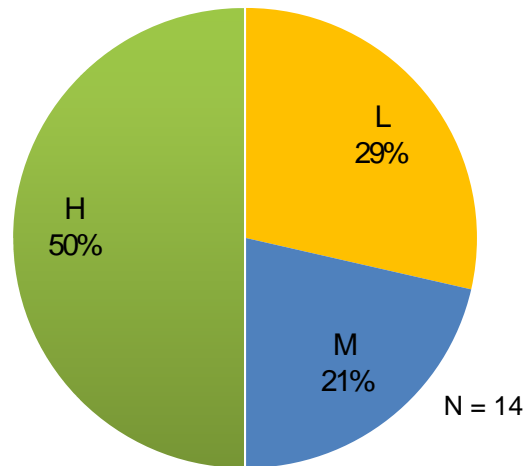
Figure 1. —Importance rating of management questions for **anadromous fish** (continued)



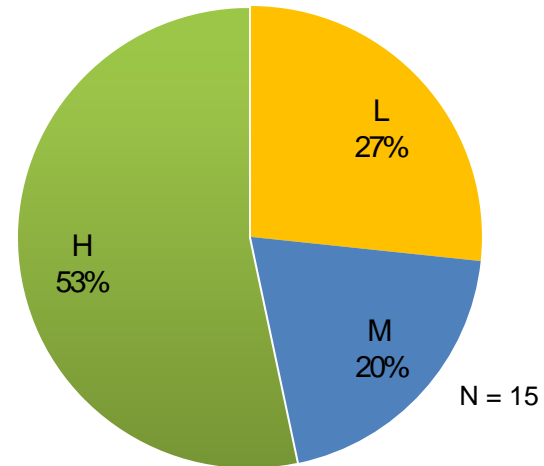
**Q11. What are the limiting factors or threats in the estuary preventing the achievement of desired habitat or fish performance objectives?**



**Q12. What effect do hatchery programs have on natural ecosystem and native fish health?**

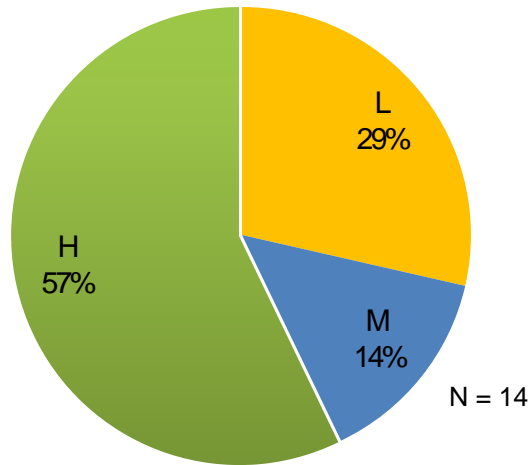


**Q13. To what extent can hatcheries be used to assist in meeting harvest management goals or maintain the viability or conserve the genetic legacy of natural fish populations?**

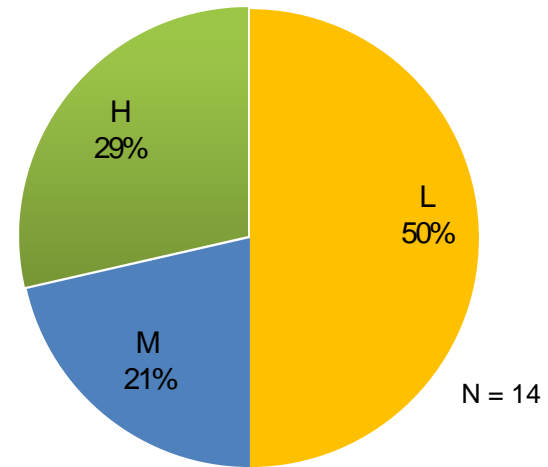


**Q14. What is the reproductive success of hatchery fish spawning in the wild relative to the reproductive success of wild fish?**

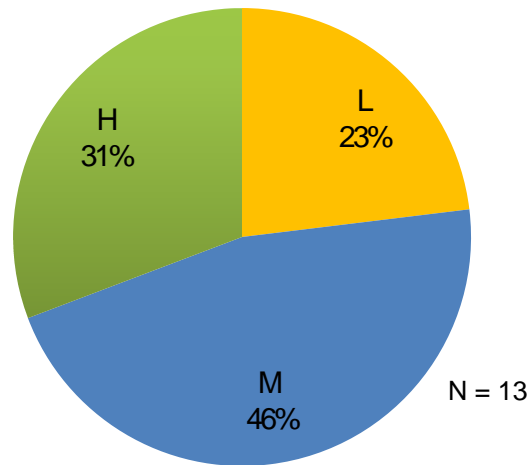
Figure 1. — Importance rating of management questions for **anadromous fish** (continued)



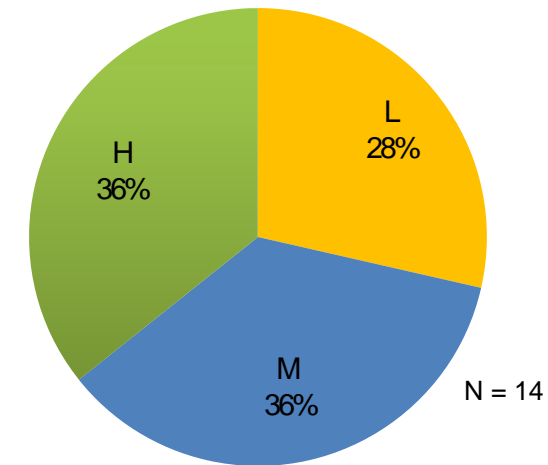
Q15. What are the harvest rates on wild and hatchery harvest management groups?



Q16. Are new selective gear types effective at harvesting?

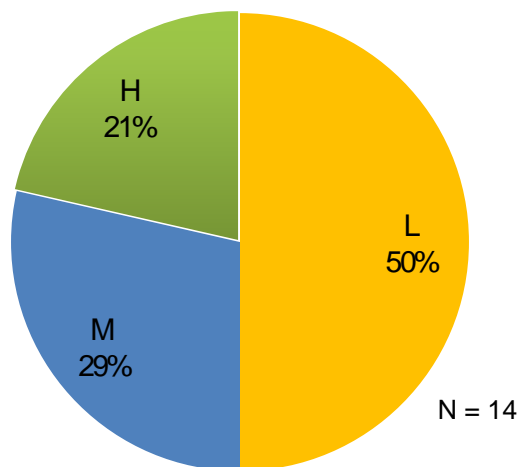


Q17. Are there delayed or incidental mortality effects associated with fish harvest?

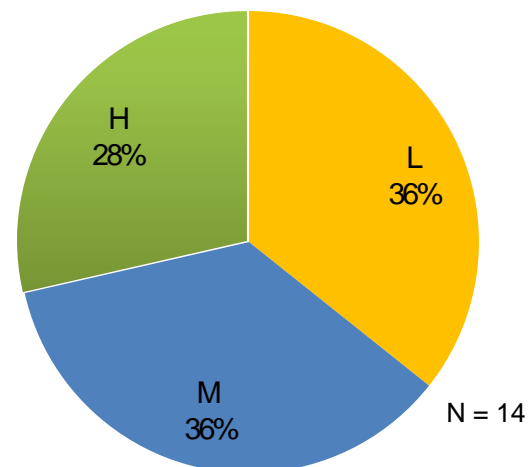


Q18. What is the impact of predator on juvenile fish?

Figure 1. — Importance rating of management questions for **anadromous fish** (continued)



Q19. What is the impact of predators on adult fish?



Q20. What are the most effective management alternatives/ actions that could be used to reduce the impact of predators?

Figure 2.— Importance rating of management questions for **resident fish** as percentage of agencies responding to the PNAMP Management Question Survey (2006). Questions 5 and 6 were omitted as the questions were not applicable to resident fish.

N: The number of responses to the question (non-response to individual questions excluded).

Rating criteria.

High (H): Management Question and Information is: a) a direct responsibility of your agency or tribe through a legal mandate or other regional commitment; b) needed to plan, implement or adapt actions by your agency or tribe that are legally mandated; or c) are necessary for your agency or tribe to monitor or regulate legally mandated performance objectives or policies.

Medium (M): Management Question and Information has no legal or other binding performance commitments, but your agency or tribe thinks it is a critical monitoring information need for regional planning, policy development, implementation and/or management of actions for recovery or maintenance of a species and should be ranked high relative to other information needs for funding allocations.

Low (L): Management Question and Information has a low value to your agency or tribe for regional planning, policy development, and/or management of actions and should be ranked low relative to other information needs for funding allocations.

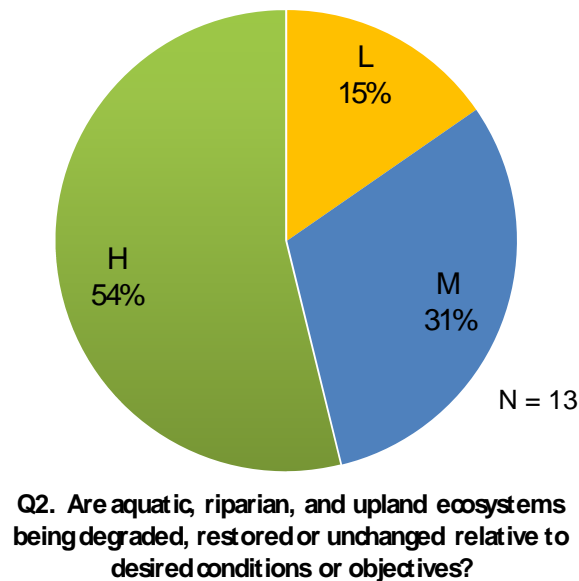
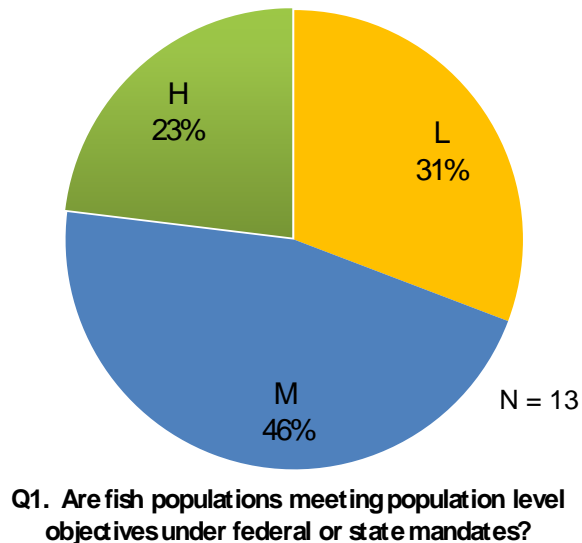
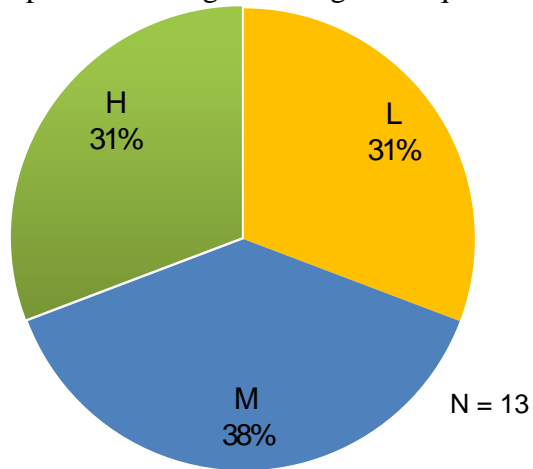
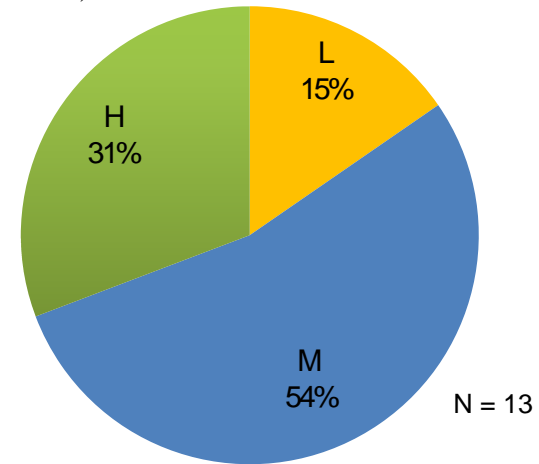


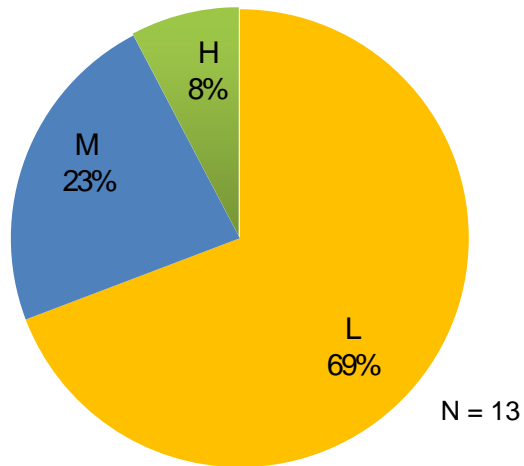
Figure 2. — Importance rating of management questions for **resident fish** (continued)



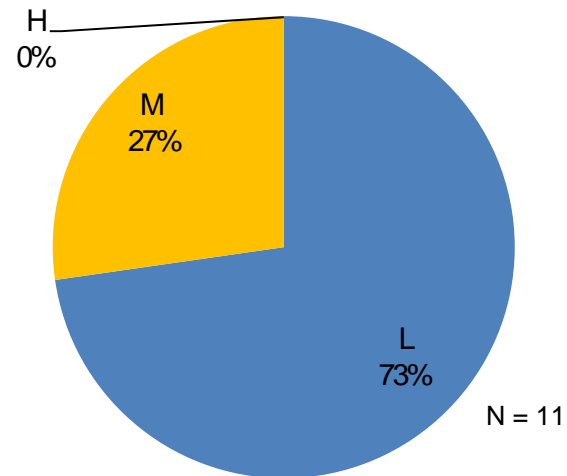
**Q3. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives?**



**Q4. What are the limiting factors or threats preventing the achievement of desired habitat or fish performance objectives?**

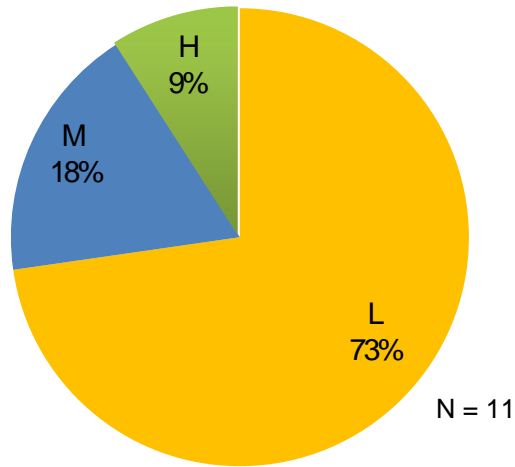


**Q7. Do fish migrating in-river through the hydro system incur delayed mortality?**

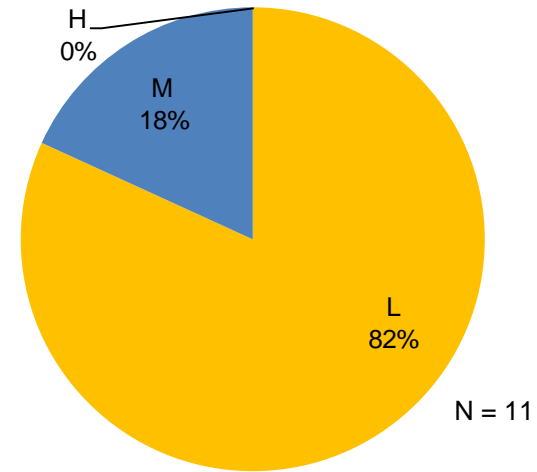


**Q8. Are aquatic, riparian, and upland ecosystems of the estuary being degraded, restored or unchanged relative to desired conditions or objectives?**

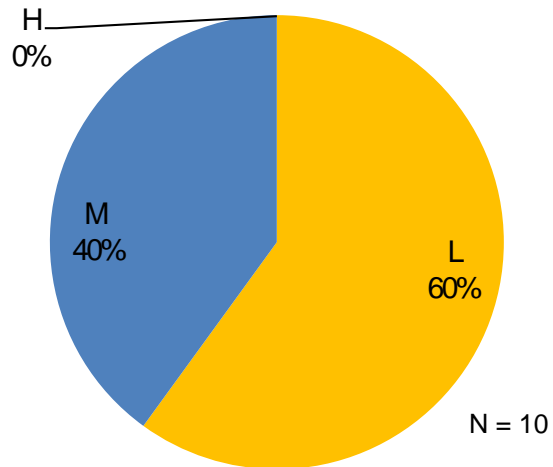
Figure 2. — Importance rating of management questions for **resident fish** (continued)



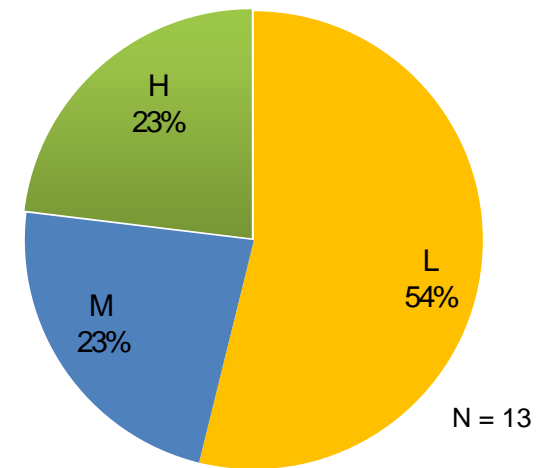
**Q9. What are the status/ trends in attributes of the estuary, plume, and ocean ecosystems?**



**Q10. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives in the Estuary or Ocean?**

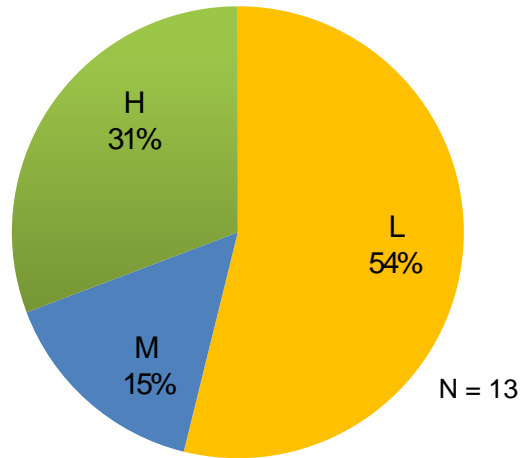


**Q11. What are the limiting factors or threats in the estuary preventing the achievement of desired habitat or fish performance objectives?**

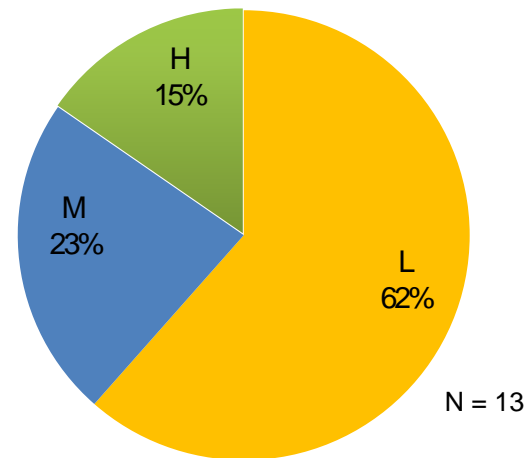


**Q12. What effect do hatchery programs have on natural ecosystem and native fish health?**

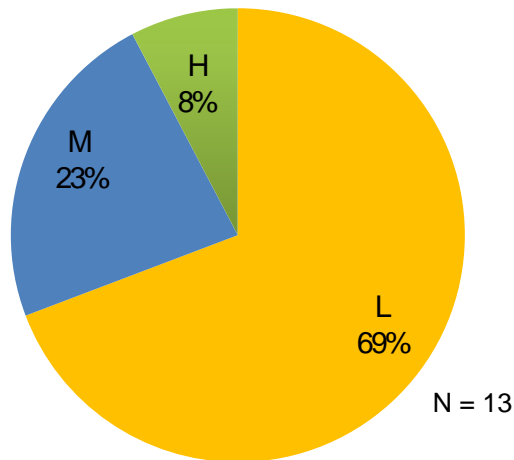
Figure 2. — Importance rating of management questions for **resident fish** (continued)



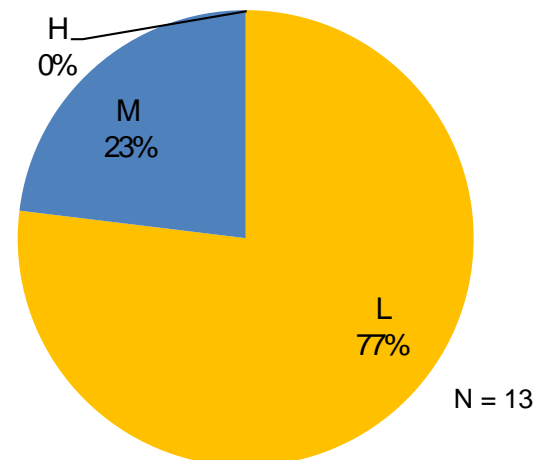
**Q13. To what extent can hatcheries be used to assist in meeting harvest management goals or maintain the viability or conserve the genetic legacy of natural fish populations?**



**Q14. What is the reproductive success of hatchery fish spawning in the wild relative to the reproductive success of wild fish?**

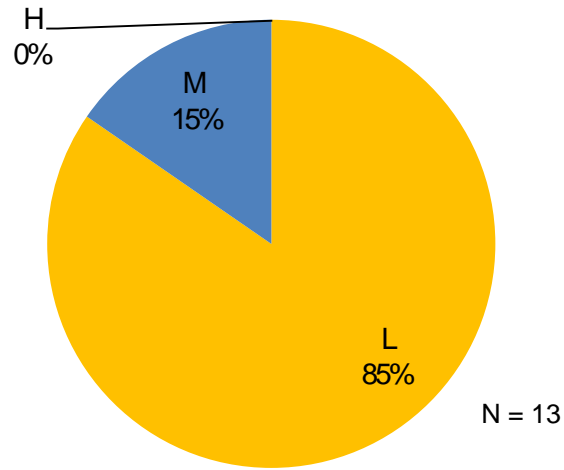


**Q15. What are the harvest rates on wild and hatchery harvest management groups?**

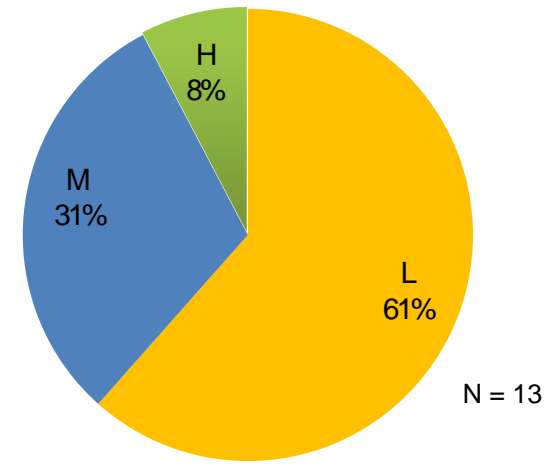


**Q16. Are new selective gear types effective at harvesting?**

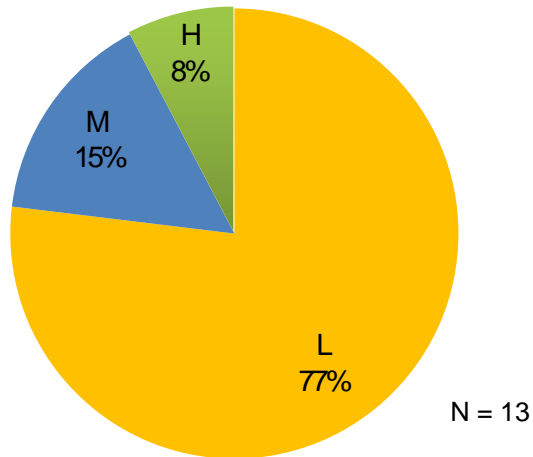
Figure 2. — Importance rating of management questions for **resident fish** (continued)



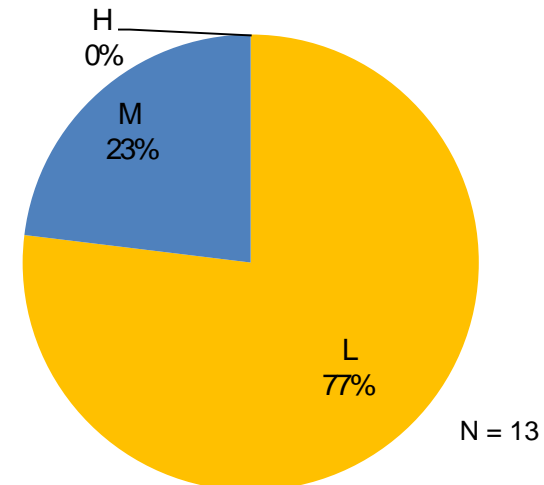
Q17. Are there delayed or incidental mortality effects associated with fish harvest?



Q18. What is the impact of predators on juvenile fish?



Q19. What is the impact of predators on adult fish?



Q20. What are the most effective management alternatives/ actions that could be used to reduce the impact of predators?

Table 2.— Responses to the PNAMP Management Question Survey (2006) by participating agencies regarding **anadromous fish** for questions of importance (as defined below) and funding provided by respondents. Text in blue, bold, and underlined indicates funding by the responding agency. Responses shaded in gray indicate a response of importance, but no response regarding funding. A “\” indicates no response to this question.

High (H): Management Question and Information is: a) a direct responsibility of your agency or tribe through a legal mandate or other regional commitment; b) needed to plan, implement or adapt actions by your agency or tribe that are legally mandated; or c) are necessary for your agency or tribe to monitor or regulate legally mandated performance objectives or policies.

Medium (M): Management Question and Information has no legal or other binding performance commitments, but your agency or tribe thinks it is a critical monitoring information need for regional planning, policy development, implementation and/or management of actions for recovery or maintenance of a species and should be ranked high relative to other information needs for funding allocations.

Low (L): Management Question and Information has a low value to your agency or tribe for regional planning, policy development, and/or management of actions and should be ranked low relative to other information needs for funding allocations.

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
1 Are fish populations meeting population level objectives under federal or state mandates?	<u>H</u>	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	<u>H</u>	<u>M</u>	\	<u>M</u>	L	H	<u>H</u>	<u>H</u>
2 Are aquatic, riparian, and upland ecosystems being degraded, restored or unchanged relative to desired conditions or objectives?	<u>M</u>	<u>H</u>	<u>M</u>	<u>M</u>	H	<u>H</u>	<u>M</u>	<u>H</u>	<u>H</u>	\	<u>H</u>	<u>M</u>	H	<u>H</u>	<u>H</u>
3 What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives?	<u>H</u>	<u>H</u>	<u>H</u>	<u>M</u>	H	<u>M</u>	<u>M</u>	<u>H</u>	<u>H</u>	\	<u>H</u>	<u>M</u>	M	<u>H</u>	<u>H</u>
4 What are the limiting factors or threats preventing the achievement of desired habitat or fish performance objectives?	<u>M</u>	<u>H</u>	<u>H</u>	M	M	<u>M</u>	<u>H</u>	H	<u>H</u>	\	<u>M</u>	<u>M</u>	H	<u>H</u>	<u>H</u>
5 Are salmon and steelhead meeting juvenile and adult hydro passage performance objectives?	<u>H</u>	<u>H</u>	\	<u>H</u>	H	L	<u>H</u>	<u>H</u>	L	\	L	L	H	M	H
6 What is the magnitude of post release mortality or stress associated with transporting smolts?	<u>H</u>	L	\	H	H	L	<u>H</u>	<u>H</u>	L	\	L	L	M	M	H
7 Do fish migrating in-river through the hydro system incur delayed mortality?	<u>H</u>	L	\	H	H	L	<u>H</u>	H	L	H	L	L	M	L	H

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN	
8	Are aquatic, riparian, and upland ecosystems of the estuary being degraded, restored or unchanged relative to desired conditions or objectives?	<u>M</u>	M	<u>M</u>	M	L	<u>M</u>	<u>M</u>	<u>H</u>	<u>M</u>	\	L	<u>M</u>	H	<u>H</u>	\
9	What are the status/trends in attributes of the estuary, plume, and ocean ecosystems?	<u>M</u>	H	<u>M</u>	L	L	<u>M</u>	<u>M</u>	<u>H</u>	L	\	L	H	M	M	\
10	What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives in the Estuary or Ocean?	<u>H</u>	H	<u>M</u>	M	L	<u>M</u>	M	<u>H</u>	L	\	L	L	M	H	\
11	What are the limiting factors or threats in the estuary preventing the achievement of desired habitat or fish performance objectives?	<u>M</u>	<u>H</u>	<u>M</u>	H	M	<u>M</u>	M	<u>H</u>	<u>M</u>	\	L	M	M	<u>H</u>	\
12	What effect do hatchery programs have on natural ecosystem and native fish health?	<u>M</u>	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	H	L	\	L	L	M	M	<u>H</u>
13	To what extent can hatcheries be used to assist in meeting harvest management goals or maintain the viability or conserve the genetic legacy of natural fish populations?	M	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	H	L	\	L	L	M	M	<u>H</u>
14	What is the reproductive success of hatchery fish spawning in the wild relative to the reproductive success of wild fish?	<u>H</u>	<u>H</u>	H	<u>H</u>	H	L	<u>H</u>	M	L	<u>H</u>	L	L	M	M	<u>H</u>
15	What are the harvest rates on wild and hatchery harvest management groups?	M	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	H	L	\	L	L	M	H	<u>H</u>
16	Are new selective gear types effective at harvesting?	<u>M</u>	<u>H</u>	M	L	L	L	<u>H</u>	H	L	\	L	L	M	H	L
17	Are there delayed or incidental mortality effects associated with fish harvest?	M	<u>M</u>	<u>H</u>	H	M	L	<u>H</u>	H	L	\	\	L	M	M	M
18	What is the impact of predators on juvenile fish?	<u>H</u>	<u>H</u>	<u>H</u>	M	M	L	<u>H</u>	<u>H</u>	L	\	L	L	M	M	<u>M</u>
19	What is the impact of predators on adult fish?	M	L	<u>H</u>	M	L	L	<u>H</u>	<u>H</u>	L	\	L	L	L	M	M
20	What are the most effective management alternatives/actions that could be used to reduce the impact of predators?	<u>H</u>	<u>H</u>	<u>M</u>	M	L	L	<u>H</u>	<u>H</u>	L	\	L	L	M	M	M

Table 3.— Responses to the PNAMP Management Question Survey (2006) by participating agencies regarding **resident fish** for questions of importance (as defined below) and funding provided by respondents. Text in blue, bold, and underlined indicates funding by the responding agency. Responses shaded in gray indicate a response of importance, but no response regarding funding. A “\” indicates no response to this question. GSRO did not respond regarding funding for all questions except Question 11 and ACOE did not respond regarding funding for Question 4. Questions 5 and 6 were omitted as the questions were not applicable to resident fish.

High (H): Management Question and Information is: a) a direct responsibility of your agency or tribe through a legal mandate or other regional commitment; b) needed to plan, implement or adapt actions by your agency or tribe that are legally mandated; or c) are necessary for your agency or tribe to monitor or regulate legally mandated performance objectives or policies.

Medium (M): Management Question and Information has no legal or other binding performance commitments, but your agency or tribe thinks it is a critical monitoring information need for regional planning, policy development, implementation and/or management of actions for recovery or maintenance of a species and should be ranked high relative to other information needs for funding allocations.

Low (L): Management Question and Information has a low value to your agency or tribe for regional planning, policy development, and/or management of actions and should be ranked low relative to other information needs for funding allocations.

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WTAC	YN
1 Are fish populations meeting population level objectives under federal or state mandates?	<u>M</u>	<u>H</u>	\	<u>H</u>	L	L	<u>M</u>	<u>H</u>	<u>M</u>	\	<u>M</u>	L	L	M	<u>M</u>
2 Are aquatic, riparian, and upland ecosystems being degraded, restored or unchanged relative to desired conditions or objectives?	<u>H</u>	<u>H</u>	\	H	M	<u>H</u>	<u>M</u>	<u>H</u>	<u>H</u>	\	<u>H</u>	<u>M</u>	L	<u>M</u>	<u>L</u>
3 What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives?	<u>H</u>	<u>M</u>	\	M	L	<u>L</u>	<u>M</u>	<u>H</u>	<u>H</u>	\	<u>H</u>	<u>M</u>	L	L	<u>M</u>
4 What are the limiting factors or threats preventing the achievement of desired habitat or fish performance objectives?	<u>H</u>	<u>H</u>	\	M	L	<u>M</u>	<u>M</u>	H	<u>H</u>	\	<u>M</u>	<u>M</u>	L	<u>M</u>	<u>M</u>
7 Do fish migrating in-river through the hydro system incur delayed mortality?	L	L	\	H	M	L	L	M	L	\	L	L	L	L	M

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN	
8	Are aquatic, riparian, and upland ecosystems of the estuary being degraded, restored or unchanged relative to desired conditions or objectives?	L	L	\	\	L	<u>M</u>	L	<u>M</u>	L	\	L	<u>M</u>	L	L	\
9	What are the status/trends in attributes of the estuary, plume, and ocean ecosystems?	L	L	\	\	L	<u>M</u>	L	M	L	\	L	H	L	L	\
10	What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives in the Estuary or Ocean?	L	L	\	\	L	<u>M</u>	L	M	L	\	L	L	L	L	\
11	What are the limiting factors or threats in the estuary preventing the achievement of desired habitat or fish performance objectives?	L	L	\	\	L	<u>M</u>	L	M	<u>M</u>	\	L	M	\	L	\
12	What effect do hatchery programs have on natural ecosystem and native fish health?	L	<u>H</u>	\	<u>H</u>	M	L	M	H	L	\	L	L	L	L	<u>M</u>
13	To what extent can hatcheries be used to assist in meeting harvest management goals or maintain the viability or conserve the genetic legacy of natural fish populations?	<u>H</u>	<u>H</u>	\	<u>H</u>	M	L	M	H	L	\	L	L	L	L	<u>L</u>
14	What is the reproductive success of hatchery fish spawning in the wild relative to the reproductive success of wild fish?	L	<u>H</u>	\	<u>H</u>	L	L	M	M	L	\	L	L	L	L	<u>M</u>
15	What are the harvest rates on wild and hatchery harvest management groups?	<u>L</u>	<u>H</u>	\	<u>M</u>	L	L	M	M	L	\	L	L	L	L	L
16	Are new selective gear types effective at harvesting?	<u>M</u>	<u>M</u>	\	L	L	L	M	L	L	\	L	L	L	L	L
17	Are there delayed or incidental mortality effects associated with fish harvest?	L	<u>L</u>	\	L	L	L	M	M	L	\	L	L	L	L	L
18	What is the impact of predators on juvenile fish?	M	<u>L</u>	\	<u>M</u>	L	L	<u>M</u>	H	L	\	L	L	L	L	<u>M</u>

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19	What is the impact of predators on adult fish?	L	L	\	M	L	L	M	<u>H</u>	L	\	L	L	L	L	L
20	What are the most effective management alternatives/actions that could be used to reduce the impact of predators?	L	<u>L</u>	\	<u>M</u>	L	L	M	M	L	\	L	L	L	L	L

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## Discussion

Of the state, federal, tribal, and regional entities that received the survey, 51% responded. These respondents consisted of federal, state, and tribal groups. Of the 19 PNAMP Charter signatory entities, 14 responded: BPA, CCT, CDFG, EPA, NOAA Fisheries, USACE, USBLM, USBR, USFS, USFW, WDE, WGSRO, WIAC, and USGS. One of the steering committee members, the Columbia River Intertribal Fish Commission, did not respond as a whole, but two member tribes responded as individuals. Four or more groups did not respond to any of the questions regarding Estuary and Ocean Management for resident fish (main questions 8-11). Overall, response was very high for the anadromous survey compared to the resident survey; response was low only for question 21 which was an accidental duplicate of question 20. Due to the duplication of main question 20 regarding predators, no question referenced invasive species and therefore responses to question 21 were omitted and we reference the section as Predator Management from here forward. Several entities noted the importance of invasive species in their comments and we regret we did not address this issue in the survey.

Between the many questions and respondents, the responses were quite varied. Trends were more evident using only the primary questions. In the Tributary Habitat Management section, most respondents placed a high value of importance and funding for both anadromous and resident fish. Frequency of response was also highest in the Tributary Habitat Management section amongst all other groupings. In contrast, the Predator Management section received the fewest high importance responses and the fewest funded responses for anadromous fish. For resident fish, Harvest Management and Predator Management received the least amount of high importance and the greatest amount of low importance. Frequency of funding was the lowest for resident fish in the Estuary and Ocean Management group.

Between anadromous and resident fish, anadromous fish garnered a higher frequency of high importance, funding, and number of entities who responded. The most prominent entities for high importance and funding of anadromous fish are the USACE, BPA, CCT, and ODEQ. USACE and BPA are largely driven by federal mandates to protect and preserve anadromous fish. Resident fish were prominently funded and associated with a high value of importance by Colville Confederated Tribes and Idaho Fish and Game. Tributary Habitat Management was the group most likely to have high or mid level importance as well as being funded.

Between each agency however, the definition of resident fish varied and may have influenced the variability in responses. For example, CDFG Coastal Program did not respond to any resident fish questions while many entities (IDFG, BPA, and USACE) answered each resident fish question for the species with the greatest management importance. Many of the fish these entities consider resident species are important (e.g. sturgeon, bull trout, and burbot) while several additional resident species are not considered important (e.g. dace, sculpin). White sturgeon were considered resident by BPA but anadromous (below Bonneville Dam) by the USACE and ODFW. Overall, anadromous fish were ranked with a higher value of importance, were funded more often, and garnered more responses than resident fish in the survey.

When examining the primary and secondary questions, few trends stand out. For both anadromous and resident fish, the responses to the secondary questions closely followed the trends of the response to the primary questions.

Respondents offered thoughts regarding questions and issues that were not included in the survey. For example, several entities remarked on the importance of invasive species. Question 21 should have been “What is the impact of invasive species on native fish populations?” In addition, several entities pointed out water quality and watershed health as being important to their agency, but not necessarily related to only fish. These groups may use fish to determine the overall health of a system, but do not focus on fish alone.

The survey intended to identify existing agreements to fund work related to these management questions. Presence of funding does not measure the effectiveness of money spent. We did not attempt to characterize if funding is inadequate (or insignificant) or if funding is exaggerated or overlapping. We do anticipate that the results of this survey will facilitate conversations to those ends. Survey responses regarding funding varied; at least one entity noted they responded with a “yes” in the funding column if they spent money on the specific subject, but noted most money came from other institutions (e.g. Bonneville Power Administration or grants).

Several respondents noted the questions were difficult to address due to the broad scope of the geographic regions they represented. Perhaps bringing the questions down to the research level would provide a variety of responses for each entity, but would be more representative for each region. Spatial level of importance was difficult to address. Entities defined spatial level in

a variety of ways, leaving the results difficult to compare or contrast. In response to this ambiguity, we omitted this category from the report. For future surveys, a more precisely defined approach to the spatial level would be desired. Aiming towards a narrower audience would allow the survey to be more specific and less broad. Focusing on anadromous versus resident fish was a good exercise, but focusing on watershed health overall might be a better way to understanding priorities for all entities.

## **Conclusions and Next Steps**

Federal, state, tribal, local, and private natural resource monitoring programs in the Pacific Northwest have evolved in response to different organizational mandates, jurisdictional needs, issues and questions. However, while some issues are unique to particular entities, PNAMP has learned there is much common ground. Where common ground exists, improved coordination can avoid duplication of effort and increase cost-effectiveness of expenditures. This cooperation also allows more timely and accessible information and increases the overall quantity and quality of scientific information used to inform public policy and resource management decisions. This common ground and cooperation is central to the PNAMP strategy and mission.

PNAMP felt it was important to document resource management questions of interest to the Pacific Northwest and, specifically, receive input as to the relative importance of specific questions for different management entities. This survey of management questions, along with PNAMP's efforts to identify shared monitoring principles, objectives, needs, and opportunities, was intended to ultimately lead to greater coordination of aquatic monitoring across the Pacific Northwest.

PNAMP anticipates the information from this survey could be used by our partners to facilitate and inform the coordination of ongoing regional efforts, prioritization of project funding, prioritization of technical efforts to develop RM&E approaches, and in the development of cost-sharing agreements for common RM&E needs. These activities directly and indirectly support various needs, including the state, federal, and tribal monitoring activities related to the ESA, the Columbia Basin Fish and Wildlife Program under the Power and Conservation Act, the Northwest Forest Plan, and other monitoring programs under the purview of governmental and non-governmental organizations. PNAMP will serve as a forum to facilitate coordination and

collaboration; however, decisions such as priorities for project funding remain the purview of individual entities or programs.

PNAMP looks forward to facilitating communication among its partners and others in the region so that the information gathered via this survey may be instrumental in improving aquatic resource monitoring in the Pacific Northwest.

## Appendix A- Survey of RM&E Management Questions and Information Needs



Pacific Northwest  
Aquatic Monitoring  
Partnership

February 3, 2006

Dear Sir or Madam,

The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) requests your assistance in gathering information on key management questions driving research, monitoring and evaluation (RM&E) activities in the Pacific Northwest. We seek to understand your agency or tribe's perspective via a survey of RM&E Management Questions and Information Needs. Identifying key management questions and their associated information needs will help define the scope and priorities of RM&E programs and projects that support aquatic habitat and fish mitigation and restoration programs in the Pacific Northwest. Identifying information needs jointly across multiple parties and regional programs can facilitate the integration and cost-sharing of these programs for more robust and cost-effective information targeting common needs.

This survey of management questions is intended to obtain agency-specific confirmation that these are the key fish and aquatic habitat management questions of common interest to entities in the Pacific Northwest, and to identify the relative importance of these questions and the spatial scale of importance. In addition, the survey asks if information specific to these questions is currently being funded. The information from this survey will be used to facilitate and inform the coordination of ongoing regional efforts, prioritization of project funding, prioritization of technical efforts to develop RM&E approaches, and in the development of cost-sharing agreements for common RM&E needs.

Recently, members of your agency or tribe may have participated in the Coordinated Systemwide Monitoring and Evaluation Project (CSMEP) survey of management questions that was targeted at information needed to prioritize CSMEP work efforts. In order to fully capture information about management priorities, we respectfully ask for your further participation in this similar survey. The results of both surveys will be presented at the March 16-17, 2006 Monitoring Practitioners' Workshop (sponsored by PNAMP and CSMEP).

Next steps include a separate survey, currently being developed through PNAMP, to identify regional monitoring activities (projects and programs) and to help meet RM&E coordination and

planning needs. This additional more detailed monitoring survey should be sent out in late February or early March.

We greatly appreciate your participation in this and future surveys. These are critical pieces of information for the coordination and development of regional RM&E programs that support common regional management goals and objectives.

***Please provide one agency level response to the attached survey to Jen Bayer at [jennifer\\_bayer@usgs.gov](mailto:jennifer_bayer@usgs.gov) no later than March 3, 2006.*** Jen may also be contacted at (509) 538-2299 ext. 273.

**Instructions:** Please fill in the survey contact information identified for your Agency or Tribe. Fill in the boxes within the following table for each of the Management Questions (i.e. Q1, Q2, ...) and the associated Subordinate Questions (a, b, c, ....), relative to your Agency or Tribe, for:

- 1) the importance of the question;
- 2) the lowest spatial level of importance (most detailed spatial level of importance for monitoring), and;
- 3) whether your Agency or Tribe is currently funding the collection of information associated with this question.

Responses should be provided separately for both anadromous and resident fish.

At the end of the form please add any questions or issues important to your agency that you feel were missed in the survey.

## Survey of RM&E Management Questions and Information Needs

**Background and Purpose:** Identifying key management questions and their associated information needs will help define the scope and priorities of Research, Monitoring and Evaluation (RM&E) programs and projects that support aquatic habitat and fish mitigation and restoration programs in the Pacific Northwest. Identifying information needs jointly across multiple parties and regional programs can facilitate the integration and cost-sharing of these programs for more robust and cost-effective information targeting common needs. The Pacific Northwest Aquatic Monitoring Partnership (PNAMP), the Coordinated Systemwide Monitoring and Evaluation Project (CSMEP), and Federal and State RM&E Programs, have all identified the development of management questions as a key first step for both designing and coordinating RM&E projects and programs. Key management questions have been developed under all of these ongoing efforts and have been reviewed by various technical and policy level groups.

This survey of management questions is intended to obtain agency-specific confirmation that these are the key fish and aquatic habitat management questions of common interest to entities in the PNW region, and to identify the relative importance of these questions and the spatial scale of importance. In addition, the survey asks if information specific to these questions is currently being funded. The information from this survey will be used to facilitate and inform the coordination of ongoing regional efforts, prioritization of project funding, prioritization of technical efforts to develop RM&E approaches, and in the development of cost-sharing agreements for common RM&E needs.

Recently, members of your agency or tribe may have participated in the CSMEP survey of management questions that was targeted at information needed to prioritize CSMEP work efforts. In order to fully capture information about management priorities, we respectfully ask for your further participation in this similar survey. The results of both surveys will be presented at the March 16-17, 2006 Monitoring Practitioners' Workshop (sponsored by PNAMP and CSMEP).

Next steps include a separate survey, currently being developed through PNAMP, to identify regional monitoring activities (projects and programs) for additional RM&E coordination and planning needs. This additional more detailed monitoring survey should be sent out in late February or early March.

We greatly appreciate your participation in this and future surveys. These are critical pieces of information for the coordination and development of regional RM&E programs that support common regional management goals and objectives.

**Please provide one agency level response to the attached survey to Jen Bayer at [jennifer\\_bayer@usgs.gov](mailto:jennifer_bayer@usgs.gov) no later than March 3, 2006.** Jen may also be contacted at (509) 538-2299 ext. 273.

**Instructions:** Please fill in the survey contact information identified for your Agency or Tribe. Fill in the boxes within the following table for each of the Management Questions (i.e. Q1, Q2, ...) and the associated Subordinate Questions (a, b, c, ...), relative to your Agency or Tribe, for:

- 1) the importance of the question;
- 2) the lowest spatial level of importance (most detailed spatial level of importance for monitoring), and;
- 3) whether your Agency or Tribe is currently funding the collection of information associated with this question.

Responses should be provided separately for both anadromous and resident fish.

At the end of each major section of the questionnaire and at the end of the survey form there are places to add any additional questions that are important to your agency that we may have missed.

**Survey Contact Information:**

Agency or Tribe:

Address:

Name of Manager Providing Agency or Tribal  
Level Confirmation for Responses:

Name of Contact Person for Survey Responses:

Contact Person Telephone Number:

Contact Person E-mail:

**Response Options within Survey Table:**

**Importance of Management Question and Information (indicate importance for both Anadromous and Resident Fish):**

**High** - Management Question and Information is: a) a direct responsibility of your agency or tribe through a legal mandate or other regional commitment; b) needed to plan, implement or adapt actions by your agency or tribe that are legally mandated; or c) are necessary for your agency or tribe to monitor or regulate legally mandated performance objectives or policies.

**Medium** - Management Question and Information has no legal or other binding performance commitments, but your agency or tribe thinks it is a critical monitoring information need for regional planning, policy development, implementation and/or management of actions for recovery or maintenance of a species and should be ranked high relative to other information needs for funding allocations.

**Low** - Management Question and Information has a low value to your agency or tribe for regional planning, policy development, and/or management of actions and should be ranked low relative to other information needs for funding allocations.

**Spatial Scale of Importance (choose the lowest, most detailed fish or geographic scale needed by your agency or tribe for both Anadromous and Resident Fish):**

- 1 – Population (or Sub-Population) Level
- 2 – Evolutionarily Significant Unit (ESU) or Designated Population Segment (DPS) Level
- 3 – Species Level
- 4 – Project Scale
- 5 – Tributary Scale
- 6 – Watershed Scale
- 7 – Region wide Scale

**Currently Funding Collection of Information:**

Indicate **Yes** or **No** separately for both Anadromous and Resident Fish

\* Spatial Levels: Population level, Evolutionarily Significant Unit (ESU) or Designated Population Segment (DPS) Level, Species level, Project scale, Tributary scale, Watershed scale, Region wide scale

Key Management Questions	Potential Information Needed From Regional Monitoring Programs	Species	Importance of Question/Information to Your Agency	Minimum Spatial Level of Importance *	Is Your Agency Currently Funding Collection of this Information?
<b><i>Tributary Habitat Management</i></b>					
<b>Q1. Are fish populations meeting population level objectives under federal or state mandates?</b>	<b>Indicators of fish abundance, productivity, spatial distribution, and genetic diversity in spawning and rearing areas</b>	Anadromous Resident Fish			
a. What is the size of adult anadromous and resident fish populations?	Numbers of adult fish	Anadromous Resident Fish			
b. What is the distribution of fish populations?	Presence/absence and relative abundance pattern of adult fish	Anadromous Resident Fish			
c. What is the population growth rate of fish populations?	Returns/Spawner, lambda, temporal trends	Anadromous Resident Fish			
d. What is the freshwater productivity of fish populations?	Egg, smolt, fry, parr or juvenile resident fish produced per adult, spawner, or redd	Anadromous Resident Fish			
e. What is the age structure of fish populations?	Age of returning adults or spawners	Anadromous Resident Fish			
f. What fraction of the spawners of fish populations is of hatchery origin?	Ratio of hatchery to total fish abundances	Anadromous Resident Fish			
g. How frequently do fish spawn?	Age and frequency of spawning	Anadromous Resident Fish			
h. What life history types make up different populations?	Age and size at maturity, residence vs. anadromy, seasonal run timing of adults, juvenile migration patterns (yearling vs. subyearling, distribution of summer and winter rearing areas	Anadromous Resident Fish			
i. Are escapement or population size goals	Numbers and distributions of adult fish	Anadromous			

\* Spatial Levels: Population level, Evolutionarily Significant Unit (ESU) or Designated Population Segment (DPS) Level, Species level, Project scale, Tributary scale, Watershed scale, Region wide scale

Key Management Questions	Potential Information Needed From Regional Monitoring Programs	Species	Importance of Question/Information to Your Agency	Minimum Spatial Level of Importance *	Is Your Agency Currently Funding Collection of this Information?
for ESU or DPS population groupings adequately defined and being met?		Resident Fish			
<b>Q2. Are aquatic, riparian, and upland ecosystems being degraded, restored or unchanged relative to desired conditions or objectives?</b>	<b>Indicators of aquatic, riparian, and upland ecosystem conditions</b>	Anadromous Resident Fish			
a. What is the biological condition of spawning and rearing habitat for fish populations?	Macro-invertebrate and fish assemblages, or Index of Biotic Integrity (IBI) metrics/indices	Anadromous Resident Fish			
b. What is the physical condition of spawning and rearing habitat for fish populations?	Valley characteristics (valley bottom types, valley widths and gradients, valley containment, road density, land ownership, land use); Channel characteristics (bed-form types, channel types, gradient, width/depth ratio, stability); Riparian vegetation (structure, disturbance, canopy cover); Habitat access (dams and diversions); Stream flows; Habitat quality (substrate, embeddedness, large woody debris, pools, off-channel habitat, fish cover, fine-sediments), Aquatic Macrophyte Levels	Anadromous Resident Fish			
c. What is the water quality in spawning and rearing habitats for fish populations?	Temperature, turbidity, conductivity, pH, dissolved oxygen, nutrients, toxic pollutants and heavy metals, benthic macro-invertebrate assemblages	Anadromous Resident Fish			
<b>Q3. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives?</b>	<b>Habitat actions and indicators of habitat and fish conditions</b>	Anadromous Resident Fish			
a. Did all tributary habitat actions in aggregate for a fish population increase juvenile survival or adult abundance,	Type, location, timing and intensity of habitat actions, and juvenile survival or adult abundances	Anadromous Resident Fish			

\* Spatial Levels: Population level, Evolutionarily Significant Unit (ESU) or Designated Population Segment (DPS) Level, Species level, Project scale, Tributary scale, Watershed scale, Region wide scale

<b>Key Management Questions</b>	<b>Potential Information Needed From Regional Monitoring Programs</b>	<b>Species</b>	<b>Importance of Question/Information to Your Agency</b>	<b>Minimum Spatial Level of Importance *</b>	<b>Is Your Agency Currently Funding Collection of this Information?</b>
compared to a similar fish population with few or no habitat actions?					
b. What contribution did all tributary habitat actions for a fish population make toward increasing the population growth rate?	Type, location, timing and intensity of habitat actions, and ESU population growth rates	Anadromous Resident Fish			
c. Did a single tributary habitat action increase local fish abundance or distribution, or improve local environmental conditions, compared to a similar control or reference site?	Type, location, timing and intensity of habitat action, local fish abundance or distribution, and/or habitat conditions	Anadromous Resident Fish			
d. Did some classes of actions (e.g., riparian restoration actions) perform better than other classes (e.g., passage improvement actions) in improving localized conditions or sub-population juvenile survival rates?	Type, location, timing and intensity of habitat actions, and local habitat conditions and/or juvenile fish survivals	Anadromous Resident Fish			
<b>Q4. What are the limiting factors or threats preventing the achievement of desired habitat or fish performance objectives?</b>	<b>Indicators of habitat and fish conditions</b>	Anadromous Resident Fish			
a. What is the relationship of habitat processes and functions of upslope, riparian, and aquatic systems to biological and environmental habitat attributes?	Watershed condition metrics identified above under Q2.	Anadromous Resident Fish			
b. What is the relationship of habitat attributes, processes, and/or functions to fish and wildlife abundance, productivity, and diversity?	Watershed condition and fish population metrics identified above under Q1 and Q2.	Anadromous Resident Fish			
c. Are there delayed mortality effects of tributary habitat conditions for migratory fish?	Habitat conditions, fish survival at subsequent life stages, Smolt-to-Adult return Ratios (SARs), other out-of-basin effects	Anadromous Resident Fish			
Additional Tributary Habitat Management Questions:					

\* Spatial Levels: Population level, Evolutionarily Significant Unit (ESU) or Designated Population Segment (DPS) Level, Species level, Project scale, Tributary scale, Watershed scale, Region wide scale

Key Management Questions	Potential Information Needed From Regional Monitoring Programs	Species	Importance of Question/Information to Your Agency	Minimum Spatial Level of Importance *	Is Your Agency Currently Funding Collection of this Information?
<b>Hydro System Management</b>					
<b>Q5. Are salmon and steelhead meeting juvenile and adult hydro passage performance objectives?</b>	<b>Indicators of fish and habitat conditions within the hydro system</b>	Anadromous			
a. Are smolts achieving survival standards prescribed in the NOAA Biological Opinions?	Smolt survival estimates through impounded reaches of the Snake and lower Columbia  System survival estimates reflecting delayed effects of transported smolts	Anadromous			
b. Are adults achieving survival standards prescribed in the NOAA Biological Opinions?	Survival indices of adult salmon and steelhead through the hydro system.	Anadromous			
<b>Q6. What is the magnitude of post release mortality or stress associated with transporting smolts?</b>	<b>Indicators of transportation, and pre and post-transportation fish and habitat conditions and mortality</b>	Anadromous			
a. Under what conditions does in river passage yield higher Smolt to Adult Ratios (SAR) than transport?	Estimates of transport and in-river SARs (TIR), and in-river survival (to calculate D) for wild and hatchery fish	Anadromous			
b. Is transport appropriate for some locations and not others?	Transport and in-river SAR estimates for wild and hatchery fish	Anadromous			
<b>Q7. Do fish migrating in-river through the hydro system incur delayed mortality?</b>	<b>Indicators of in-river, and pre- and post-in-river fish and habitat conditions and mortality</b>	Anadromous  Resident Fish			
a. What is the magnitude of such effects?	SARs linked to different smolt passage fates or experiences	Anadromous  Resident Fish			
b. What are the causes and can they be rectified?	Localized smolt survival rates (identify zones of particularly intense mortality that could depress SAR)	Anadromous  Resident Fish			

\* Spatial Levels: Population level, Evolutionarily Significant Unit (ESU) or Designated Population Segment (DPS) Level, Species level, Project scale, Tributary scale, Watershed scale, Region wide scale

Key Management Questions	Potential Information Needed From Regional Monitoring Programs	Species	Importance of Question/Information to Your Agency	Minimum Spatial Level of Importance *	Is Your Agency Currently Funding Collection of this Information?
Additional Hydro System Management Questions:					
<b>Estuary and Ocean Management</b>					
<b>Q8. Are aquatic, riparian, and upland ecosystems of the estuary being degraded, restored or unchanged relative to desired conditions or objectives?</b>	<b>Indicators of aquatic, riparian, and upland ecosystem conditions of the estuary</b>	Anadromous Resident Fish			
a. To what quantitative extent are we avoiding further loss to existing shallow water wetland habitat and restoring degraded habitats?	Characterization of vegetation cover, geology/soils, floodplain topography, bathymetry, hydrology, salinity, temperature	Anadromous Resident Fish			
b. What is the amount of habitat that is restored annually for each habitat type and for each reach of the estuary?	Measurements of area affected	Anadromous Resident Fish			
c. What is the index of habitat connectivity by reach and its status/trend?	<u>Connectivity</u> – inventory of passage barriers and total edge, density and sinuosity of floodplain and tidal channels.	Anadromous Resident Fish			
<b>Q9. What are the status/trends in attributes of the estuary, plume, and ocean ecosystems?</b>	<b>Indicators of fish and habitat conditions in the estuary, plume, and ocean</b>	Anadromous Resident Fish			
a. What are estuary habitat physical properties?	<u>Habitat</u> – Characterization of vegetation cover, geology/soils, floodplain topography, measurements of bathymetry, hydrology, salinity, temperature	Anadromous Resident Fish			
b. What are estuary fish population properties?	<u>Fish</u> – Estimates of species composition, age/size-structure, stock identity, temporal distribution, spatial distribution, migration pathways, growth rate, residence time, prey availability, foraging success, survival rate, predation index	Anadromous Resident Fish			
c. What are estuary hydrograph and water quality properties?	<u>Water</u> – Measurements of hydrograph, temperature, salinity, dissolved oxygen, pH, turbidity, nutrients, toxics. <u>Barriers</u> – flow,	Anadromous Resident Fish			

\* Spatial Levels: Population level, Evolutionarily Significant Unit (ESU) or Designated Population Segment (DPS) Level, Species level, Project scale, Tributary scale, Watershed scale, Region wide scale

Key Management Questions	Potential Information Needed From Regional Monitoring Programs	Species	Importance of Question/Information to Your Agency	Minimum Spatial Level of Importance *	Is Your Agency Currently Funding Collection of this Information?
	floodplain connectivity.				
d. What are the environmental conditions and ecology in the plume and ocean relative to anadromous and resident fish production and survival?	<u>Plume and Ocean</u> – Estimates of juvenile salmon usage, growth, survival, zooplankton prey base, and anchovy/ herring index in the plume and measurements of sea surface temperature, northern oscillation index, upwelling index, chlorophyll	Anadromous Resident Fish			
<b>Q10. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives in the Estuary or Ocean?</b>	<b>Actions and associated habitat and fish responses in the estuary and ocean</b>	Anadromous Resident Fish			
a. What is the cumulative effect of multiple habitat restoration or protection projects on the estuary ecosystem?	See “Connectivity”, “Habitat” and “Fish” above under Q8 and Q9	Anadromous Resident Fish			
b. What are the effects of hydrologic reconnection projects (e.g., dike breaches, new tide gates and culverts) and revegetation projects on the estuary?	See “Connectivity”, “Habitat”, “Fish” and “Invasives” above under Q8 and Q9	Anadromous Resident Fish			
c. What possible changes to hydro power operations might improve habitat conditions in the estuary for salmonids?	See “Connectivity”, “Habitat”, “Fish” and “Invasives” above under Q8 and Q9	Anadromous Resident Fish			
<b>Q11. What are the limiting factors or threats in the estuary preventing the achievement of desired habitat or fish performance objectives?</b>	<b>Indicators of habitat and fish conditions in the estuary</b>	Anadromous Resident Fish			
a. What is the ecological importance of the estuary and oceanic plume to the viability and recovery of fish populations?	See “Connectivity”, “Habitat”, “Fish”, “Invasives” and “Plume and Ocean” above under Q8 and Q9	Anadromous Resident Fish			
b. What are the effects of toxics in the estuary on fish populations?	See “Fish” above under Q9, plus estimates of concentrations and distributions of toxics	Anadromous Resident Fish			

\* Spatial Levels: Population level, Evolutionarily Significant Unit (ESU) or Designated Population Segment (DPS) Level, Species level, Project scale, Tributary scale, Watershed scale, Region wide scale

<b>Key Management Questions</b>	<b>Potential Information Needed From Regional Monitoring Programs</b>	<b>Species</b>	<b>Importance of Question/Information to Your Agency</b>	<b>Minimum Spatial Level of Importance *</b>	<b>Is Your Agency Currently Funding Collection of this Information?</b>
c. What are the causal mechanisms affecting survival of juvenile salmon during their first months in the ocean?	See "Fish" and "Plume and Ocean" above under Q9	Anadromous Resident Fish			
d. What is the survival rate by species of fish migrating downstream through the estuary?	Estimates of fish survival rates and predation indices	Anadromous Resident Fish			
Additional Estuary and Ocean Management Questions:					
<b>Hatchery Management</b>					
<b>Q12. What effect do hatchery programs have on natural ecosystem and native fish health?</b>	<b>Hatchery production and indicators of ecosystem and native fish health</b>	Anadromous Resident Fish			
a. What is the relative proportion of hatchery spawning fish compared to wild fish populations?	Ratio of hatchery fish to total fish abundance	Anadromous Resident Fish			
<b>Q13. To what extent can hatcheries be used to assist in meeting harvest management goals or maintain the viability or conserve the genetic legacy of natural fish populations?</b>	<b>Indicators of hatchery and wild fish production and harvest rates</b>	Anadromous Resident Fish			
a. Can hatchery reforms and new programs reduce the deleterious effects of artificial production on listed populations, thereby contributing to increased viability and a reduction in extinction risk for affected natural populations?	Returns/spawner, lambda, temporal trends, or other metrics as determined by experimental design	Anadromous Resident Fish			
b. Can properly designed intervention programs using artificial production make a net positive contribution to recovery of listed populations?	Returns/spawner, lambda, temporal trends	Anadromous Resident Fish			
<b>Q14. What is the reproductive success of hatchery fish spawning in the wild</b>	Number of offspring produced by hatchery x hatchery, hatchery x wild, and wild x wild	Anadromous			

\* Spatial Levels: Population level, Evolutionarily Significant Unit (ESU) or Designated Population Segment (DPS) Level, Species level, Project scale, Tributary scale, Watershed scale, Region wide scale

<b>Key Management Questions</b>	<b>Potential Information Needed From Regional Monitoring Programs</b>	<b>Species</b>	<b>Importance of Question/Information to Your Agency</b>	<b>Minimum Spatial Level of Importance *</b>	<b>Is Your Agency Currently Funding Collection of this Information?</b>
<b>relative to the reproductive success of wild fish?</b>	matings in natural spawning areas and subsequent adult returns from each type of cross	Resident Fish			
Additional Hatchery Management Questions:					
<b>Harvest Management</b>					
<b>Q15. What are the harvest rates on wild and hatchery harvest management groups?</b>	<b>Numbers of adult fish harvested and numbers of adult fish escaping</b>	Anadromous Resident Fish			
a. What is the uncertainty around harvest point estimates?	Numbers of adult fish harvested and numbers of adult fish escaping	Anadromous Resident Fish			
b. What are the estimates of population size and escapement for each harvest management group?	Coded Wire Tags, catch per unit effort, age class data, numbers of jacks and adults	Anadromous Resident Fish			
c. What is the target and nontarget harvest and when is it projected to reach allowable levels?	Fish harvest and escapement numbers	Anadromous Resident Fish			
<b>Q16. Are new selective gear types effective at harvesting?</b>	<b>Catch per unit of effort; catch related to capital and operating expense</b>	Anadromous Resident Fish			
<b>Q17. Are there delayed or incidental mortality effects associated with fish harvest?</b>	<b>Harvest and subsequent life stage survival rates</b>	Anadromous Resident Fish			
a. What is the post-release survival of fish caught in a selective fishery compared to fish that were not harvested?	Catch, Release, and Survival rates	Anadromous Resident Fish			
Additional Hatchery Management Questions:					
<b>Predator and Invasive Species Management</b>					
<b>Q18. What is the impact of predators on juvenile fish?</b>	<b>Indicators of predator populations and fish conditions or mortality</b>	Anadromous Resident Fish			

\* Spatial Levels: Population level, Evolutionarily Significant Unit (ESU) or Designated Population Segment (DPS) Level, Species level, Project scale, Tributary scale, Watershed scale, Region wide scale

<b>Key Management Questions</b>	<b>Potential Information Needed From Regional Monitoring Programs</b>	<b>Species</b>	<b>Importance of Question/Information to Your Agency</b>	<b>Minimum Spatial Level of Importance *</b>	<b>Is Your Agency Currently Funding Collection of this Information?</b>
a. What are the nesting distribution, colony size, and colony productivity for avian predators?	Presence/absence of avian predator colonies, colony size, number of nesting pairs, reproductive chronology, reproductive success rates	Anadromous Resident Fish			
b. What are the fish consumption rates of major avian predators?	Diet composition, consumption rates	Anadromous Resident Fish			
c. What are the consumption rates of major piscivorous predators in the?	Abundance, distribution, diet composition, fecundity consumption rates	Anadromous Resident Fish			
<b>Q19. What is the impact of predators on adult fish?</b>	<b>Indicators of predator populations and adult fish conditions or mortality</b>	Anadromous Resident Fish			
a. What are the consumption rates of mammalian predators (marine)?	Abundance, distribution, consumption rates, diet composition	Anadromous Resident Fish			
<b>Q20. What are the most effective management alternatives/actions that could be used to reduce the impact of predators?</b>	<b>Actions and predator or fish responses</b>	Anadromous Resident Fish			
a. What is the effect of alternative management alternatives/actions used to reduce the impact of avian predators?	% change in juvenile fish survival % change in avian predation rate	Anadromous Resident Fish			
b. What is the effect of management alternatives/actions used to reduce the impact of piscivorous predators?	% change in fish survival % change in piscivorous predation rate	Anadromous Resident Fish			
<b>Q21. What are the most effective management alternatives/actions that could be used to reduce the impact of predators?</b>	% change in juvenile salmonid survival % change in piscivorous predation rate	Anadromous Resident Fish			
Additional Predator and Invasive Species Management Questions:					

PLEASE ADD ANY ADDITIONAL MANAGEMENT QUESTIONS or issues IMPORTANT TO YOUR AGENCY OR TRIBE THAT YOU THINK WE HAVE MISSED IN THIS SURVEY:

Please add any comments you would have regarding this survey:

Make sure to [SAVE](#) your responses before you return this survey to Jen Bayer at [jennifer\\_bayer@usgs.gov](mailto:jennifer_bayer@usgs.gov).

Thank you for participating in this survey. The results will be circulated to you once they have been compiled.

## Appendix B- Agency/ Tribe Responses

Appendix Table B1.— Summary of responses to PNAMP Management Question Survey (2006) by participating agencies regarding anadromous fish for questions of importance (as defined below) and funding provided by respondents. Text in blue, bold, and underlined indicates funding by the responding agency. Responses shaded in gray indicate a response of importance, but no response regarding funding. A “\” indicates no response to this question.

High (H): Management Question and Information is: a) a direct responsibility of your agency or tribe through a legal mandate or other regional commitment; b) needed to plan, implement or adapt actions by your agency or tribe that are legally mandated; or c) are necessary for your agency or tribe to monitor or regulate legally mandated performance objectives or policies.

Medium (M): Management Question and Information has no legal or other binding performance commitments, but your agency or tribe thinks it is a critical monitoring information need for regional planning, policy development, implementation and/or management of actions for recovery or maintenance of a species and should be ranked high relative to other information needs for funding allocations.

Low (L): Management Question and Information has a low value to your agency or tribe for regional planning, policy development, and/or management of actions and should be ranked low relative to other information needs for funding allocations.

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
1. Are fish populations meeting population level objectives under federal or state mandates?	<u>H</u>	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	<u>H</u>	<u>M</u>	\	<u>M</u>	L	H	<u>H</u>	<u>H</u>
1a. What is the size of adult anadromous and resident fish populations?	<u>H</u>	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	<u>H</u>	<u>M</u>	<u>H</u>	<u>H</u>	L	H	<u>H</u>	<u>H</u>
1b. What is the distribution of fish populations?	<u>H</u>	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	<u>H</u>	<u>M</u>	<u>H</u>	<u>H</u>	H	M	<u>H</u>	<u>H</u>
1c. What is the population growth rate of fish populations?	<u>H</u>	<u>H</u>	<u>M</u>	<u>H</u>	H	L	<u>H</u>	<u>H</u>	<u>M</u>	\	<u>M</u>	L	M	M	<u>H</u>
1d. What is the freshwater productivity of fish populations?	<u>M</u>	<u>H</u>	<u>H</u>	<u>M</u>	M	L	<u>H</u>	H	<u>M</u>	<u>H</u>	L	L	H	<u>H</u>	<u>H</u>
1e. What is the age structure of fish populations?	<u>M</u>	<u>H</u>	<u>M</u>	<u>M</u>	M	L	<u>H</u>	<u>H</u>	<u>M</u>	\	L	L	M	M	<u>H</u>
1f. What fraction of the spawners of fish populations is of hatchery origin?	<u>H</u>	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	<u>H</u>	L	<u>H</u>	<u>L</u>	L	M	<u>H</u>	<u>M</u>
1g. How frequently do fish spawn?	M	<u>L</u>	<u>M</u>	<u>M</u>	M	L	<u>H</u>	<u>M</u>	<u>H</u>	\	L	L	L	M	<u>H</u>
1h. What life history types make up different populations?	L	<u>H</u>	<u>H</u>	<u>M</u>	M	L	<u>H</u>	<u>H</u>	<u>M</u>	\	L	L	M	M	<u>H</u>
1i. Are escapement or population size goals for ESU or DPS population groupings adequately defined and being met?	M	<u>H</u>	<u>H</u>	<u>H</u>	M	L	<u>H</u>	<u>H</u>	<u>M</u>	L	L	L	H	H	<u>H</u>

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
2. Are aquatic, riparian, and upland ecosystems being degraded, restored or unchanged relative to desired conditions or objectives?	<u>M</u>	<u>H</u>	<u>M</u>	<u>M</u>	H	<u>H</u>	<u>M</u>	<u>H</u>	<u>H</u>	\	<u>H</u>	<u>M</u>	H	<u>H</u>	<u>H</u>
2a. What is the biological condition of spawning and rearing habitat for fish populations?	<u>M</u>	<u>H</u>	<u>M</u>	L	L	<u>H</u>	<u>M</u>	<u>H</u>	<u>M</u>	<u>H</u>	<u>H</u>	<u>M</u>	M	<u>H</u>	<u>H</u>
2b. What is the physical condition of spawning and rearing habitat for fish populations?	<u>M</u>	<u>H</u>	<u>M</u>	M	<u>H</u>	<u>H</u>	<u>M</u>	<u>H</u>	<u>H</u>	<u>H</u>	<u>H</u>	<u>M</u>	H	<u>H</u>	<u>H</u>
2c. What is the water quality in spawning and rearing habitats for fish populations?	<u>M</u>	<u>H</u>	<u>M</u>	M	H	<u>H</u>	M	<u>H</u>	<u>H</u>	\	<u>H</u>	<u>H</u>	H	<u>H</u>	<u>H</u>
3. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives?	<u>H</u>	<u>H</u>	<u>H</u>	<u>M</u>	H	<u>M</u>	<u>M</u>	<u>H</u>	<u>H</u>	\	<u>H</u>	<u>M</u>	M	<u>H</u>	<u>H</u>
3a. Did all tributary habitat actions in aggregate for a fish population increase juvenile survival or adult abundance, compared to a similar fish population with few or no habitat actions?	<u>H</u>	<u>H</u>	H	<u>M</u>	H	L	M	H	<u>M</u>	H	<u>M</u>	<u>L</u>	M	<u>H</u>	<u>H</u>
3b. What contribution did all tributary habitat actions for a fish population make toward increasing the population growth rate?	<u>H</u>	<u>H</u>	H	<u>M</u>	H	L	M	H	<u>M</u>	\	M	<u>L</u>	H	<u>H</u>	<u>H</u>
3c. Did a single tributary habitat action increase local fish abundance or distribution, or improve local environmental conditions, compared to a similar control or reference site?	<u>M</u>	<u>M</u>	<u>M</u>	<u>M</u>	M	<u>H</u>	<u>M</u>	<u>H</u>	<u>M</u>	<u>H</u>	<u>M</u>	<u>L</u>	L	<u>H</u>	<u>H</u>
3d. Did some classes of actions (e.g., riparian restoration actions) perform better than other classes (e.g., passage improvement actions) in improving localized conditions or sub-population juvenile survival rates?	<u>M</u>	<u>H</u>	H	M	H	<u>H</u>	M	H	<u>M</u>	H	<u>H</u>	<u>M</u>	M	<u>H</u>	\
4. What are the limiting factors or threats preventing the achievement of desired habitat or fish performance objectives?	<u>M</u>	<u>H</u>	<u>H</u>	M	M	<u>M</u>	<u>H</u>	H	<u>H</u>	\	<u>M</u>	<u>M</u>	H	<u>H</u>	<u>H</u>
4a. What is the relationship of habitat processes and functions of upslope, riparian, and aquatic systems to biological and environmental habitat attributes?	L	<u>H</u>	<u>H</u>	M	L	<u>H</u>	M	H	<u>H</u>	<u>H</u>	<u>H</u>	<u>M</u>	L	M	\

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
4b. What is the relationship of habitat attributes, processes, and/or functions to fish and wildlife abundance, productivity, and diversity?	<u>M</u>	<u>H</u>	<u>H</u>	M	M	<u>M</u>	M	H	<u>H</u>	<u>H</u>	<u>H</u>	<u>L</u>	L	M	\
4c. Are there delayed mortality effects of tributary habitat conditions for migratory fish?	M	<u>M</u>	<u>M</u>	M	L	L	<u>M</u>	H	M	H	M	<u>L</u>	L	M	\
5. Are salmon and steelhead meeting juvenile and adult hydro passage performance objectives?	<u>H</u>	<u>H</u>	\	<u>H</u>	H	L	<u>H</u>	<u>H</u>	L	\	L	L	H	M	H
5a. Are smolts achieving survival standards prescribed in the NOAA Biological Opinions?	<u>H</u>	L	\	<u>H</u>	H	L	<u>H</u>	<u>H</u>	L	H	L	L	H	<u>H</u>	\
5b. Are adults achieving survival standards prescribed in the NOAA Biological Opinions?	<u>H</u>	<u>H</u>	\	<u>H</u>	H	L	<u>H</u>	<u>H</u>	L	\	L	L	H	H	\
6. What is the magnitude of post release mortality or stress associated with transporting smolts?	<u>H</u>	L	\	H	H	L	<u>H</u>	<u>H</u>	L	\	L	L	M	M	H
6a. Under what conditions does in river passage yield higher Smolt to Adult Ratios (SAR) than transport?	<u>H</u>	L	\	<u>H</u>	H	L	<u>H</u>	<u>H</u>	L	\	L	L	M	M	\
6b. Is transport appropriate for some locations and not others?	<u>M</u>	L	\	<u>M</u>	H	M	<u>H</u>	<u>H</u>	L	\	L	L	L	L	\
7. Do fish migrating in-river through the hydro system incur delayed mortality?	<u>H</u>	L	\	H	H	L	<u>H</u>	H	L	H	L	L	M	L	H
7a. What is the magnitude of such effects?	<u>H</u>	L	\	<u>H</u>	M	L	<u>H</u>	H	L	H	L	L	M	L	\
7b. What are the causes and can they be rectified?	<u>M</u>	L	\	H	M	L	<u>H</u>	<u>H</u>	L	\	L	L	M	M	\
8. Are aquatic, riparian, and upland ecosystems of the estuary being degraded, restored or unchanged relative to desired conditions or objectives?	<u>M</u>	M	<u>M</u>	M	L	<u>M</u>	<u>M</u>	<u>H</u>	<u>M</u>	\	L	<u>M</u>	H	<u>H</u>	\
8a. To what quantitative extent are we avoiding further loss to existing shallow water wetland habitat and restoring degraded habitats?	<u>M</u>	M	<u>M</u>	L	L	L	<u>M</u>	H	L	\	<u>M</u>	<u>H</u>	M	L	\
8b. What is the amount of habitat that is restored annually for each habitat type and for each reach of the estuary?	<u>M</u>	M	<u>M</u>	L	L	L	<u>M</u>	H	L	\	<u>M</u>	L	M	<u>H</u>	\
8c. What is the index of habitat connectivity by reach and its status/trend?	M	H	<u>M</u>	<u>L</u>	L	L	M	H	<u>M</u>	\	<u>M</u>	L	M	<u>H</u>	\
9. What are the status/trends in attributes of the estuary, plume, and ocean ecosystems?	<u>M</u>	H	<u>M</u>	L	L	<u>M</u>	<u>M</u>	<u>H</u>	L	\	L	H	M	M	\

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
9a. What are estuary habitat physical properties?	<u>M</u>	M	<u>M</u>	L	L	<u>H</u>	<u>M</u>	<u>H</u>	<u>M</u>	\	<u>M</u>	H	H	M	\
9b. What are estuary fish population properties?	<u>M</u>	H	M	L	M	L	<u>H</u>	<u>H</u>	L	\	<u>M</u>	L	M	L	\
9c. What are estuary hydrograph and water quality properties?	<u>M</u>	M	<u>M</u>	L	L	<u>H</u>	M	<u>H</u>	L	\	<u>H</u>	H	M	M	\
9d. What are the environmental conditions and ecology in the plume and ocean relative to anadromous and resident fish production and survival?	<u>M</u>	H	M	M	M	L	M	<u>H</u>	L	\	<u>L</u>	H	M	L	\
10. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives in the Estuary or Ocean?	<u>H</u>	H	<u>M</u>	M	L	<u>M</u>	M	<u>H</u>	L	\	L	L	M	H	\
10a. What is the cumulative effect of multiple habitat restoration or protection projects on the estuary ecosystem?	<u>H</u>	H	M	L	L	H	M	H	L	\	M	L	M	<u>H</u>	\
10b. What are the effects of hydrologic reconnection projects (e.g., dike breaches, new tide gates and culverts) and revegetation projects on the estuary?	<u>M</u>	H	<u>M</u>	M	L	L	<u>M</u>	H	<u>H</u>	\	<u>M</u>	L	M	<u>H</u>	\
10c. What possible changes to hydro power operations might improve habitat conditions in the estuary for salmonids?	<u>M</u>	H	L	M	M	L	M	H	L	\	L	L	M	M	\
11. What are the limiting factors or threats in the estuary preventing the achievement of desired habitat or fish performance objectives?	<u>M</u>	<u>H</u>	<u>M</u>	H	M	<u>M</u>	M	<u>H</u>	<u>M</u>	\	L	M	M	<u>H</u>	\
11a. What is the ecological importance of the estuary and oceanic plume to the viability and recovery of fish populations?	M	H	M	M	M	L	M	<u>H</u>	M	\	M	M	M	M	\
11b. What are the effects of toxics in the estuary on fish populations?	M	M	M	L	M	H	M	M	L	\	L	M	M	M	\
11c. What are the causal mechanisms affecting survival of juvenile salmon during their first months in the ocean?	M	H	M	M	L	L	M	<u>H</u>	L	\	L	L	M	H	\
11d. What is the survival rate by species of fish migrating downstream through the estuary?	<u>H</u>	H	<u>H</u>	M	M	L	M	<u>H</u>	L	\	L	<u>L</u>	M	L	\
12. What effect do hatchery programs have on natural ecosystem and native fish health?	<u>M</u>	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	H	L	\	L	L	M	M	<u>H</u>

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
12a. What is the relative proportion of hatchery spawning fish compared to wild fish populations?	<u>H</u>	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	<u>H</u>	L	H	L	L	M	<u>H</u>	<u>H</u>
13. To what extent can hatcheries be used to assist in meeting harvest management goals or maintain the viability or conserve the genetic legacy of natural fish populations?	M	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	H	L	\	L	L	M	M	<u>H</u>
13a. Can hatchery reforms and new programs reduce the deleterious effects of artificial production on listed populations, thereby contributing to increased viability and a reduction in extinction risk for affected natural populations?	<u>M</u>	<u>M</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	H	L	H	L	L	M	H	<u>H</u>
13b. Can properly designed intervention programs using artificial production make a net positive contribution to recovery of listed populations?	<u>H</u>	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	H	L	H	<u>L</u>	L	M	M	<u>H</u>
14. What is the reproductive success of hatchery fish spawning in the wild relative to the reproductive success of wild fish?	<u>H</u>	<u>H</u>	H	<u>H</u>	H	L	<u>H</u>	M	L	<u>H</u>	L	L	M	M	<u>H</u>
15. What are the harvest rates on wild and hatchery harvest management groups?	M	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	H	L	\	L	L	M	H	<u>H</u>
15a. What is the uncertainty around harvest point estimates?	M	<u>M</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	H	L	\	L	L	M	H	<u>M</u>
15b. What are the estimates of population size and escapement for each harvest management group?	M	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	H	L	\	L	L	H	M	<u>H</u>
15c. What is the target and nontarget harvest and when is it projected to reach allowable levels?	M	<u>H</u>	<u>H</u>	<u>H</u>	H	L	<u>H</u>	H	L	\	L	L	M	M	<u>H</u>
16. Are new selective gear types effective at harvesting?	<u>M</u>	<u>H</u>	M	L	L	L	<u>H</u>	H	L	\	L	L	M	H	L
17. Are there delayed or incidental mortality effects associated with fish harvest?	M	<u>M</u>	<u>H</u>	H	M	L	<u>H</u>	H	L	\	\	L	M	M	M
17a. What is the post-release survival of fish caught in a selective fishery compared to fish that were not harvested?	M	<u>H</u>	<u>H</u>	H	M	L	<u>H</u>	H	L	\	L	L	L	M	H
18. What is the impact of predators on juvenile fish?	<u>H</u>	<u>H</u>	<u>H</u>	M	M	L	<u>H</u>	<u>H</u>	L	\	L	L	M	M	<u>M</u>
18a. What are the nesting distribution, colony size, and colony productivity for avian predators?	<u>M</u>	M	M	M	L	L	H	<u>H</u>	L	\	L	L	M	M	M
18b. What are the fish consumption rates of major avian predators?	<u>H</u>	M	H	M	M	L	H	<u>H</u>	L	\	L	L	M	M	<u>H</u>

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
18c. What are the consumption rates of major piscivorous predators in the [Columbia River Basin]?	<u>H</u>	<u>H</u>	<u>H</u>	M	L	L	<u>H</u>	H	L	\	L	L	M	M	<u>H</u>
19. What is the impact of predators on adult fish?	M	L	<u>H</u>	M	L	L	<u>H</u>	<u>H</u>	L	\	L	L	L	M	M
19a. What are the consumption rates of mammalian predators (marine)?	M	L	<u>H</u>	M	L	L	<u>H</u>	<u>H</u>	L	\	L	L	L	M	H
20. What are the most effective management alternatives/actions that could be used to reduce the impact of predators?	<u>H</u>	<u>H</u>	<u>M</u>	M	L	L	<u>H</u>	<u>H</u>	L	\	L	L	M	M	M
20a. What is the effect of alternative management alternatives/actions used to reduce the impact of avian predators?	<u>H</u>	L	M	M	L	L	H	<u>H</u>	L	\	L	L	M	M	M
20b. What is the effect of management alternatives/actions used to reduce the impact of piscivorous predators?	<u>H</u>	<u>H</u>	<u>H</u>	M	L	L	<u>H</u>	H	L	\	L	L	M	M	M

Appendix Table B2.— Summary of responses to PNAMP Management Question Survey (2006) by participating agencies regarding resident fish for questions of importance (as defined below) and funding provided by respondents. Text in blue, bold, and underlined indicates funding by the responding agency. Responses shaded in gray indicate a response of importance, but no response regarding funding. A “\” indicates no response to this question. WGSRO did not respond regarding funding for all questions except Question 11 and USACE did not respond regarding funding for Question 4. Questions 5 and 6 were omitted as the questions were not applicable to resident fish.

High (H): Management Question and Information is: a) a direct responsibility of your agency or tribe through a legal mandate or other regional commitment; b) needed to plan, implement or adapt actions by your agency or tribe that are legally mandated; or c) are necessary for your agency or tribe to monitor or regulate legally mandated performance objectives or policies.

Medium (M): Management Question and Information has no legal or other binding performance commitments, but your agency or tribe thinks it is a critical monitoring information need for regional planning, policy development, implementation and/or management of actions for recovery or maintenance of a species and should be ranked high relative to other information needs for funding allocations.

Low (L): Management Question and Information has a low value to your agency or tribe for regional planning, policy development, and/or management of actions and should be ranked low relative to other information needs for funding allocations.

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
1. Are fish populations meeting population level objectives under federal or state mandates?	<u>M</u>	<u>H</u>	\	<u>H</u>	L	L	<u>M</u>	<u>H</u>	<u>M</u>	\	<u>M</u>	L	L	M	<u>M</u>
1a. What is the size of adult anadromous and resident fish populations?	<u>M</u>	<u>H</u>	\	<u>H</u>	M	L	<u>M</u>	<u>H</u>	<u>M</u>	\	<u>H</u>	L	L	\	<u>H</u>
1b. What is the distribution of fish populations?	<u>L</u>	<u>H</u>	\	<u>H</u>	L	L	<u>M</u>	<u>H</u>	<u>M</u>	\	<u>H</u>	H	L	<u>H</u>	<u>H</u>
1c. What is the population growth rate of fish populations?	L	<u>H</u>	\	M	L	L	<u>M</u>	<u>H</u>	<u>M</u>	\	<u>M</u>	L	L	L	<u>M</u>
1d. What is the freshwater productivity of fish populations?	<u>H</u>	<u>H</u>	\	M	L	L	<u>M</u>	H	<u>M</u>	\	L	L	L	L	<u>M</u>
1e. What is the age structure of fish populations?	<u>M</u>	<u>L</u>	\	M	L	L	<u>M</u>	<u>H</u>	<u>M</u>	\	L	L	L	L	<u>M</u>
1f. What fraction of the spawners of fish populations is of hatchery origin?	L	<u>H</u>	\	<u>H</u>	L	L	L	<u>M</u>	L	\	<u>L</u>	L	L	H	<u>M</u>
1g. How frequently do fish spawn?	<u>L</u>	<u>L</u>	\	M	M	L	<u>M</u>	<u>M</u>	<u>H</u>	\	L	L	L	M	<u>M</u>
1h. What life history types make up different populations?	<u>L</u>	<u>M</u>	\	M	L	L	<u>M</u>	<u>M</u>	<u>M</u>	\	L	L	L	L	<u>M</u>
1i. Are escapement or population size goals for ESU or DPS population groupings adequately defined and being met?	<u>H</u>	<u>M</u>	\	H	L	L	<u>M</u>	<u>H</u>	<u>M</u>	\	L	L	L	M	<u>M</u>

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
2. Are aquatic, riparian, and upland ecosystems being degraded, restored or unchanged relative to desired conditions or objectives?	<u>H</u>	<u>H</u>	\	H	M	<u>H</u>	<u>M</u>	<u>H</u>	<u>H</u>	\	<u>H</u>	<u>M</u>	L	<u>M</u>	<u>L</u>
2a. What is the biological condition of spawning and rearing habitat for fish populations?	<u>M</u>	<u>H</u>	\	L	L	\	<u>M</u>	<u>H</u>	<u>M</u>	\	<u>H</u>	<u>M</u>	L	<u>H</u>	<u>M</u>
2b. What is the physical condition of spawning and rearing habitat for fish populations?	<u>L</u>	<u>H</u>	\	M	<u>H</u>	<u>H</u>	<u>M</u>	<u>H</u>	<u>H</u>	\	<u>H</u>	<u>M</u>	L	<u>H</u>	<u>M</u>
2c. What is the water quality in spawning and rearing habitats for fish populations?	<u>M</u>	<u>H</u>	\	M	L	<u>M</u>	M	<u>H</u>	<u>H</u>	\	<u>H</u>	<u>H</u>	L	<u>H</u>	<u>M</u>
3. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives?	<u>H</u>	<u>M</u>	\	M	L	<u>L</u>	<u>M</u>	<u>H</u>	<u>H</u>	\	<u>H</u>	<u>M</u>	L	L	<u>M</u>
3a. Did all tributary habitat actions in aggregate for a fish population increase juvenile survival or adult abundance, compared to a similar fish population with few or no habitat actions?	<u>M</u>	<u>H</u>	\	M	L	L	M	<u>H</u>	<u>M</u>	L	<u>M</u>	<u>L</u>	L	L	<u>M</u>
3b. What contribution did all tributary habitat actions for a fish population make toward increasing the population growth rate?	<u>M</u>	<u>M</u>	\	M	L	L	M	<u>H</u>	<u>M</u>	\	M	<u>L</u>	L	L	<u>M</u>
3c. Did a single tributary habitat action increase local fish abundance or distribution, or improve local environmental conditions, compared to a similar control or reference site?	<u>M</u>	<u>L</u>	\	M	L	<u>H</u>	<u>M</u>	<u>H</u>	<u>M</u>	L	<u>M</u>	<u>L</u>	L	<u>M</u>	<u>M</u>
3d. Did some classes of actions (e.g., riparian restoration actions) perform better than other classes (e.g., passage improvement actions) in improving localized conditions or sub-population juvenile survival rates?	<u>M</u>	<u>M</u>	\	M	M	<u>H</u>	M	H	<u>M</u>	L	<u>H</u>	<u>M</u>	L	<u>M</u>	\
4. What are the limiting factors or threats preventing the achievement of desired habitat or fish performance objectives?	<u>H</u>	<u>H</u>	\	M	L	<u>M</u>	<u>M</u>	H	<u>H</u>	\	<u>M</u>	<u>M</u>	L	<u>M</u>	<u>M</u>
4a. What is the relationship of habitat processes and functions of upslope, riparian, and aquatic systems to biological and environmental habitat attributes?	<u>M</u>	<u>H</u>	\	M	L	<u>H</u>	M	H	<u>H</u>	H	<u>H</u>	<u>M</u>	L	L	\

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
4b. What is the relationship of habitat attributes, processes, and/or functions to fish and wildlife abundance, productivity, and diversity?	<u>M</u>	<u>H</u>	\	M	L	<u>M</u>	M	H	<u>H</u>	H	<u>H</u>	<u>L</u>	L	M	\
4c. Are there delayed mortality effects of tributary habitat conditions for migratory fish?	L	<u>L</u>	\	M	L	L	<u>M</u>	H	M	\	M	<u>L</u>	L	M	\
5. Are salmon and steelhead meeting juvenile and adult hydro passage performance objectives?	L	L	\	H	M	L	L	M	L	\	L	L	L	L	M
5a. Are smolts achieving survival standards prescribed in the NOAA Biological Opinions?	L	L	\	H	M	L	L	L	L	\	L	L	L	L	\
5b. Are adults achieving survival standards prescribed in the NOAA Biological Opinions?	L	L	\	H	L	L	L	L	L	\	L	L	L	M	\
6. What is the magnitude of post release mortality or stress associated with transporting smolts?	L	L	\	\	L	<u>M</u>	L	<u>M</u>	L	\	L	<u>M</u>	L	L	\
6a. Under what conditions does in river passage yield higher Smolt to Adult Ratios (SAR) than transport?	L	L	\	\	L	L	L	M	L	\	<u>M</u>	<u>H</u>	L	L	\
6b. Is transport appropriate for some locations and not others?	L	L	\	\	L	L	L	M	L	\	<u>M</u>	L	\	L	\
7. Do fish migrating in-river through the hydro system incur delayed mortality?	L	L	\	\	L	L	L	M	<u>M</u>	\	<u>M</u>	L	\	M	\
7a. What is the magnitude of such effects?	L	<u>L</u>	\	M	L	L	<u>M</u>	H	M	\	M	<u>L</u>	L	M	\
7b. What are the causes and can they be rectified?	L	L	\	H	M	L	L	M	L	\	L	L	L	L	M
8. Are aquatic, riparian, and upland ecosystems of the estuary being degraded, restored or unchanged relative to desired conditions or objectives?	L	L	\	H	M	L	L	L	L	\	L	L	L	L	\
8a. To what quantitative extent are we avoiding further loss to existing shallow water wetland habitat and restoring degraded habitats?	L	L	\	H	L	L	L	L	L	\	L	L	L	M	\
8b. What is the amount of habitat that is restored annually for each habitat type and for each reach of the estuary?	L	L	\	\	L	<u>M</u>	L	<u>M</u>	L	\	L	<u>M</u>	L	L	\
8c. What is the index of habitat connectivity by reach and its status/trend?	L	L	\	\	L	L	L	M	L	\	<u>M</u>	<u>H</u>	L	L	\
9. What are the status/trends in attributes of the estuary, plume, and ocean ecosystems?	L	L	\	\	L	<u>M</u>	L	M	L	\	L	H	L	L	\

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
9a. What are estuary habitat physical properties?	L	L	\	\	L	<u>H</u>	M	M	L	\	<u>M</u>	H	L	L	\
9b. What are estuary fish population properties?	L	L	\	\	L	L	L	<u>M</u>	L	\	<u>M</u>	L	L	L	\
9c. What are estuary hydrograph and water quality properties?	L	L	\	\	L	<u>H</u>	L	<u>M</u>	L	\	<u>H</u>	H	L	L	\
9d. What are the environmental conditions and ecology in the plume and ocean relative to anadromous and resident fish production and survival?	L	L	\	\	L	L	L	M	L	\	<u>L</u>	H	\	M	\
10. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives in the Estuary or Ocean?	L	L	\	\	L	<u>M</u>	L	M	L	\	L	L	L	L	\
10a. What is the cumulative effect of multiple habitat restoration or protection projects on the estuary ecosystem?	L	L	\	\	L	<u>H</u>	L	M	L	\	M	L	L	L	\
10b. What are the effects of hydrologic reconnection projects (e.g., dike breaches, new tide gates and culverts) and revegetation projects on the estuary?	L	L	\	\	L	L	L	M	<u>H</u>	\	<u>M</u>	L	L	L	\
10c. What possible changes to hydro power operations might improve habitat conditions in the estuary for salmonids?	L	L	\	\	L	L	L	M	L	\	L	L	L	<u>L</u>	\
11. What are the limiting factors or threats in the estuary preventing the achievement of desired habitat or fish performance objectives?	L	L	\	\	L	<u>M</u>	L	M	<u>M</u>	\	L	M	\	L	\
11a. What is the ecological importance of the estuary and oceanic plume to the viability and recovery of fish populations?	L	L	\	\	L	L	L	M	M	\	M	M	L	M	\
11b. What are the effects of toxics in the estuary on fish populations?	L	L	\	\	L	H	L	M	L	\	L	M	L	L	\
11c. What are the causal mechanisms affecting survival of juvenile salmon during their first months in the ocean?	L	L	\	\	L	L	L	L	L	\	L	L	L	L	\
11d. What is the survival rate by species of fish migrating downstream through the estuary?	L	L	\	\	L	L	L	L	L	\	L	L	L	L	\
12. What effect do hatchery programs have on natural ecosystem and native fish health?	L	<u>H</u>	\	<u>H</u>	M	L	M	H	L	\	L	L	L	L	<u>M</u>

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
12a. What is the relative proportion of hatchery spawning fish compared to wild fish populations?	L	<u>H</u>	\	<u>M</u>	L	L	M	<u>M</u>	L	\	L	L	L	L	<u>L</u>
13. To what extent can hatcheries be used to assist in meeting harvest management goals or maintain the viability or conserve the genetic legacy of natural fish populations?	<u>H</u>	<u>H</u>	\	<u>H</u>	M	L	M	H	L	\	L	L	L	L	<u>L</u>
13a. Can hatchery reforms and new programs reduce the deleterious effects of artificial production on listed populations, thereby contributing to increased viability and a reduction in extinction risk for affected natural populations?	L	<u>M</u>	\	<u>M</u>	L	L	M	H	L	\	L	L	L	L	<u>M</u>
13b. Can properly designed intervention programs using artificial production make a net positive contribution to recovery of listed populations?	<u>H</u>	<u>H</u>	\	<u>H</u>	L	L	M	H	L	\	L	L	L	L	<u>M</u>
14. What is the reproductive success of hatchery fish spawning in the wild relative to the reproductive success of wild fish?	L	<u>H</u>	\	<u>H</u>	L	L	M	M	L	\	L	L	L	L	<u>M</u>
15. What are the harvest rates on wild and hatchery harvest management groups?	<u>L</u>	<u>H</u>	\	<u>M</u>	L	L	M	M	L	\	L	L	L	L	L
15a. What is the uncertainty around harvest point estimates?	L	<u>H</u>	\	<u>M</u>	M	L	M	M	L	\	L	L	L	L	L
15b. What are the estimates of population size and escapement for each harvest management group?	L	<u>L</u>	\	L	M	L	M	M	L	\	L	L	L	L	L
15c. What is the target and nontarget harvest and when is it projected to reach allowable levels?	L	<u>M</u>	\	L	M	L	M	M	L	\	L	L	L	L	L
16. Are new selective gear types effective at harvesting?	<u>M</u>	<u>M</u>	\	L	L	L	M	L	L	\	L	L	L	L	L
17. Are there delayed or incidental mortality effects associated with fish harvest?	L	<u>L</u>	\	L	L	L	M	M	L	\	L	L	L	L	L
17a. What is the post-release survival of fish caught in a selective fishery compared to fish that were not harvested?	L	<u>L</u>	\	L	M	L	M	M	L	\	L	L	L	L	L
18. What is the impact of predators on juvenile fish?	M	<u>L</u>	\	<u>M</u>	L	L	<u>M</u>	H	L	\	L	L	L	L	<u>M</u>
18a. What are the nesting distribution, colony size, and colony productivity for avian predators?	L	L	\	H	L	L	L	<u>L</u>	L	\	L	L	L	L	L
18b. What are the fish consumption rates of major avian predators?	L	L	\	M	L	L	M	M	L	\	L	L	L	M	<u>L</u>

	BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
18c. What are the consumption rates of major piscivorous predators in the [Columbia River Basin]?	L	<u>L</u>	\	<u>M</u>	L	L	M	L	L	\	L	L	L	L	<u>L</u>
19. What is the impact of predators on adult fish?	L	L	\	M	L	L	M	<u>H</u>	L	\	L	L	L	L	L
19a. What are the consumption rates of mammalian predators (marine)?	L	L	\	L	L	L	M	<u>M</u>	L	\	L	L	L	L	L
20. What are the most effective management alternatives/actions that could be used to reduce the impact of predators?	L	<u>L</u>	\	<u>M</u>	L	L	M	M	L	\	L	L	L	L	L
20a. What is the effect of alternative management alternatives/actions used to reduce the impact of avian predators?	L	L	\	<u>H</u>	L	L	M	M	L	\	L	L	L	L	L
20b. What is the effect of management alternatives/actions used to reduce the impact of piscivorous predators?	L	<u>L</u>	\	<u>H</u>	L	L	M	M	L	\	L	L	L	L	L

## Appendix C- Comments and Additional Questions from Agencies/ Tribes

### **\*\*BPA\*\***

Question 21 should have been: What is the impact of invasive species on native fish populations?

VERY IMPORTANT: For responses to level of importance, the designation of High (legal mandate) was interpreted to be a SHARED RESPONSIBILITY for most questions and not an indication that this management question and information was the sole responsibility of a single agency.

VERY IMPORTANT: For resident fish, responses in the questionnaire reflect the most important population issues we face. Kootenai R. white sturgeon is the archetype for most of the responses. In contrast, at the opposite end of the spectrum, many resident species/populations, geographic areas, and/or site-specific situations have virtually zero importance with respect to our mitigation responsibilities. Therefore, these management questions and ratings do not have the level of resolution needed to accurately represent BPA's information needs, obligations, and priorities for all resident fish mitigation.

### **\*\*CCT\*\***

What level of tribal trust responsibility is currently being met?

Are resources adequate for meeting your management needs?

To what degree are funding resources adequate or inadequate?

What level of historic fish habitat and/or fish population numbers are present in your area of responsibility or interest?

What other processes affect your management of fish resources (i.e., transboundary and international processes)?

Results from other basins will vary and care should be exercised in drawing conclusions from combined surveys.

Results from each ESU, subbasin and Province should be provided in the analysis as well as information derived from combinations or trends in the response patterns

A yes response was given on funding although it mostly comes from BPA and other grants.

### **\*\*CDFG\*\***

There are some problems with Q20 and Q21 being too closely alike. Q21 was left blank as a result.

We declined to respond to any resident fish questions as beyond the scope of our programs' domains and charges (see comments).

The secondary response in the Spatial Level of Importance column's cells pertains to just that: The spatial level of importance. Thus there are both biological and geographic responses. The geographic response appears in the Resident Fish row response box, but is not about resident fish.

We included humans, as in poaching, in the mammalian predator category.

The Hydro System category questions are not very applicable to the CA Coastal drainages, and we did not respond to those questions.

Due to the size and diversity of the Coastal Domain, let alone all of CA, most all the questions have importance somewhere, but are not of universal importance or applicability throughout. We tried to answer in the most balanced manner possible.

We limited our responses to the coastal draining streams of CA, and excluded the Central Valley anadromous streams and the Sierra resident trout waters. Within this coastal domain, we identified the "Regional" scales to be North Coast, Central Coast, and South Coast in our spatial scale responses. We also limited our responses to CDFG legal dictums and excluded our sister Departments,' including ones with whom we consult on their legal dictums. Any activity that has some funding from CDFG, including just staff time, was indicated with a yes response; in some cases the amount is not very significant. Responses were limited to current activities and do not include past or planned projects.

Tributary Habitat Management Additional Questions: Are restoration activities promoting improvement in habitat condition and processes function beneficial for anadromous fishes?

Estuary and Ocean Marine Management Additional Question: What is the residence of fishes in different estuaries and what affects residence time?

Predator and Invasive Species Management Additional Questions: What is the impact of predators on specific fish populations?

#### **\*\*IDFG\*\***

Many of the genetic concerns with respect to hatchery/wild interaction among resident species have been addressed in Idaho by stocking sterile triploid fish only in areas where hatchery and wild interactions are of concern.

Resident species and programs are numerous and wide ranging. Responses to questions take into consideration a number of species whereas priority was assigned to the species of greatest management importance we selected the lowest spatial scale that could also address other species of concern. In most cases, responses of other resident species would be less than the primary species of interest. Several of the questions regarding estuarine habitat had no applicability to management actions that we can put into effect in Idaho for resident species and in those instances we left a null response.

**\*\*ODEQ\*\***

Does water quality support the recognized beneficial uses of the water?

What are the sources of water quality impairment?

What percentage of waters are impaired?

What specific water bodies are impaired?

To what extent has the native aquatic biological community been adversely altered by anthropogenic activities?

What is the relative risk to the native aquatic biological community posed by various stressors?

Is water quality and ecological integrity improving or declining over time?

DEQ focus is on water quality that provides for beneficial uses of the water. In some ways, this is a broader context than just focusing on salmonids. Our goal is that the water quality and aquatic habitats support the native biological community. This includes all fish species salmonid or not, as well as invertebrates, amphibians, etc.. Our regulatory authorities are specific to water quality. There are clear links between habitat conditions and certain water quality parameters, such as temperature, or suspended solids. Our authority however when it comes to habitat is far less clear.

**\*\*ODFW\*\***

We considered sturgeon under the anadromous category.

We did not consider marine fish species in our responses.

**\*\*USACE\*\***

The questions are broad and are challenging to answer. The Northwestern Division of the Corps covers 15 states of which I attempted to represent 3 of the 5 districts west of the Rockies. In asking about resident fish, we might be quite interested in White Sturgeon, Bull Trout and Burbot, but perhaps less interested in Carp or dace, therefore the high end of the bar was chosen with respect to endangered species or other species of concern. In addition, White Sturgeon may be Highly Important for study in the Seattle District, but of lower importance in Portland District. This survey is a broad stroke that is difficult to fully grasp.

The Corps has concerns for resident fish in the ocean and estuary, however sturgeon and cutthroat trout below Bonneville Dam are considered anadromous although not necessarily semelparous and therefore are not in the category of resident fish. However, piscivorous fish in the estuary may be of concern, particularly as they affect anadromous species. Therefore a medium was applied.

**\*\*USFS\*\***

R1 note: you did not ask any question on invasive species (only predators) in the last section. We are very interested in invasive species (including aquatic species) and are currently working on a Regional invasive species plan

R6 note: question 1a-d were answered to include ESA and Sensitive Species only.

Responses were collected from FS Region 1 (Western MT, no ID); FS Region 4 (ID); and FS Region 6 (OR, WA). Where ratings (i.e., importance of Question) or responses varied (i.e., minimum spatial level of importance) by question between FS Regions, the highest rating or minimum scale identified was used. Even if only one FS Region responded "yes" to the funding question, the funding column was filled with a "yes" response.

**\*\*\*USBR\*\*\***

This level of information does not advance significantly the goals of PNAMP as identified in its Strategy document. We should ask PNAMP representatives to select the type of studies needed to collect this information and specifically how they are or plan to fund these studies. We've agreed that status and trend monitoring is important. The states and the federal regulatory agencies have primary responsibility. They largely identified the relevant management questions. They need to identify the work that they fund and the gaps that need funding. PNAMP members agree that the Intensively Monitored Watershed is the proper scale for effectiveness monitoring for scientific and public policy reasons. Yet the State of Washington is the only significant funding agency for IMWs. The questionnaire should have focused on how other PNAMP agencies could expand the development and implementation of the IMW concept.

**\*\*\*WDE\*\*\***

Ecology is generally concerned with water quality and watershed health not limited to the specific effects on fish populations. For example, Ecology measures toxic contaminant levels in fish tissues as an indicator of overall contamination in the food chain, and to provide data to the Department of Health with regard to concerns for human health impacts (supporting DOH human consumption warnings).

Ecology is concerned with other indicators of watershed health, including bacterial contamination (not explicit in the questionnaire) and nutrient contamination as it leads to eutrophication and reduced oxygen levels.

Ecology is also concerned with invasive species because of larger impacts to the overall aquatic ecosystem and not limited to the more narrow concern of only invasive predators on fish.

Comments:

In filling out this survey, I've taken an "expansive" view. In particular, Ecology is involved in many aspects of estuarine monitoring and management, especially in Puget Sound. References in this survey to "the estuary" imply the question was focused on only the Columbia River estuary.

Many of Ecology's interests with regard to fish distribution or presence/absence have to do with how Ecology sets water quality standards (based on supporting aquatic life uses). Therefore we may be concerned with indicators of habitat quality (e.g. riparian shade) - not specifically tied to fish survival, abundance, or productivity, but as it relates to providing shade to reduce in-stream temperatures - a water quality standard or criterion that may be based on supporting aquatic life or maintaining "fishable" stream beneficial uses.

Per the above, many of the questions are focused on "anadromous" and "resident" fish. Ecology generally is not approaching water quality or watershed health from the perspective of an individual resource category. We are generally focused on measures of water quality or indicators of watershed health not specifically tied to one or another class of fisheries.

**\*\*YN\*\***

Ocean and Estuary - Q8 questions are NOAA management responsibilities

Adaptive Management - We have listed many of these high because we believe in the Kai Lee philosophy information should be collected in order to make the best decisions based on complete information.

**\*\*\*NOAA\*\*\***

**Additional Tributary Habitat Management Questions for anadromous salmonids and steelhead:**

1. Are all MPGs within the ESU at, or clearly trending toward, a low risk status? (What is the aggregate status and change in status of the MPGs in the ESU relative to viability criteria?)
2. Is the number of populations at high viability/low risk consistent with recommended ESU viability criteria (e.g., are 2 or more populations within each MPG at low risk of extinction)? Are the remaining populations and streams within the MPG at sufficient status or quality to meet ESU viability criteria?
  1. Overall MPG question and viability criteria: Are 50% of historical populations (no fewer than 2) viable within the MPG?
  2. Low-risk populations within the MPG: Is at least one (if not proportionally represented) of each major life history type, or core/genetic legacy, population viable within the MPG?

3. Higher-risk populations within the MPG: Do higher risk populations provide the degree of ecological function for MPG persistence such that overall MPG persistence does not fall below replacement?

4. For ESUs with only one MPG (Upper Columbia, Snake River Fall Chinook, IC Sockeye) (Note: All extirpated populations will be evaluated by the ICTRT to determine how they should contribute to the population's viability.): Do populations in the MPG provide the degree of ecological function for MPG persistence such that overall MPG achieves desired viability objectives?

3. What is the status and change in status of the population's viability parameters relative to its target viability parameters and status?

1. What is the abundance/productivity status of the population based on population change criteria or viability curves for natural-origin salmon considering historical/ intrinsic capacity estimates<sup>1</sup>, depensation thresholds<sup>2</sup>, or natural return ratio<sup>3</sup>?

2. What is the current state, and change in state, of the genetic diversity of the population based on consideration of natural patterns of gene flow, existing diversity, habitats and environmental variation? ("Natural" fish are defined as spawners whose parents spawned naturally.)

a. What is the current fraction and change in fraction of hatchery vs. natural spawners in the population?

b. What is the origin of hatchery fish in the population?

c. What is the effect of generations of hatchery fish on the population?

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<sup>1</sup> Intrinsic Capacity: An estimate of the historical abundance/productivity of a specific population.

<sup>2</sup> Depensation threshold definition: A depensatory effect is the tendency for the population growth rate to decrease as the population abundance decreases below a certain, taxon-specific threshold. Depensatory effects heighten extinction risk. A species is endangered if it declines to a taxon-specific depensation threshold below which the demographic and genetic behavior of any given population becomes highly uncertain.

<sup>3</sup> Natural Return Ration (NRR): The number of naturally produced fish that are born during a given brood year and subsequently return to spawn, divided by the total number of fish on the natural spawning grounds (including naturally spawning hatchery fish) in that brood year.

1. What is the status of the spatial structure of the population based on consideration of the existing number, size, productivity and distribution of spawning and rearing locations relative to what is sufficient for the population to be viable?

### **Habitat**

What is the effect of present or threatened habitat degradation (limiting factors) on the observed abundance, productivity, diversity (includes run timing), and distribution of the natural-origin fish in this population? [The limiting factors below are presented as examples. Limiting factors are population-specific and will differ in number and type.]

- a) What is the effect of the status and change in status of fish passage conditions (connectivity) on the population's abundance, productivity, spatial distribution and diversity?
- b) What is the effect of the status and change in status of water quantity (altered in stream flow/hydrologic alteration) on the population's abundance, productivity, spatial distribution and diversity?
- c) What is the effect of the status and change in status of channel morphology and complexity (bed, banks, sediment, LWD, riparian) on the population's abundance, productivity, spatial distribution and diversity?
- d) What is the effect of the status and change in status of water quality (temperature, toxics, pollution, etc.): on the population's abundance, productivity, spatial distribution and diversity?
- e) What is the effect of the status and change in status of habitat fragmentation and loss on the population's abundance, productivity, spatial distribution and diversity?
- f) What is the effect of the status and change in status of interspecific interactions on the population's abundance, productivity, spatial distribution and diversity?

2. If there are habitat-related effects of limiting factors on observed abundance, productivity, diversity, or distribution of the natural-origin fish, what is the significance of those effects for the viability of the population?

The significance of any observed effects will be determined by considering the status and change in status of the population's viability parameters against a benchmark, such as recovery plan viability criteria/objectives.

a) Does/will the effect of fish passage conditions (connectivity) on the population prevent the population from achieving population-specific goals for abundance, productivity, diversity or spatial distribution established in the final recovery plan or interim recovery guidance?

b) Does/will the effect of water quantity (altered in stream flow or hydrologic alteration) on the population inhibit (increase the risk to?) the population from achieving population specific goals for abundance, productivity, diversity or spatial distribution established in the final recovery plan or interim recovery guidance?

c) Does/will the effect of the channel morphology and complexity on the population inhibit the population from achieving population specific goals for abundance, productivity, diversity or spatial distribution established in the final recovery plan or interim recovery guidance?

d) Does/will the effect of the stream water quality on the population inhibit the population from achieving population specific goals for abundance, productivity, diversity or spatial distribution established in the final recovery plan or interim recovery guidance?

e) Does/will the effect of the habitat fragmentation and loss on the population inhibit the population from achieving population specific goals for abundance, productivity, diversity or spatial distribution established in the final recovery plan or interim recovery guidance?

f) Does/will the effect of interspecific interactions on the population currently inhibit the population from achieving population specific goals for abundance, productivity or distribution or diversity established in the final recovery plan or interim recovery guidance?

3. Is the significance of the effect of this listing factor (habitat), on the population's ability to achieve specific goals for abundance, productivity, spatial distribution, or diversity as established in the final recovery plan or interim recovery guidance, affected by the cumulative impact of the other listing factors (hydro, harvest, disease and predation, and hatcheries)? In other words, does the status of the *other* listing factors modify the absolute risk posed by the current and potential future status of *this* listing factor?

### **Uncertainty Research**

1. What are the quantitative relationships between tributary in stream flow and juvenile rearing and outmigrant survival?

2. What is the uncertainty associated with models (EDT, Shiraz) used for evaluating limiting factors?
3. Relationship of habitat type and quality to a quantitative fish productivity level
4. Which habitats are most important in explaining juvenile and adult migration patterns and potential for increases in viability?
5. Increased genetic research to identify genotypic variations in habitat use
6. Make more use of ongoing PIT tagging and other tagging and marking studies and data to determine origin and estuarine habitat use patterns of different stocks.
7. How can action effectiveness be linked to changes in population and ESU status and viability (multiple scales)?
8. What is the effect of toxic contaminants on salmonid fitness and survival in the CRE and ocean?
9. What effect do invasive species have on salmon, and how can those effects be controlled?
10. The relationships between micro- and macro-detrital inputs, transport, and end-points
11. How have historical changes in estuary morphology and hydrology affected habitat availability and ecosystem processes?

**Additional Hydro System Management Questions for anadromous salmonids and steelhead:**

1. Have statutory listing factors been addressed such that threats to the ESU have been ameliorated to the extent that they no longer pose a threat to the continued existence of the ESU?
2. Is the ESU achieving or clearly trending toward a low risk status in response to actions that have been implemented to diminish those factors limiting achievement of ESU viability objectives? (as it stands there needs to be an effort to define the “threats” and make a matrix for establishing the relationship to limiting factors)
  - A. What is the effect of this threat (hydropower) on the observed abundance, productivity, diversity (includes timing), and distribution of the natural-origin fish in this population?
    - a) What is the effect of the status and change in status of hydro-related impairment to fish passage and modification of habitat conditions upstream and downstream of each dam (including water quantity, quality, etc.) on the population’s abundance, productivity and escapement rate?

b) What is the effect of the status and change in status of hydro-related impairment to fish passage and modification of habitat conditions upstream and downstream of each dam (including water quantity, quality, etc.) on the population's spatial distribution?

c) What is the effect of the status and change in status of hydro-related impairment to fish passage and modification of habitat conditions upstream and downstream of each dam (including water quantity, quality, etc.) on the population's temporal diversity (timing)?

B. What is the effect of any hydro-related impacts to observed rates, abundance, diversity (includes timing) and distribution of the natural-origin fish on the desired viability of the population? (Relates effect on population attributes to effect on population viability based on forthcoming viability criteria.)

a) What is the effect of the status and change in status of hydro-related impairment to fish passage and modification of habitat conditions upstream and downstream of each dam (including water quantity, quality, etc.) on the population's abundance, productivity and escapement rate?

b) What is the effect of the status and change in status of hydro-related impairment to fish passage and modification of habitat conditions upstream and downstream of each dam (including water quantity, quality, etc.) on the population's spatial distribution?

c) What is the effect of the status and change in status of hydro-related impairment to fish passage and modification of habitat conditions upstream and downstream of each dam (including water quantity, quality, etc.) on the population's temporal diversity (timing)?

C. Is the significance of the effect of this listing factor (habitat), on the population's ability to achieve specific desired viability criteria goals for abundance, productivity, spatial distribution, or diversity as established in the final recovery plan or interim recovery guidance, affected by the cumulative impact of the other listing factors (habitat, harvest, disease and predation, and hatcheries)? In other words, does the status of the other listing factors modify the absolute risk posed by the current and potential future status of this listing factor?

#### Uncertainty Research Questions

1. Evaluate impact of reservoir temperature impact on fish (Snake River Fall Chinook).
2. Evaluate delayed mortality of transported fish (Snake River Fall Chinook).

3. Early life history (Snake River Fall Chinook)
4. Passage and survival (Snake River sockeye)
5. Kelt passage and survival (Snake, UCR and MC Steelhead)
6. Determine feasibility of re-establishing self-sustaining anadromous populations upstream of hydropower (Snake River Fall Chinook).
7. Determine effects of flow on habitat in the estuary & lower mainstem (Snake River Fall Chinook).
8. How do uncertainties in estimates of delayed mortality affect conclusions regarding population status and viability? (all ESUs)
9. Pre-spawning mortality (all ESUs)

Determine the cause and remedy for headburns (all ESUs).

**Additional Estuary and Ocean Management Questions for anadromous salmonids and steelhead:**

1. What are the patterns of estuarine habitat use by different stocks?
2. How have historical changes in the estuary morphology and hydrology affected habitat availability and ecosystem processes?

What is the current and potential future effect of other natural factors on the observed abundance, productivity, spatial distribution, and diversity (includes timing) of the natural-origin fish in this population? Examples:

- a) What is the current and potential future effect of ecosystem interactions on the population's viability attributes?
- b) What is the current and potential future effect of ocean conditions on the population's viability attributes?
- c) What is the current and potential future effect of climate change on the population's viability attributes?
- d) What is the potential effect of any likely future catastrophic event on the population's viability attributes?

2. If there are natural factor-related effects on observed abundance, productivity, diversity, or distribution of the natural-origin fish, what is the significance of those effects for the viability of the population?

a) Does/will the effect of ecosystem interactions inhibit the population from achieving population-specific goals for abundance, productivity, spatial distribution or diversity established in the final recovery plan or interim recovery guidance? (Does the actual risk [probability of occurrence, magnitude of effect] warrant consideration in the recovery plan?)

b) Does/will the effect of climate change inhibit the population from achieving population-specific goals for abundance, productivity, spatial distribution or diversity established in the final recovery plan or interim recovery guidance? (Does the actual risk [probability of occurrence, magnitude of effect] warrant consideration in the recovery plan?)

c) Does/will the effect of ocean conditions inhibit the population from achieving population specific goals for abundance, productivity, spatial distribution or diversity established in the final recovery plan or interim recovery guidance? (Does the actual risk [probability of occurrence, magnitude of effect] warrant consideration in the recovery plan?)

d) Does/will the effect of catastrophic events inhibit the population from achieving population specific goals for abundance, productivity, spatial distribution or diversity established in the final recovery plan or interim recovery guidance? (Does the actual risk [probability of occurrence, magnitude of effect] warrant consideration in the recovery plan?)

**Additional Hatchery Management Questions for anadromous salmonids and steelhead:**

1. What is the effect of hatchery operations on the observed abundance, productivity, diversity (includes timing) or distribution of the natural-origin fish in this population?

a) What is the effect of broodstock collection on the population's abundance and productivity?

b) What is the effect of genetic introgression/residualism on the population's diversity?

c) What is the effect of genetic masking on the population's diversity?

d) What is the effect of hatchery-related disease on the abundance, productivity, distribution or diversity of the population?

- e) What is the effect of hatchery-related competition/density dependent effects on the abundance, productivity and distribution of the population?
- f) What is the effect of hatchery-related changes to predation rates on the abundance, productivity, diversity and distribution of the population?
- g) What is the effect of hatchery-related changes to ecosystem nutrient dynamics on the abundance, productivity and distribution of the population?
- h) What is the effect of hatchery spawning times on the diversity of the population?

2. If there are hatchery-related impacts on observed abundance, productivity, diversity (includes timing) or distribution of the natural-origin fish, what is the significance of these effects for the population's ability to achieve desired viability objectives?

- a) Does/will the broodstock collection effect on the population inhibit (increase the risk to?) the population from achieving population-specific goals for abundance, productivity, diversity and distribution established in the final recovery plan or interim recovery guidance?
- b) Does/will the effect of genetic introgression/residualism on the population currently inhibit the population from achieving population-specific goals for abundance, productivity, diversity and distribution established in the final recovery plan or interim recovery guidance?
- c) Does/will the effect of genetic masking on the population currently inhibit the population from achieving population-specific goals for abundance, productivity, diversity and distribution established in the final recovery plan or interim recovery guidance?
- d) Does/will the effect of hatchery-related disease on the population currently inhibit the population from achieving population-specific goals for abundance, productivity, diversity and distribution established in the final recovery plan or interim recovery guidance?
- e) Does/will the effect of hatchery related competition/density dependent effects on the population currently inhibit the population from achieving population-specific goals for abundance, productivity, diversity and distribution established in the final recovery plan or interim recovery guidance?

f) Does/will the effect of hatchery-related changes to predation rates on the population currently inhibit the population from achieving population-specific goals for abundance, productivity, distribution or diversity established in the final recovery plan or interim recovery guidance?

g) Does/will the effect of hatchery-related changes to ecosystem nutrient dynamics on the population currently inhibit the population from achieving population-specific goals for abundance, productivity or distribution or diversity established in the final recovery plan or interim recovery guidance?

h) Does/will the effect of hatchery spawning times on the population currently inhibit the population from achieving population-specific goals for abundance, productivity, diversity and distribution established in the final recovery plan or interim recovery guidance?

3. Is the significance of the effect of this listing factor (hatcheries) on the population's achievement of specific goals for abundance, productivity, spatial distribution, or diversity established in the final recovery plan or interim recovery guidance, affected by the cumulative effect of the other listing factors (habitat, hydro, harvest, disease and predation)?

#### **Uncertainty Research**

How do uncertainties in estimates of reproductive success of hatchery and natural-origin fish spawning affect evaluations of the effect of hatchery practices on population status and viability?

How do surplus hatchery-origin fish on the spawning grounds affect the productivity and genetic integrity of the natural population?

What are the short- and long-term effects of hatchery fish intervention on the status of viability attributes of natural-origin populations within the subbasins as well as within the migratory corridors?

Is early spawn time of hatchery steelhead stocks a successful management tool for segregating hatchery and natural fish?

How effective are fish culture techniques, such as acclimation, in segregating hatchery fish from natural populations?

#### **Additional Hatchery Management Questions for anadromous salmonids and steelhead:**

What is the effect of harvest on the observed abundance, productivity, diversity (includes timing), and spatial distribution of the natural-origin fish in this population?

- a) What is the extent of this threat's impact, expressed in terms of current total fishery exploitation rate, on the population?
- b) What is the effect of the status and change in status of the exploitation rate on the population's productivity and escapement?
- c) What is the effect of the status and change in status of the exploitation rate on the genetic diversity (timing) of the population?
- d) What is the effect of the status and change in status of the exploitation rate on the spatial distribution of the spawning population?

2. If there are harvest-related impacts on observed abundance, productivity, diversity (includes timing) or distribution of the natural-origin fish, what is the significance of these effects for the viability of the population?

- a) Does/will the total fishery exploitation rate on the population, given observed abundance of spawners (escapement) currently inhibit the population from achieving population-specific viability criteria goals for productivity established in the final recovery plan or interim recovery guidance?
- b) Does/will the total fishery exploitation rate on the population, in consideration of observed escapement, currently inhibit the population from achieving population-specific viability criteria goals for abundance established in the final recovery plan or interim recovery guidance?
- c) Has/will the total fishery exploitation rate on the population, given observed diversity of spawners (escapement) currently inhibit(ed) the population from achieving population specific viability criteria goals for genetic diversity established in the final recovery plan or interim recovery guidance?
- d) Has/will the total fishery exploitation rate on the population, in consideration of observed distribution of spawner escapement, inhibited the population from achieving population-specific viability criteria goals for spatial distribution established in the final recovery plan or interim recovery guidance?

- e) What is the genetic diversity of spawners relative to Recovery Plan objectives or assumptions?
3. Is the significance of the effect of this listing factor (harvest), on the population's ability to achieve specific desired viability criteria goals for abundance, productivity, spatial distribution, or diversity as established in the final recovery plan or interim recovery guidance, affected by the cumulative impact of the other listing factors (habitat, hydro, disease and predation, and hatcheries)? In other words, does the status of the *other* listing factors modify the absolute risk posed by the current and potential future status of *this* listing factor?

#### Uncertainty research Questions

How do uncertainties in exploitation rate estimates affect evaluations of the effects of harvest on VSP and population status?

How does uncertainty surrounding the use of indicator (hatchery) stocks to infer fishery mortality on natural-origin fish affect conclusions regarding population status and viability?

Are there gaps in quantitative data available for analyses of fishery impacts at relevant units (e.g., by population, MPG, or ESU) and if so, how does this affect the certainty of concluding the status of the population and ESU?

How have distributions (instead of point estimates) of parameter estimates been used to improve our understanding of how harvest effects impact populations, and how our management is working to reduce negative impacts?

Is the accuracy of estimates of incidental mortality related to bycatch in non-target fisheries and from specific gear types in catch and release fisheries known, and how does that affect our management?

#### **Additional Predator and Invasive Species Management Questions for anadromous salmonids and steelhead:**

Is predation by marine mammals a significant factor limiting the status of the population, and if so, how can that be managed if marine mammal status improves?

What is the rate of infection of disease in the natural population?