

PACIFIC NORTHWEST AQUATIC MONITORING PARTNERSHIP

Annual Report for 2006

Performance Period:
January 1, 2006 - December 31, 2006

DATE SUBMITTED
August 2007

SUBMITTED BY
Jennifer Bayer and Jacquelyn Schei
PNAMP Coordination Team

Table of Contents

EXECUTIVE SUMMARY	2
SECTION I. BACKGROUND.....	5
SECTION II. CALENDAR YEAR 2006 ACTIVITIES.....	7
<i>Section II (a). “Overview of Progress and Direction: Challenges of Meeting Multiple Expectations”</i>	<i>11</i>
III. APPENDICES	21
<i>Section III (a). Entities signatory to the PNAMP Charter, December 2006.</i>	<i>21</i>
<i>Section III (b). PNAMP/CSMEP Second Annual Monitoring Practitioner’s Workshop Report - Executive Summary</i>	<i>22</i>
<i>Section III (c). PNAMP Management Question Survey Summary Report.....</i>	<i>33</i>

Executive Summary

Federal, state, tribal, local, and private aquatic monitoring programs in the Pacific Northwest have evolved independently in response to different organizational mandates, jurisdictional needs, issues and questions. Planning and coordination of federal, state and tribal monitoring activities have evolved slowly but steadily over the past ten years. In 2004, the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) emerged from an ad hoc effort to become a formal institution charged with providing a forum for coordination of aquatic monitoring efforts in the region. As of 2006, 19 state, tribal, federal, and regional entities were signatory to the PNAMP Charter.

The basis of PNAMP is that monitoring will be improved if we:

Collaborate

- Incorporate monitoring as critical element of program planning and support monitoring policy and management objectives
- Support collaborative teams across agency boundaries
- Seek efficiencies and cost-effectiveness across monitoring programs through compatible and cooperative monitoring efforts

Use consistent approaches and protocols

- Agree on a scientific foundation
- Agree on common attributes and how to measure them
- Agree on sets of widely used indicators

Collect and present information in a manner that can be shared

- Agree on data standards
- Support regional activity to link information systems

In 2006, PNAMP continued to focus on providing opportunities for inter-organizational committees to work together to identify and address elements of the goals listed above. Additional focus has been on the “cross-cut tasks” identified the previous year. Some accomplishments from 2006 include: initiation of a plan to identify management questions relevant to PNAMP partners, implementation of a plan to conduct an inventory of aquatic monitoring activities in the Pacific Northwest, completion of a regional plan to establish a network of intensively monitored watersheds, initiation of coordination of high level indicators on a regional scale, testing of new software to manage protocols (Protocol Manager), completion and review of three documents in preparation of a recommendation, and preparation of technical forums (open to the public): “Second Annual Monitoring Practitioners Workshop” hosted by PNAMP and CSMEP; “Nonnative Aquatic Species Forum” to consider invasive species monitoring collaboration opportunities; and “Status and Trends Integrated Monitoring Program Workshop” to discuss if an integrated interagency, aquatic status and trends monitoring program could be supported in the long term and what would be the advantages and impediments of such a program.

In addition, PNAMP drafted a document titled “Overview of Progress and Direction: Challenges of Meeting Multiple Expectations” to clearly define what the expectations of PNAMP are, where PNAMP is in terms of its goals, and what PNAMP needs in order to meet expectations. This document is to help readers better understand PNAMP and set the stage for consideration of potential direction changes.

Lastly, in addition to specific tasks, PNAMP continuously functions as a forum where monitoring practitioners and policy staff can interact and exchange information. This opportunity to collectively focus on issues, results, and future needs related to monitoring

increases coordination and collaboration in the near term, and in the long term, effectiveness and efficiency of aquatic resource monitoring on a regional scale.

Section I. Background

Federal, state, tribal, local, and private aquatic monitoring programs in the Pacific Northwest have evolved independently in response to different organizational mandates, jurisdictional needs, issues and questions. Planning and coordination of federal, state and tribal monitoring activities have evolved slowly but steadily over the past ten years. In 2004, the Pacific Northwest Aquatic Monitoring Partnership (PNAMP) emerged from an ad hoc effort to become a formal institution charged with providing a forum for coordination of aquatic monitoring efforts in the region. The geographic area of this coordination includes the Pacific Northwest region from Northern California to Canada where the participating entities are implementing monitoring efforts. As of 2006, 19 state, tribal, federal, and regional entities signed the PNAMP Charter (Appendix A).

The basis of PNAMP is that monitoring will be improved if: all programs use consistent monitoring approaches and protocols; follow a scientific foundation; support monitoring policy and management objectives; and collect and present information in a manner that can be shared. These goals will require considerable effort and commitment to collaboration by many entities and individuals. PNAMP strives to provide the forum where this collaboration can occur and to facilitate the exchange among technical experts and between technical and policy staff that is necessary to accomplish these goals.

Although we are eager for more participation, we believe PNAMP has the right combination of types of participants to address these goals. PNAMP's organizational structure includes a Steering Committee, Coordinator, and technical workgroups defined by aquatic monitoring topics: watershed condition monitoring, fish population monitoring, estuary monitoring, effectiveness monitoring, and data management. The Steering Committee is composed of representatives from all entities that are signatory to the Charter and leaders of the

technical workgroups, a combination which allows the interface of technical and policy interests. The agency representatives are responsible for communication to PNAMP regarding their respective agencies' work and needs, as well as delivering PNAMP progress and challenges to their agencies.

More recently, PNAMP has had a better understanding of how the goals and tasks of each technical workgroup, PNAMP subcommittee, and individual partners are inherently interdependent. PNAMP has identified and been working on a number of concepts important to establishing a regional partnership for aquatic resource monitoring that bridge technical focus areas and individual agencies. These are critical elements of a large scale, efficient, coordinated effort to monitor resources. We refer to these as “cross cut tasks”:

- Protocols: what to measure and how to measure it
- Survey design: how to decide where monitor
- Data management: what are our data needs; what must we do before, during, and after data collection to facilitate data sharing
- Monitoring inventory: better facilitate coordination by describing ‘who is doing what monitoring where’
- High level indicators: seek agreement on a set of indicators (and metrics necessary to determine indicators) to describe landscape level changes in the region
- Facilitate regional network of monitoring efforts: explore ways to continuously improve our efficiency and effectiveness of monitoring on a regional scale

Each of these tasks is complex and resolution involves collaboration with other regional and national organizations as well as many individual participants. However, successful

coordination and collaboration on these fundamentals could be a first step in the creation of a regional monitoring effort.

The PNAMP Steering Committee, Workgroup Leaders and Coordinator share the responsibility to work across PNAMP to accomplish our goals efficiently and consistently. We encourage those in the region who seek assistance with aquatic resource monitoring issues to contribute to PNAMP. Coordination on complex topics with many partners takes time and hard work. Since PNAMP is a voluntary organization, our progress is directly correlated to participation. Support is also essential for PNAMP to respond to needs of the region; we need to hear from both technical and policy staff what is needed for better coordinated aquatic resource monitoring.

Section II. Calendar Year 2006 Activities

The PNAMP Coordination Team includes the Coordinator (Jennifer Bayer) and Administrative Assistant (Debra Niemann). In 2006 we transitioned to a technical support position and USGS allowed Amy Braatz to serve on a temporary assignment as Assistant Coordinator for 90 days. The Coordination Team's goals are to facilitate the transfer of information within PNAMP and across all relevant organizations, work to support relationships between science and monitoring, and promote communication among organizations to help assure that monitoring plans and information are coordinated across the Pacific Northwest. The Coordination Team works to initiate and facilitate the development, presentation, and distribution of products aimed at heightening understanding of PNAMP issues, successes, and problems and to serve as a clearinghouse for PNAMP activities and products.

The Coordination Team is responsible for administrative requirements of PNAMP activities (e.g. meeting logistical support, record keeping, and responsibility for maintenance of

membership information). Organizational support was provided to PNAMP by developing and negotiating fiscal support with government and non-government entities, and managing budgets and associated contracts with government and non-government entities. Required progress reporting regarding Coordinator's activities (within PNAMP) and PNAMP activities to interested external parties was completed.

Currently, there are five technical workgroups (WG) within PNAMP (Watershed Monitoring, Project Effectiveness Monitoring, Fish Population Monitoring, Data Management, and Estuary Monitoring), as well as a number of subcommittees formed to deal with specific tasks. These groups have met throughout the year on an as needed basis. Workgroup leaders initiate these meetings; the Coordination Team assists with preparation, facilitation, and meeting follow-up, as well as assisting with WG products.

In addition to meetings, workshops were held on specific topics as necessary, including:

- PNAMP/CSMEP Second Annual Monitoring Practitioner's Workshop (March 2006; Appendix B),
- Nonnative Aquatic Species Forum to consider invasive species monitoring collaboration opportunities (June 2006) and,
- Status and Trends Integrated Monitoring Program Workshop (August 2006) to discuss the feasibility of an integrated interagency, aquatic status and trends monitoring program.

The PNAMP Steering Committee (SC) provides the science-policy interface between the Executive partners and technical workgroups, guides work of technical workgroups, obtains resources needed to accomplish tasks, and directs the activities of the Coordinator. The SC provides assistance to PNAMP initiatives by participating in the formulation, development, and

review of recommendations for activities of PNAMP workgroups and integrating these activities with agency activities. The SC facilitates the transfer of information between PNAMP and their respective agencies. By promoting communication among organizations, the SC strives to assure that monitoring plans and information are coordinated across the Pacific Northwest.

In 2006, the Steering Committee implemented a plan to identify management questions relevant to PNAMP partners and to conduct an inventory of aquatic monitoring activities in the Pacific Northwest. 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. In addition, the SC has focused on identification of issues that "cross cut" PNAMP technical workgroups. These issues are of importance to a variety of monitoring types and technical emphasis, and if coordinated, we believe would contribute to regional monitoring. In particular, the SC led tasks to:

- continue coordination of high level indicators on a regional scale,
- advance development of an integrated watershed status and trend monitoring design pilot,
- draft a report summarizing high level management questions and their related hierarchical set of information needs shared by PNAMP partners (Appendix C),
- facilitate review of data management design for project tracking ("Data Management Needs for Regional Project Tracking to Support Implementation and Effectiveness Monitoring",
- implement a plan to conduct an inventory of aquatic monitoring activities in the Pacific Northwest,

- facilitate review of data management protocols related to time and location data (“NED Best Practices for Reporting Location and Time Related Data”),
- contribute to the State of the Salmon effort to document 19 salmonid field methods and facilitate review of the product (“Salmonid Field Protocols Handbook”), and
- support development of a regional data dictionary and protocol management tool.

PNAMP members have also begun work toward improved monitoring coordination associated with:

- high level indicators for use in reports to decision-makers across the Pacific Northwest,
- estuary and nearshore marine environments,
- aquatic habitat conditions in larger (i.e., non-wadeable) streams and rivers, and
- aquatic invasive species.

Monthly Steering Committee (SC) meetings have occurred on schedule throughout the year, with occasional teleconferences as necessary. The primary activity at these meetings is tracking the progress of current activities and discussion of new tasks that align with PNAMP’s goals. These meetings also facilitate of information exchange between SC and Workgroups. The PNAMP Coordinator facilitates meetings and prepares notes following the meeting. The focus of the Annual Steering Committee Retreat was how to continue to complete products in a timely manner and provide recommendations based on PNAMP’s work, how to clearly articulate the difficulty of managing expectations considering budgetary concerns and the voluntary nature of PNAMP, and how to better track the status of PNAMP tasks. A white paper titled “Overview of Progress and Direction: Challenges of Meeting Multiple Expectations” emerged from the discussions at the retreat.

Section II (a). “Overview of Progress and Direction: Challenges of Meeting Multiple Expectations”

Overview of Progress and Direction:
Challenges of Meeting Multiple Expectations

The Pacific Northwest
Aquatic Monitoring Partnership

May 3, 2007

This document will help readers better understand the Pacific Northwest Aquatic Monitoring Partnership (PNAMP), what it is doing, and how to gauge expectations. It should also help set the stage for consideration of changes in direction that may be desired. It provides a snapshot of the major monitoring components PNAMP has focused on. Further, it identifies a set of core elements for all monitoring programs that are intended to complement and support regional needs. Finally, this paper includes basic policy options to help inform the direction and pacing of coordination for ongoing and future monitoring, consistent with PNAMP’s guiding principles, recommendations, and strategic plan.

Background – Response to the call for improved coordination

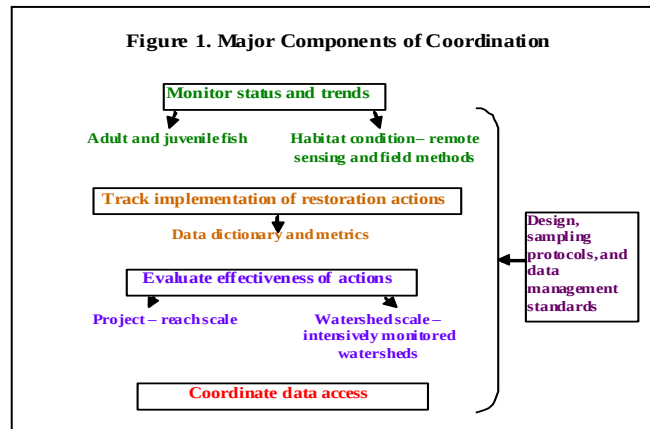
Federal, state, tribal, local, and private natural resource monitoring programs in the Pacific Northwest have evolved in response to different organizational mandates, jurisdictional needs, issues and questions. However, while some issues are unique to particular entities, PNAMP has learned there is 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.

Considerable progress has been made in coordinating aquatic monitoring across the Pacific Northwest in recent years. In 2004, a collaboration of parties interested in improving the effectiveness and efficiency of monitoring through improved

The work of PNAMP is guided by the following principles:

- *Resource Policy and Management:* The purpose of monitoring efforts is to provide the most important scientific information needed to inform public policy and resource management decisions.
- *Efficiency and Effectiveness:* Cooperative monitoring will enhance efficiencies and effectiveness of our respective and collective efforts.
- *Scientifically Based:* Environmental monitoring must be scientifically sound.
- *Shared Information:* Monitoring data must be accessible to all participants on a timely basis.

coordination, coalesced to form PNAMP¹. Their work has identified shared monitoring principles, objectives, questions, needs, and opportunities. These activities directly and indirectly support various needs, including the state, federal, and tribal monitoring activities related to resource management, 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.

To date, PNAMP has provided functional support, a venue, and a monitoring coordination framework by:

- Providing policy support and direction by member organizations,
- Committing technical resources and staff time,
- Providing funding for desired levels of coordination, and
- Providing higher-level focus and guidance for regional monitoring outcomes.²

A Framework for Coordination – Focusing on major components

As detailed in the PNAMP Strategy³ and annual work plans, PNAMP work has focused first on improving coordination of monitoring efforts addressing four “*major components*,” that together represent the greatest shared interest among PNAMP members. As illustrated in Figure 1, these components are:

- Status and trends of fish populations (particularly those listed under the ESA [VSP⁴ considerations]) and habitat,
- Tracking implementation of actions,
- Effectiveness of management actions, and
- Coordination of data access.

¹ PNAMP charter (2004)

² Excerpted from PNAMP (2005) strategy.

³ PNAMP’s coordination plan for monitoring in the Pacific Northwest, “*Recommendations for Coordinating State, Federal, and Tribal Watershed and Salmon Monitoring Programs in the Pacific Northwest*” (PNAMP 2004), and “*Strategy for Coordinating Monitoring of Aquatic Environments in the Pacific Northwest*” (2005).

⁴ VSP (NOAA Viable Salmonid Population).

Each of the four components has many dimensions and challenges. However, the components are very interrelated, and thus should be viewed as part of an integrated whole. Each depends on the other for success. For example, to understand effectiveness of actions, it is essential to have an appropriate design, to know what actions have been implemented, and because evaluations occur over long time frames, to also have a sense of how biological and environmental features are changing so that information can be interpreted in that context. Finally, for each component, data must be collected and accessible for the evaluation, reporting, and decision-making.

Within the above four components, PNAMP's work has focused on common "*core elements*." When applied to all current and potential future components of PNAMP work, resolving details associated with these core elements will make monitoring across the Pacific Northwest more efficient and effective.

The core elements are:

- Common management and monitoring questions and critical information needs
- Monitoring design(s) that allow cooperative monitoring and information sharing
- Compatible and documented protocols for sampling, analysis, and quality assurance
- Supporting the need for data management standards and structure(s) to provide common access to information and multi-level reporting

Overview of Progress and Direction

PNAMP has contributed to development of products containing monitoring guidance and/or recommendations on all major components and most core elements. Table 1 provides a summary and analysis, at-a-glance, of progress to date (as denoted by color-coding) along with examples of associated PNAMP products from 2004 to 2006 listed in Appendix A. A summary of PNAMP's 2007 work plan identifying tasks and products is provided in Appendix B. All PNAMP products are accessible online at www.pnamp.org.

Table 1 shows that considerable progress has been made in resolving some components, while much less progress has been made in others. For example, identifying shared monitoring objectives and questions for fish, habitat, and action effectiveness has moved along fairly well. However, significantly less progress has been made on remote sensing of habitat condition because PNAMP work on that topic started only relatively recently. PNAMP efforts have helped to support improved data management standards and structures, although much work remains to be done. The PNAMP data management efforts are supported by the Northwest Environmental Data Network and PNAMP data management interests are discussed in this forum.

Improved coordination across the wide spectrum of monitoring efforts of shared interest (e.g., design and implementation, from local to Pacific Northwest scales) will only occur if commitments exist within and among the hierarchy of affected programs. As reflected in the membership of PNAMP, these include local, state, tribal, federal and other entities and programs. While the mere existence of PNAMP represents a base level of commitment toward improved coordination, the specifics of how much coordination is sufficient for individual entities or how

much coordination is attainable or sufficient to meet management expectations needs further clarification through interaction with and among PNAMP Executives.

Table 1. Relative progress of PNAMP coordination by major component and core element

<u>Key:</u>
Blue = major accomplishment(s) and/or product(s)
Yellow = minor accomplishment(s) and/or products in progress
Orange = minimal to no progress to date

Major component	Core element			
	Common questions and information needs	Cooperative designs	Compatible protocols	Data management standards and structure(s)
Monitoring status and trends				
<i>Fish population</i>				
- Juvenile	Report ^a	Workshop ^b	Review ^c	
- Adult	Report ^a	Workshop ^b	Review ^c	
Habitat condition				
- Field methods	Report ^a	Watershed pilot ^d	Side-by-side watershed protocols test ^e	
- Remote sensing	Workshop ^f			
Monitoring the effectiveness of actions				
Project-reach scale	Report ^{a, g}		Review ^g	Protocol Catalogue, data dictionary and tools ^h
Watershed scale (IMWs)	Report ⁱ	Report ⁱ	Report ⁱ	
Monitoring the implementation of actions				
Restoration actions	Report ^{a, g}	Review ^g	Review ^g	Review ^g

Note: Products corresponding with the letters are listed in Appendix A

Summary of some key PNAMP products to be completed in 2007 and 2008:

- Common questions and information needs:
 - Report recommending a core set of indicators for use in high level reporting of high level indicators for use in reports to decision-makers across the Pacific Northwest
 - Report summarizing results of a PNAMP survey of monitoring and resource management questions

- Cooperative designs:
 - Integrated watershed condition status and trends sampling design framework and demonstration project
- Comparable protocols:
 - Recommendations and scientific publications summarizing the watershed habitat condition protocol test evaluating the comparability of field attributes and sampling protocols used by various agencies of protocol comparison project
 - Report and recommendations on protocols for macroinvertebrate field and laboratory sampling
- Data management:
 - Recommendations on data management design for project implementation and effectiveness monitoring (produced by S. Katz et al, NOAA Fisheries)
 - Recommendations for locational and time-related data (produced by the Northwest Environmental Data Network)
- Technical workshops on remote sensing
- Recommendations on use of protocol catalogue tool (Protocol Manager) to manage protocol and data dictionary information

Additional Coordination Possibilities – What else merits coordinating?

In addition to or in conjunction with the four major components discussed above, PNAMP has also begun work toward improving monitoring coordination associated with:

- estuary and nearshore marine environments,
- aquatic habitat conditions in larger (i.e., non-wadeable) streams and rivers, and
- aquatic invasive species.

In addition, a number of topics have been identified of interest to some PNAMP members, but for which meaningful coordination by PNAMP has not been initiated to date. These topics include:

- resident fish or wildlife,
- water quality,
- stream flows,
- research related to monitoring,
- adaptive management decision tools, and
- cost analyses.

A fundamental ongoing challenge has been to balance PNAMP's resources with the level of shared interest in working on potential subject areas. There will always be many more areas of interest than there is the capacity to address them.

Obstacles and Limitations

It is important to recognize that, if PNAMP has been successful in any way, it has done so essentially as a volunteer organization. PNAMP has operated since its inception with a minimal amount of formal organizational structure and funding dedicated to complete tasks and deliverables. For example, with the exception of the coordination/administrative support, and some of the costs of the habitat protocol comparison project, PNAMP's accomplishments have for the most part been performed via in-kind contributions of staff from member organizations and other interested parties.

This volunteer approach, combined with the diverse interests of participants, presents many challenges. Although PNAMP has made progress, expectations about scope and pace of work need to be realistic given this infrastructure. Expectations of PNAMP members and others should be tempered with these realities, while recognizing that adjustments in approach would yield different results. Most importantly, consistent with PNAMP's guiding principles, PNAMP's expertise and limited resources must be focused on topics of the highest priority to decision-makers.

Adjusting Expectations – What are the options?

The rate or direction of PNAMP's progress can be adjusted by the PNAMP Executive Network if needed. The PNAMP charter describes the organizational structure and formal process for PNAMP Executives to make changes in direction if and when deemed necessary.

PNAMP has identified policy options below for consideration by the Executive Network that would maintain, accelerate, or modify PNAMP progress and/or direction; they are not mutually exclusive.

Option	Policy description	Pros	Cons
1	<i>No change</i>	Lowest cost; Implies work is proceeding acceptably	Continues risk that important needs and expectations will not be met or not met in timely manner
2	<i>Rebalance existing workplan</i> – modify PNAMP's workplan of activities within the limits of available resources	Keeps cost low; Assures alignment of PNAMP work with the priorities of most importance to Executives	Creates the need to manage unmet expectations for activities that become lower priorities; Puts burden on executives to establish priorities
3	<i>Increase capacity</i> – accelerate progress and/or change direction to address new or higher priority (ongoing or new) activities and products	Improves ability to complete work and meet expectations of Executives	Increases cost; Puts burden on executives to establish priorities

Appendix A

Summary of key PNAMP products - 2004 to 2006 ⁵

(Note: Letters in **(bold)** correspond to products identified in Table 1)

2004

- **Charter and Business Practices** signed by 19 state, federal, tribal and regional entities.
- Prepared considerations for monitoring in **subbasin plans**.

2005

- (c) Facilitated review of the State of the Salmon handbook on **salmonid field monitoring protocols**, and facilitated implementation of those protocols by and through PNAMP partners.
- Supported or hosted three publicly accessible technical **workshops** or forums:
 - (b) Workshop for fish practitioners
 - (f) Remote sensing
 - Large-scale monitoring symposium (at the American Fisheries Society North Pacific International Chapter meeting)
- (e) Initiated a **habitat condition protocol test** in which field attributes and sampling protocols used across numerous agencies are compared.
- (i) Prepared a regional plan to establish a network of **intensively monitored watersheds** (IMWs).
 - Prepared long-range **strategic plan**.
 - Developed **website** for PNAMP information and products.

2006

- (d) Advanced development of an integrated watershed **status and trend monitoring design pilot**.
- (g) Facilitated review of **data management design for project tracking**.
- (h) Supported development and began testing of a regional **data dictionary and protocol catalogue** tool.
 - Conducted a pilot **inventory** of aquatic monitoring activities.
 - Hosted technical **workshops** on:
 - Coordination of aquatic invasive species monitoring
 - Workshop for monitoring practitioners

⁵ All PNAMP products are accessible online at www.pnamp.org

Appendix B

Summary of PNAMP Products Anticipated in FY 2007

Note: not all recommendations and products have arisen from PNAMP; some items have been brought to PNAMP by outside entities for review and support; some have benefited from joint development by PNAMP and other entities.

Recommendations regarding products originating outside PNAMP:

- NED Best Practices for Reporting Locational and Time Related Data
- Salmonid Field Protocols Handbook (prepared with assistance from PNAMP)
- Effectiveness Protocols: standardized metrics for project tracking for RME (document review and recommendations associated with NOAA-Fisheries proposal)

PNAMP products/recommendations

- High level indicators “white paper” to identify and recommend a core set of indicators that can be shared among all types of aquatic monitoring.
- Management questions “white paper” to facilitate coordination by identifying relative importance of management questions (and their related hierarchical set of information needs) shared by the PNAMP partners.
- Habitat protocols recommendations (watershed assessment methods): report the results of protocol comparison project.
- Macroinvertebrate field and laboratory sampling protocol recommendation
- Monitoring Survey Design recommendation for a regional aquatic status & trends monitoring design (using the EMAP probabilistic GRTS design developed by the EPA).
- Project Effectiveness Monitoring Protocols: protocols shared by Oregon and Washington agencies; facilitate discussion about formally recommending these to PNAMP partners.
- Project Effectiveness Monitoring Protocols: recommend strategy for implementation of the PNAMP-recommended network of Intensively Monitored Watersheds (IMW) and reach specific studies for effectiveness monitoring.
- Remote Sensing Applications for Aquatic Monitoring Workshop (spring 2007) to facilitate application of remote sensing tools for aquatic monitoring.
- Identify and implement a process for developing/refining common GIS layers by working in partnership with Pacific Northwest Regional Geographic Information Committee (PNW RGIC).

Products that require funding for completion

- PNAMP Aquatic Monitoring Activity Inventory to facilitate collaboration by identifying who is doing what monitoring where, how, etc.
- Pilot regional data dictionary & protocol catalogue tool (Protocol Manager)
- Fish Protocols: Develop Protocol Comparison Tests
- Standardized field method training manual (template to be used to foster consistent implementation of protocols)

III. Appendices

Section III (a). Entities signatory to the PNAMP Charter, December 2006.

PNAMP Partners	PNAMP Steering Committee Representative	PNAMP Executive Network Representative
Bonneville Power Administration	Jim Geiselman	Greg Delwiche VP Environment, Fish and Wildlife
California Department of Fish and Game	Scott Downie	Don Koch CDFG Manager Northern CA-North Coast Region
Columbia Basin Fish and Wildlife Authority	Ken MacDonald	Dan Diggs Chair
Columbia River Intertribal Fish Commission	Phil Roger	Olney Patt, Jr. Executive Director
Confederated Tribes of the Colville Reservation	John Arterburn	Joe Peone Director, Fish and Wildlife Department
Environmental Protection Agency	Dave Powers	Ron Kreizenbeck Actg Regional Administrator
NOAA Fisheries	Kim Kratz	Usha Varanasi Science and Research Director
Northwest Indian Fisheries Commission	Fran Wilshusen	Mike Grayum Executive Director
Northwest Power and Conservation Council	Steve Waste	Tom Karier Chair
Oregon Watershed Enhancement Board	Greg Sieglitz	Tom Byler Executive Director
Pacific States Marine Fisheries Commission	Bruce Schmidt	Randy Fisher Executive Director
US Army Corps of Engineers	Paul Ocker	Gregg Martin Brigadier General US Army Division Engineer
US Bureau of Land Management	Al Doelker	Edward W. Shepard State Director Oregon/Washington
US Bureau of Reclamation	Michael Newsom	J. William McDonald Regional Director
US Forest Service	Linda Ulmer	Linda Goodman Regional Forester Pacific Northwest Region
US Geological Survey	David Woodson	Alan Mikuni Acting Regional Biologist
Washington Department of Ecology	Ken Dzinbal	Josh Baldi Special Assistant to the Director
Washington Governor's Salmon Recovery Office	Steve Leider	Chris Drivdahl Team Leader
Washington Salmon Recovery Funding Board	Bruce Crawford	William Ruckelshaus Chair

Section III (b). PNAMP/CSMEP Second Annual Monitoring Practitioner's Workshop Report - Executive Summary (the full 115 page report can be found [here](#)).

Second Annual Research, Monitoring and Evaluation (RME) Workshop for Decision-Makers, Program Managers, Scientists and Field Practitioners

March 16-17, 2006

**Executive Summary Excerpted from the Final Report
*October 17, 2006***



The Pacific Northwest Aquatic Monitoring
Partnership (PNAMP)

&



The Collaborative Systemwide Monitoring &
Evaluation Project (CSMEP)

Citation: **Pacific Northwest Aquatic Monitoring Partnership (PNAMP) & The Collaborative Systemwide Monitoring and Evaluation Project (CSMEP)**. 2006. Second Annual Research, Monitoring and Evaluation (RME) Workshop for Decision Makers, Program Managers, Scientists and Field Practitioners.

Executive Summary

The Pacific Northwest Aquatic Monitoring Partnership (PNAMP) and the Collaborative Systemwide Monitoring and Evaluation Project (CSMEP) convened a joint workshop on March 16/17, 2006 to stimulate dialogue on key issues facing research, monitoring and evaluation (RME) practitioners in the Pacific Northwest. The workshop was attended by a total of 120 participants representing a mix of field biologists, biometricians, quantitative scientists and program managers from federal, state, county and tribal environmental organizations, as well as private consulting firms and universities. Organizations represented at the workshop included: BEE, BioAnalysts, BPA, Cascadia Ecosystems, CBFWA, CCT, Cd'AT, CDFG, Chelan County PUD, CC PUD, CRITFC, CTUIR, Eco-Logical Research, EPA, ESSA, GSRO, HCCC, IDFG, IMST, KC DNRP, KWA/CCT, LCFRB, M&M Environmental, NED, NOAA, NPCC, NPT, NWIFC, ODEQ, ODF, ODFW, OMSI, OSU, OWEB, PER, PNNL, PSMFC, Quantitative Consultants, SBT, SRFB, TNC, TTECI, UI, USACE, USBR, USFS, USFWS, USGS, WDE, WDFW, WEST, and YN.

Specific objectives of this workshop were to:

1. Share, review and discuss results of recent surveys conducted by CSMEP and PNAMP of the relative importance of different resource management questions and information needs in the Columbia Basin (CSMEP) and Pacific Northwest (PNAMP).
2. Share, review and discuss current advances in research, monitoring, and evaluation (RME) (e.g., indicators, analytical approaches to evaluation, sampling designs, monitoring protocols, integrated M&E programs).
3. Share, review and discuss on-the-ground implementation issues from 2004 and 2005 field seasons with an eye towards learning how to increase scientific rigor and efficiency, standardize efforts and approaches, and improve coordination across regional monitoring efforts.
4. Host concurrent technical work sessions to assess current monitoring activities, approaches and methods, gaps, and critical problems associated with status and trend RME, action effectiveness RME, and their integration.
5. Provide feedback and recommendations to PNAMP and CSMEP and the entities involved in these groups.

The initial organizing structure for the workshop was a series of plenary presentations (and associated moderated discussion) on suggested directions from both scientific and policy perspectives for both identifying the key RME priorities and improving the coordination of regional programs to monitor fish and aquatic habitat in the Pacific Northwest. General discussions were then followed by a series of concurrent technical sessions that focused on identifying and proposing potential solutions to:

1. Specific issues facing Status & Trends RME of both fish populations and fish habitat:
(1A) Fish in Watersheds, (1B) Habitat Conditions in Watersheds, (1C) Fish &

Habitat in Large Rivers with Dams, and (1D) Fish & Habitat in Estuary/Nearshore Areas.

2. Specific issues facing Action Effectiveness RME of: (2A) Habitat Actions, (2B) Harvest Actions, (2C) Hatchery Actions, and (2D) Hydro Actions.
3. Specific issues facing efforts to create a better synthesis and integration of RME information across the various regional programs monitoring Status & Trends and action effectiveness.

The key RME issues identified during the workshop's plenary and technical break out sessions and recommendations for improvements/solutions are presented below.

Prioritizing and Coordinating RME

Issues:

- The range of RME questions that can be addressed within current monitoring programs is limited; only some questions can be reliably answered.
- There is a sense that all agencies need to work together to maximize the efficiency of data collection, but no single agency is responsible to force it to happen. The region needs leadership in this regard.
- Limited time frames for many current RME funding processes is a significant problem.
- There is not enough communication between technical and policy staff on priorities for regional RME.
- Coordination is more than meeting to tell each other what we're doing. Very hard currently to get out of corporate mindsets, takes time to convince people and make the required institutional changes to allow greater real coordination of RME to happen.
- The role of communities is also critical in restoration of stocks and habitat and is often overlooked in RME plans.

Overall conclusions/recommendations:

- RME needs to be given priority; needs to be planned up front and projects must be designed to include RME.
- RME needs to become an element of longer term funding across programs.
- RME will benefit from development and participation in regional processes to standardize data so that data can be shared and used effectively.
- Agencies need to support innovative approaches at the Executive policy level.
- As it is unlikely that we can afford to do monitoring for everything/everywhere we need to develop a clear hierarchical RME program across the stakeholders. We need to build a program that can provide some useful information (e.g., indicators) at a range of spatial and temporal scales, yet acknowledges that intensive monitoring can only be applied at certain critical scales.
- RME will benefit from the integration and cost-sharing of RME programs for more robust and cost-effective information targeting common needs.

- Scaled RME strategies must be developed that are coordinated with regional approaches and are designed to deliver information back to community and watershed councils.

Status and Trends Monitoring

I) Fish In Watersheds

Issues:

- There is uncertainty about the priority management questions that should inform appropriate fish sample designs and monitoring approaches
- Obtaining information about fish populations at appropriate scales (spatial/temporal) for Endangered Species Act (ESA), recovery planning purposes or local management issues can be a serious challenge
- Ability to answer management questions (as they have been so far identified) is limited by lack of adequate long-term funding.

Overall conclusions/recommendations:

- Develop a framework for identifying the priority management questions across agencies, including identifying levels of required precision and appropriate evaluative approaches (CSMEP has begun this process)
- Identify “priority” fish populations for monitoring –this process should involve the recovery planning partners as well as the stake holders in tribal trust and other issues.
- Develop a monitoring plan to sample all populations at some low level of effort, while identified “priority” populations are monitored at higher levels of effort.
- Encourage current efforts using EMAP probabilistic sampling for the development of a region-wide approach to assessing the basic questions of fish abundance, diversity, distribution, and productivity.
- Increase region-wide pit tagging as a way to improve assessments of fish populations from smolt to adult life stages
- Increase cross-walk comparisons of fish sampling approaches (e.g., comparison tests of census redd counts vs. reach or index based redd counts) to determine their reliability for evaluating S&T at different spatial scales

II) Habitat Condition in Watersheds

Issues:

- Current funding/time commitments from management do not allow for technical RME to occur with confidence levels acceptable to the scientific community.
- Scope and scale of current habitat sampling is not adequate to address the required scope and scale of management questions.
- Sharing of data and information on habitat and coordination between RME entities and private groups and individuals is poor.

Overall conclusions/recommendations:

- Establish standard metrics and protocols for habitat sampling.
- Set up good meta-data and data management systems to improve efficiency.
- Establish acceptable high level watershed indicators to measure status and trends of watershed health in relationship to stream and fishery RME.
- Facilitate implementation of a reference condition concept across the region.
- Establish broadscale tracking of watershed process and condition status; stream and habitat conditions; and biological status and trends.
- Develop Columbia Basin and region-wide status & trends monitoring designs for tracking of watershed process and condition status; stream and habitat conditions; and biological status and trends at evolutionary significant unit (ESU), minimum population group (MPG), and land ownership spatial scales.
- Promote ongoing workshops to develop consistency in RME and restoration priorities.

III) Fish and Habitat in Large Rivers with Dams**Issues:**

- Lack of consistent, coordinated methods of data collection
- Difficult to integrate across required scales for monitoring: operational monitoring at projects, mainstem passage survival, smolt to adult returns (SARs), and whole life cycle
- Lack of dedicated funding for analysis and evaluation of existing information
- RME is Endangered Species Act (ESA) species-driven; little understanding of ecosystem baseline and long term threats

Overall conclusions/recommendations:

- Apply PIT-tagging, and active life-cycle tags to integrate across life history stages
- Develop broad status & trend monitoring to provide context for understanding limiting factors, effects of actions
- For contentious issues, use CSMEP Data Quality Objectives process to define management needs, systematically evaluate alternative RME designs
- Fund core indicators in perpetuity through central entity with shared resources
- Develop integrative indicators of stream condition
- Analyze threats over next 100 years (e.g. population, economic growth, water demands, climate change) to focus actions and RME appropriately

IV) Fish & Habitat in Estuary/Near Shore Areas**Issues:**

- No single group responsible for tracking habitat permits, loss, and degradation in estuary and near shore habitats
- Limiting factors for estuaries are not well-defined, species specific, and some are unknown
- No consistent processes in place for data standardization/consistent methods, data dissemination among agencies relating to estuarine monitoring
- Natural variation in estuarine conditions broadscale monitoring very difficult
- Uncertain how to define and measure habitat connectivity for estuaries

Overall conclusions/recommendations:

- Develop better conceptual models for understanding estuary processes
- Promote a range of new remote sensing approaches for improving estuary monitoring
- Promote ongoing workshops to better define habitat connectivity and how to measure this
- Develop common indicators for estuaries and develop consistent standards (data collection, metadata formats, definitions) for publishing and sharing this data
- Work towards a universal survey design where appropriate
- Undertake a regional status and trend analysis of existing data
- Expand research on the impacts of toxics on salmonids and resident fishes
- Require a long term funding commitment to estuary RME

Action Effectiveness Monitoring

I) Habitat Actions

Issues:

- Difficult to quantify the change resulting from a specific habitat action, or from a group of actions
- Limited funding available for habitat effectiveness RME
- Monitoring is often of insufficient duration or spatial scope to measure broad changes associated with habitat actions (effects lost in environmental “noise”)
- Habitat action effectiveness studies are generally undertaken at smaller scales, very difficult to make inferences to larger watershed, population or ESU scales
- Very difficult to find independent “control” sites that are not also affected by human activities
- Approaches/techniques for measuring habitat change vary across agencies
- Information on habitat project planning, implementation and results are not readily available
- Decision makers on habitat actions (e.g. forest supervisor vs. watershed council member etc.) often require different scale monitoring designs to address their particular questions

Overall conclusions/recommendations:

- Identify objective habitat parameters that can be measured accurately and precisely, are responsive to change, and can also be related to fish population changes, regardless of species

- Undertake protocol comparison tests to determine which sampling methods might be best for assessing habitat changes
- Develop common protocols and training for collection of habitat data (groundbased and remotely sensed) across the region to answer habitat effectiveness questions at a variety of scales
- Encourage continuation and growth of a network of multi-agency collaborations (e.g., Columbia River Basin Pilot Projects, Intensively Monitored Watersheds (IMWs), Salmon Recovery Funding Board) for determining how best to evaluate habitat and fish response to habitat restoration actions at multiple spatial and temporal scales
- Develop a regionally centralized and accessible database of information on habitat project planning, implementation and results
- Develop paired-watershed analyses with controls to measure changes from habitat actions
- Expand remote sensing monitoring to evaluate habitat response at broader scales
- Develop approaches to assess the effects of multiple projects (determine what is really required to address such questions)
- Work to establish the analytical linkages and causal relationships between habitat/fish responses on a region by region basis
- Improve cost efficiencies for monitoring by developing a program of volunteers to collect field data and train/support them in this process and develop better arrangements between monitoring agencies and academic research groups

II) Harvest Actions

Issues:

- Unknown amounts of incidental/delayed mortality affect fishery estimates
- Limited ability to consolidate harvest data from different fisheries
- Harvest metrics are typically expressed as point estimates and do not characterize variation in accuracy or precision
- Current catch assessments do not allow assessment of fishery impacts at finer scales (e.g., population)
- Uncertain what population or production parameters are impacted by harvest

Overall conclusions/recommendations:

- Develop more stock-specific information to monitor harvest
- Begin to monitor demographics of populations in addition to number
- Undertake more fish in, fish out analyses that should also address other viable salmon population (VSP) parameters (e.g., spatial structure and life history diversity)
- Determine what specific harvest information is required for Technical Recovery Teams (TRTs), and CSMEP analyses (and at what resolutions) and determine what harvest managers need to know about new policies or analyses related to the other H's.
- Employ current stock assessment tools applied in fisheries harvest management (e.g., stock assessments, run reconstructions, forecasting, goal setting) at subbasin, province, population, MPG, etc. for use relative to other recovery and restoration actions

III) Hatchery Actions

Issues:

- Limited knowledge of harvest rates and ability of hatcheries to meet harvest goals
- Many current hatchery monitoring projects are viewed as case-specific (uncertain of inferences to broader scales or broader effectiveness questions)
- Many hatchery effectiveness questions require long time series of data (+10 years)
- Operations and maintenance and RME funding for hatcheries are often improperly lumped
- While hatchery management has changed (e.g., from solely harvest augmentation to a mixture of purposes including supplementation), hatcheries generally still operate in the same way as historically (e.g., collect broodstock and release progeny in the same locations and at the same time every year)
- Comprehensive hatchery RME plans, with the capacity to address many of the decision makers prioritized information needs, have been developed but remain unfunded

Overall conclusions/recommendations:

- Develop and implement a sampling design across broad scales that could overcome the case-specificity of current hatchery effectiveness monitoring results
- Develop a regional database with well defined performance measures and data quality standards for hatcheries
- Promote the use of new technologies for improved marking and tracking of hatchery populations (genetics, PIT tags, sonic tags, automated trailers)
- Improve our understanding of hatchery effectiveness using rotating release schedules and other management alternatives
- Promote the completion, technical review and funding of broad hatchery RME plans

IV) Hydro Actions

Issues:

- Current understanding of hydrosystem effects varies by fish species or type (e.g., hatchery fish better understood than wild fish, chinook better understood than sockeye or lamprey, etc.)
- Hydrosystem effectiveness evaluations require information collected across multiple lifestages and scales
- A lack of explicit decision rules regarding smolt to adult survival rates (SARs), Transport/Control (T/C) ratios, which species are most important, etc.
- Hydro RME studies are often prohibited if deemed too costly in terms of revenue generation, regardless of the opinions of environmental agencies
- Uncertainty over flow-survival relationships
- Uncertainty as to the proximate causes for D (i.e., the ratio of transport vs. in-river posthydrosystem SARs) and latent mortality

Overall conclusions/recommendations:

- There is good current monitoring of SARs, need to establish specific goals in this regard
- Increase PIT-tagging efforts to attain better evaluations of D and integrate information needs across the varied scales of hydrosystem evaluations
- Implement EPA's Data Quality Objectives (DQO) process for policy-level question identification and clarification (an approach currently being undertaken by CSMEP)
- Identify hydrosystem effectiveness questions that will require longer time scales and cannot be completed in the short term regardless of the level of investment
- Develop greater interaction of BiOp planners/policy people on hydro goals with technical groups
- Develop experimental designs for deliberate contrasts in actions (flow, spill, transport, hatchery releases) to strongly test alternative hypotheses

RME Synthesis and Integration

Issues:

- Integration of current regional status monitoring projects is poor
- Difficult to identify M&E commonalities across agencies and determine how to allocate effort
- Limiting factors that affect fish populations will vary across MPGs and ESUs
- Unclear how to effectively share data and information
- Can't develop or prioritize integrated M&E objectives at a technical level – balancing Status & Trends and “4 Hs” (Hatchery, Harvest, Hydrosystem, Habitat) questions across agencies requires prioritization at higher policy level

Overall conclusions/recommendations:

- Identify limiting factors at population/watershed scale and focus on these for integrated monitoring
- Improve Status & Trends monitoring by extending and integrating existing index sites (trend evaluations) with the USEPA Environmental Monitoring and Assessment Program (EMAP) probabilistic samples (status evaluations)
- Identify information inputs that are common across the Status & Trends and “4 Hs” (Hatchery, Harvest, Hydrosystem, Habitat)
- Move away from single use data collection efforts; build a core set of variables that can serve multiple uses
- Integrate sampling design and monitoring techniques across shared areas of interest
- Develop common protocols for both Status & Trend and action effectiveness M&E programs, and provide common training materials to reduce error drift
- Identify potential connections with ongoing national programs (and perhaps tie project funding to some degree of coordination with such programs)
- Use limiting factors analyses to focus monitoring resources

- Use life cycle models to initially evaluate each H's impacts that will have most effects on fish survival; concentrate your monitoring on what the model has identified as highest risk elements or highest uncertainty (where, when, what) relative to costs
- Undertake continuing and regular shared stakeholder meetings, workshops, retreats
- Educate policy groups on options and trade-offs of monitoring choices

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.

Table of Contents

ACKNOWLEDGEMENTS.....	34
TABLE OF CONTENTS.....	35
EXECUTIVE SUMMARY.....	37
INTRODUCTION AND BACKGROUND.....	40
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.	41
METHODS.....	43
RESULTS	45
Figure 1. — Importance rating of management questions for anadromous fish as percentage of agencies responding to the PNAMP Management Question Survey (2006).....	46
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.....	52
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.	57
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.....	59
DISCUSSION	62
CONCLUSIONS AND NEXT STEPS.....	64
APPENDIX B- AGENCY/ TRIBE RESPONSES	80
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. 80

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..... 86

APPENDIX C- COMMENTS AND ADDITIONAL QUESTIONS FROM AGENCIES/ TRIBES. 92

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?
- What is the size of adult anadromous and resident fish populations?
 - What is the distribution of fish populations?
 - What is the population growth rate of fish populations?
 - What is the freshwater productivity of fish populations?
 - What is the age structure of fish populations?
 - What fraction of the spawners of fish populations is of hatchery origin?
 - How frequently do fish spawn?
 - What life history types make up different populations?
 - 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?
- What is the biological condition of spawning and rearing habitat for fish populations?
 - What is the physical condition of spawning and rearing habitat for fish populations?
 - 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?
- 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?
 - What contribution did all tributary habitat actions for a fish population make toward increasing the population growth rate?
 - 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?
 - 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?
- What is the relationship of habitat processes and functions of upslope, riparian, and aquatic systems to biological and environmental habitat attributes?
 - What is the relationship of habitat attributes, processes, and/or functions to fish and wildlife abundance, productivity, and diversity?
 - 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 (NOAAAF), 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 (NWPCC), 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.

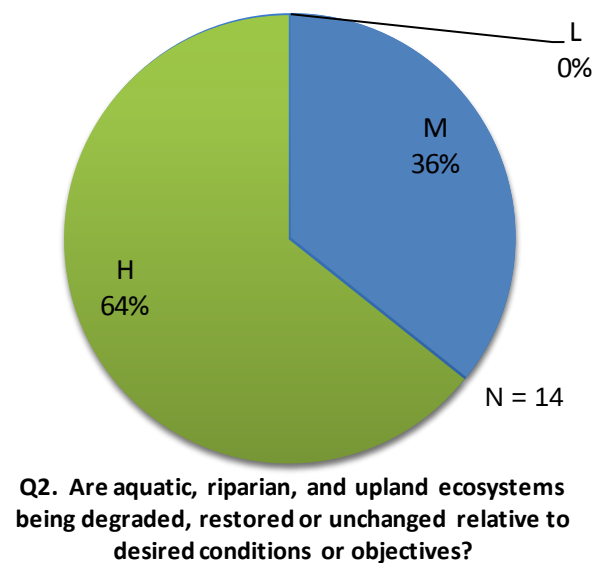
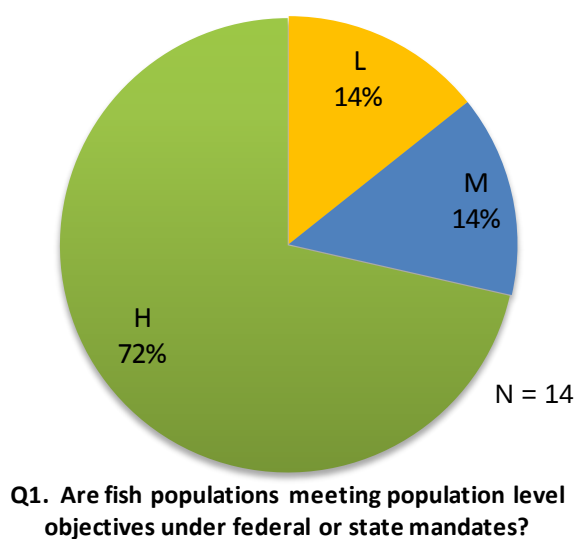
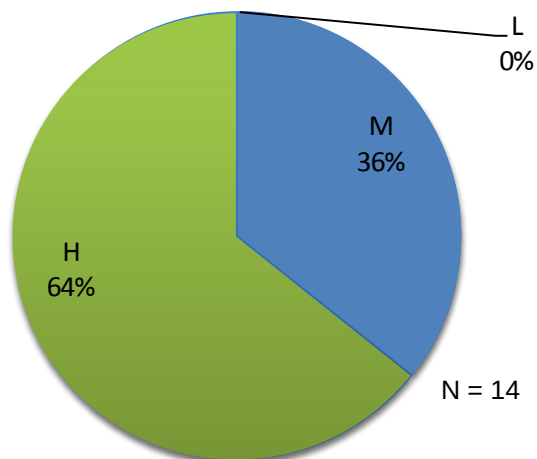
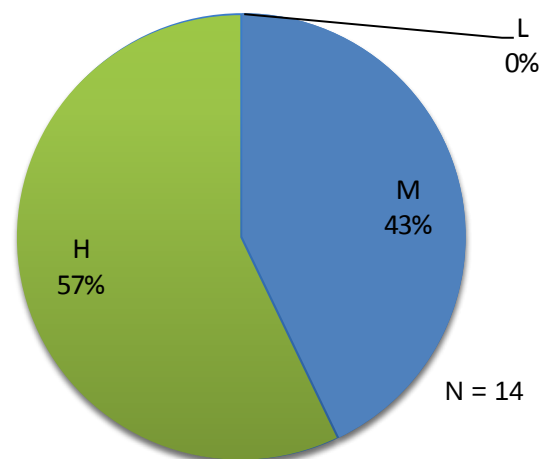


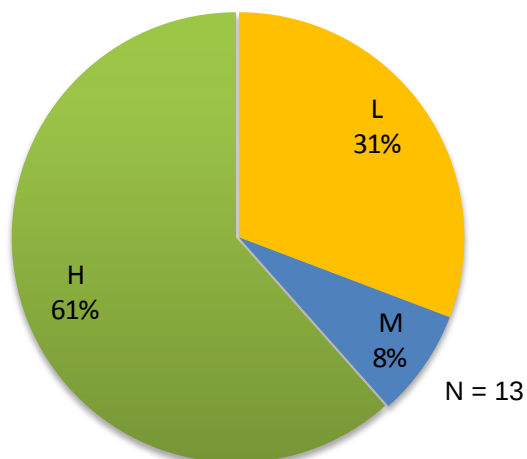
Figure 1. — Importance rating of management questions for **anadromous fish** (continued)



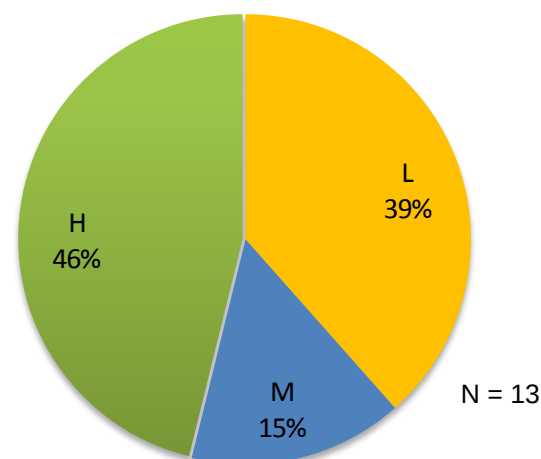
Q3. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives?



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

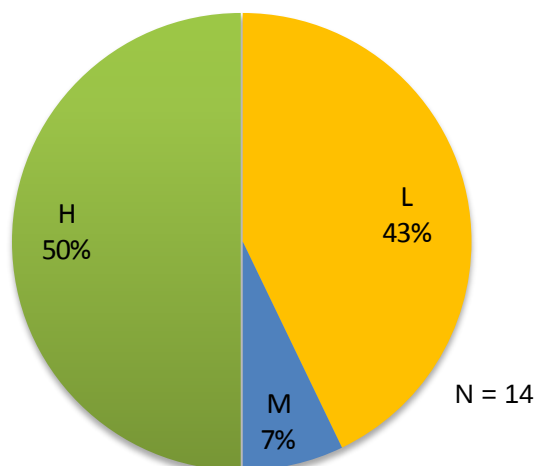


Q5. Are salmon and steelhead meeting juvenile and adult hydro passage performance objectives?

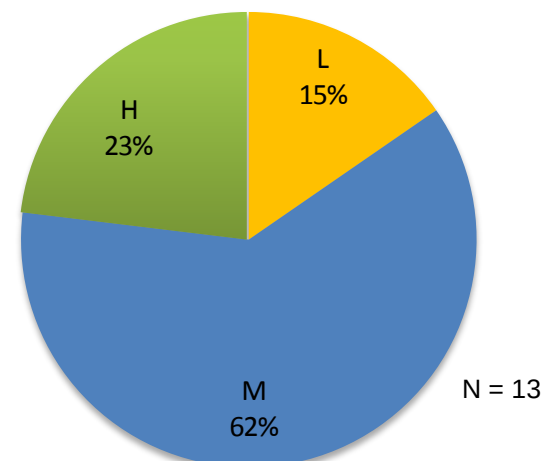


Q6. What is the magnitude of post release mortality or stress associated with transporting smolts?

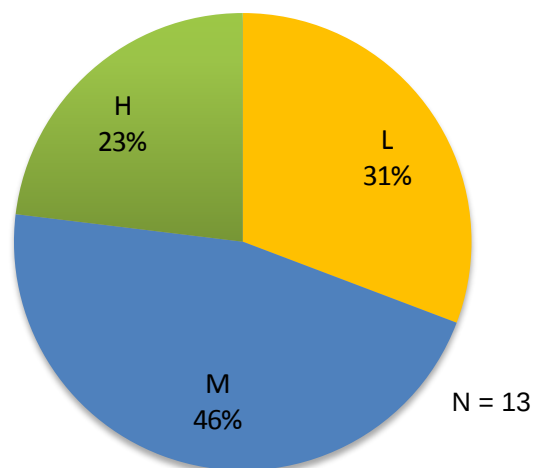
Figure 1. — Importance rating of management questions for **anadromous fish** (continued)



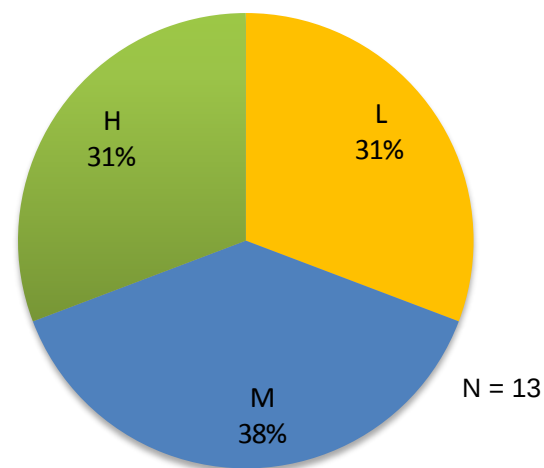
Q7. Do fish migrating in-river through the hydro system incur delayed mortality?



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

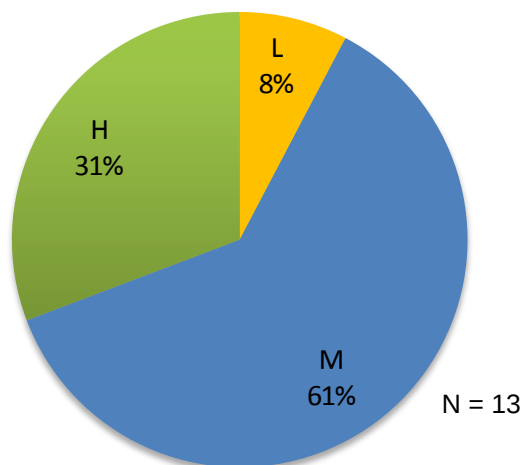


Q9. What are the status/trends in attributes of the estuary, plume, and ocean ecosystems?

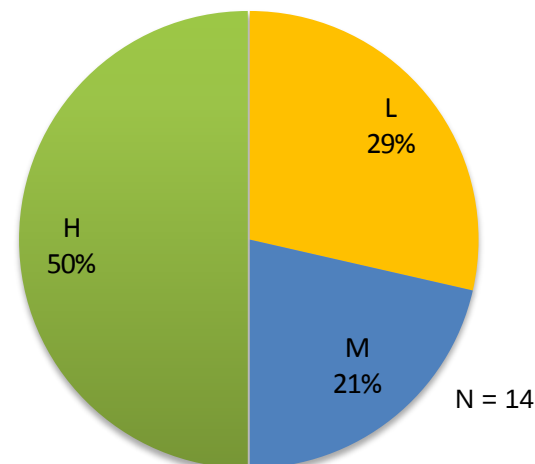


Q10. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives in the Estuary or Ocean?

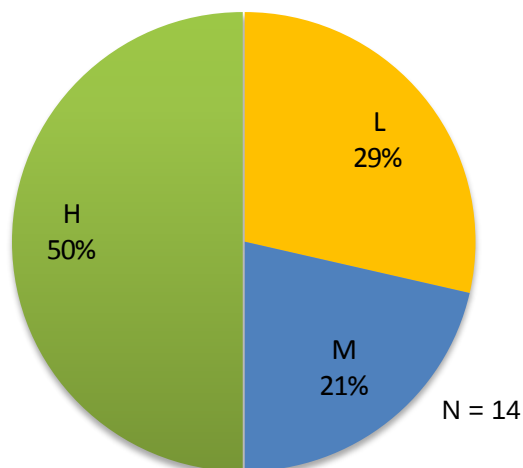
Figure 1. —Importance rating of management questions for **anadromous fish** (continued)



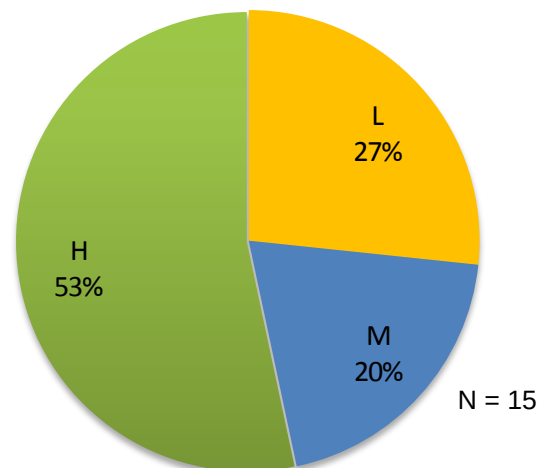
Q11. What are the limiting factors or threats in the estuary preventing the achievement of desired habitat or fish performance objectives?



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

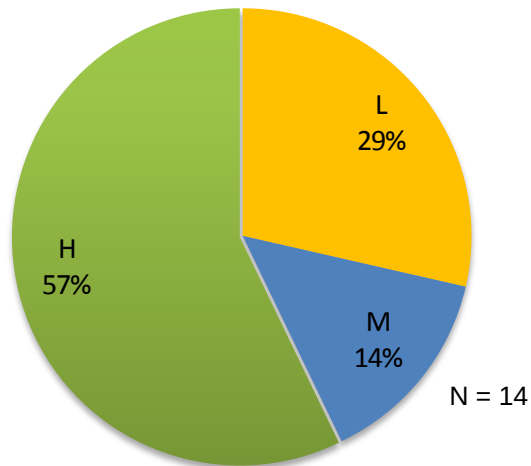


Q13. To what extent can hatcheries be used to assist in meeting harvest management goals or maintain the viability or conserve the genetic legacy of natural fish populations?

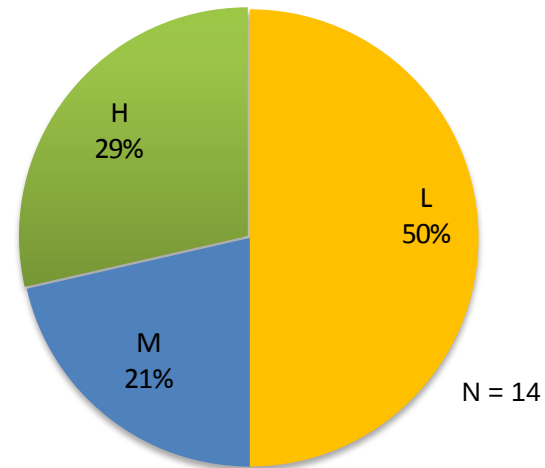


Q14. What is the reproductive success of hatchery fish spawning in the wild relative to the reproductive success of wild fish?

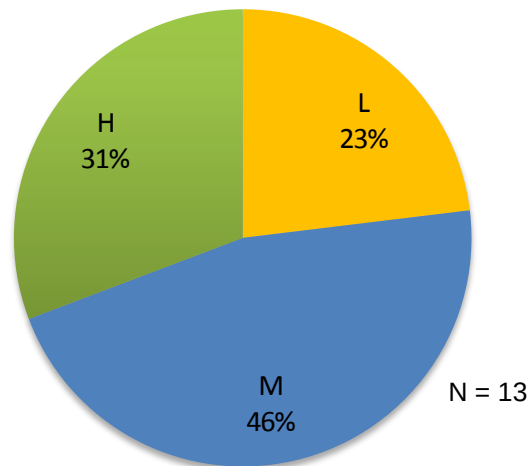
Figure 1. — Importance rating of management questions for **anadromous fish** (continued)



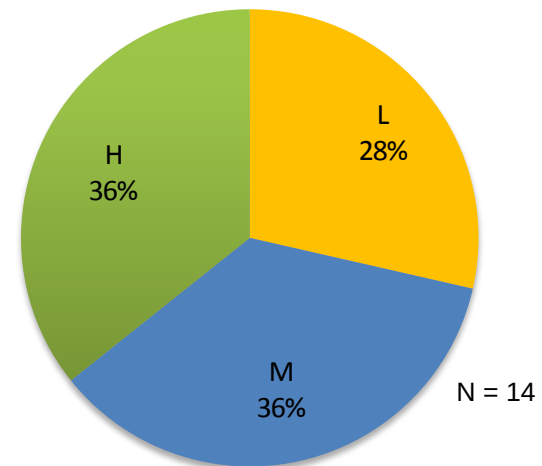
Q15. What are the harvest rates on wild and hatchery harvest management groups?



Q16. Are new selective gear types effective at harvesting?

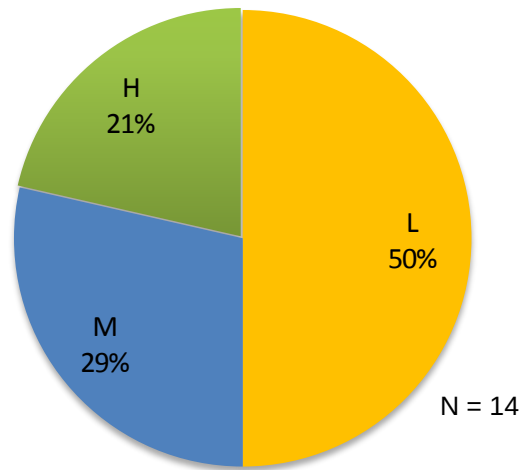


Q17. Are there delayed or incidental mortality effects associated with fish harvest?

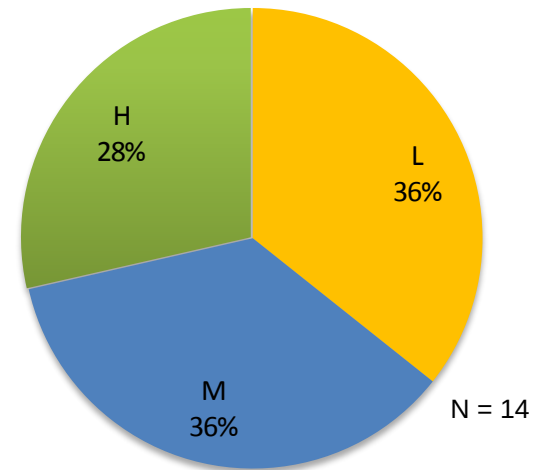


Q18. What is the impact of predators on juvenile fish?

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.

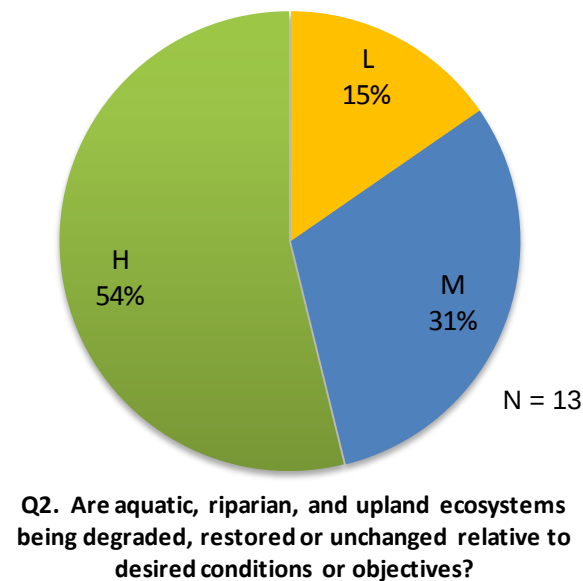
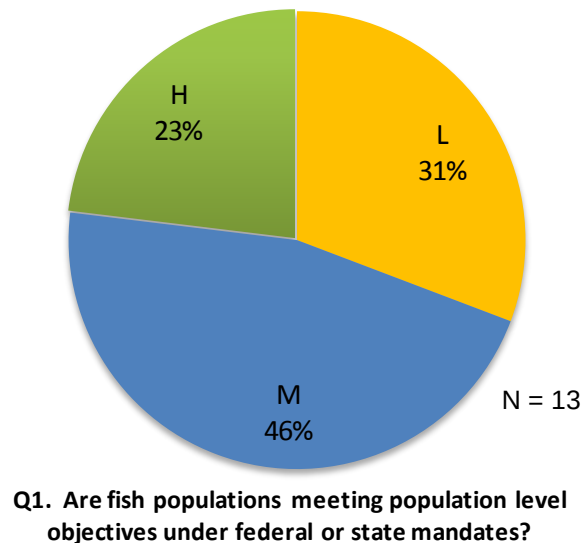
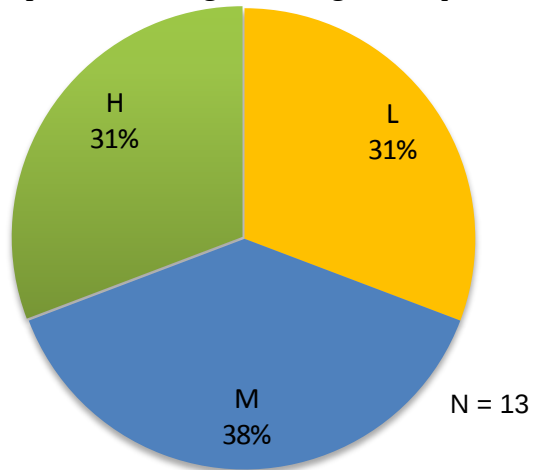
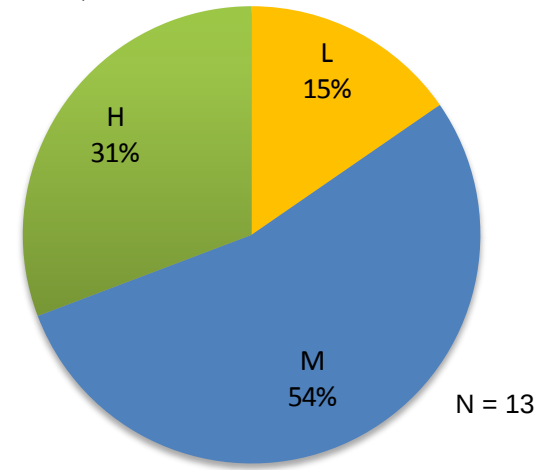


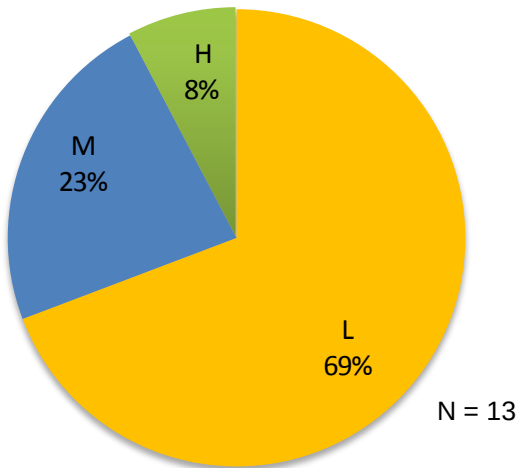
Figure 2. — Importance rating of management questions for **resident fish** (continued)



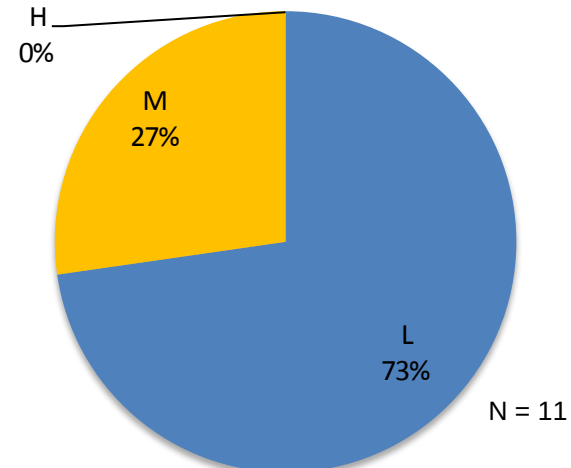
Q3. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives?



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

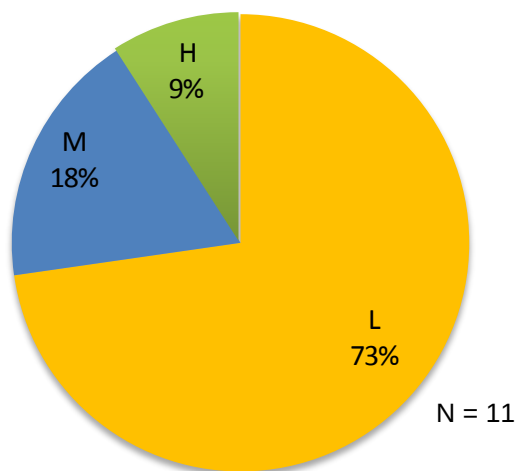


Q7. Do fish migrating in-river through the hydro system incur delayed mortality?

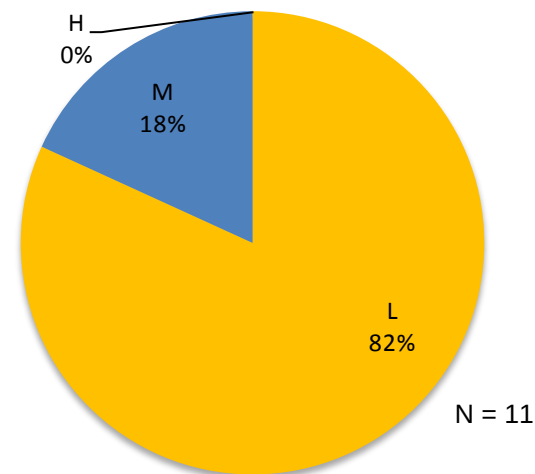


Q8. Are aquatic, riparian, and upland ecosystems of the estuary being degraded, restored or unchanged relative to desired conditions or objectives?

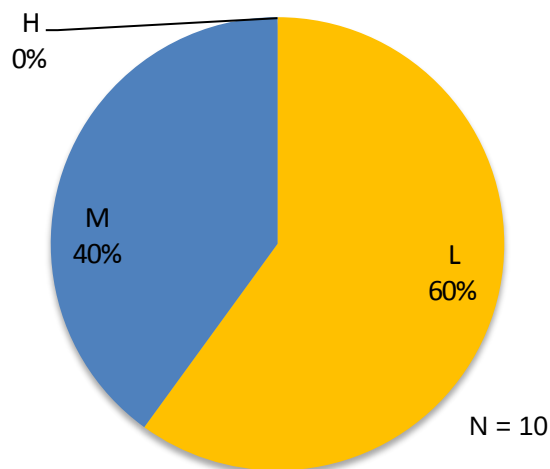
Figure 2. — Importance rating of management questions for **resident fish** (continued)



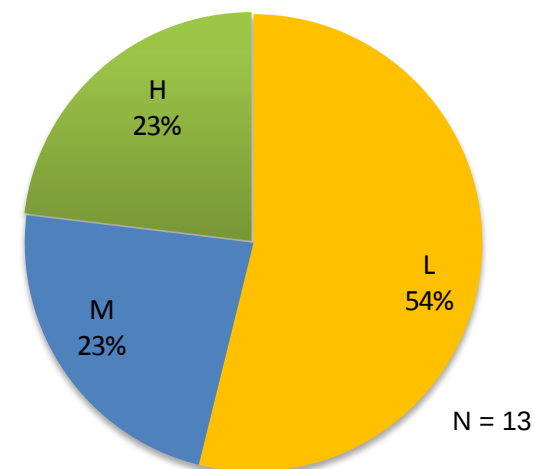
Q9. What are the status/trends in attributes of the estuary, plume, and ocean ecosystems?



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

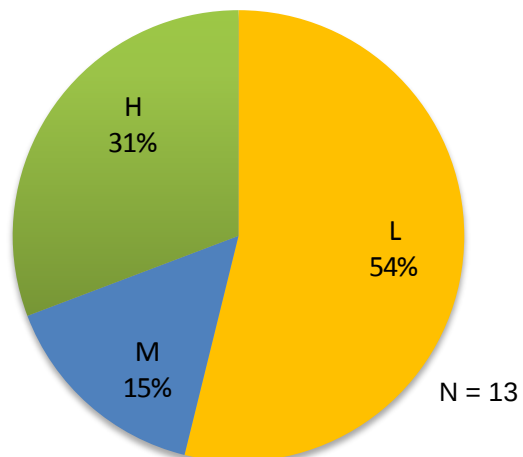


Q11. What are the limiting factors or threats in the estuary preventing the achievement of desired habitat or fish performance objectives?

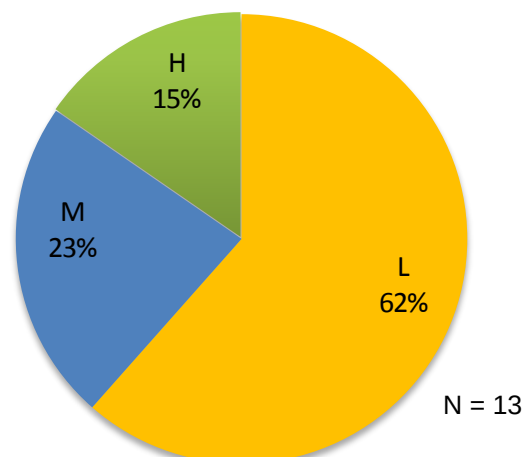


Q12. What effect do hatchery programs have on natural ecosystem and native fish health?

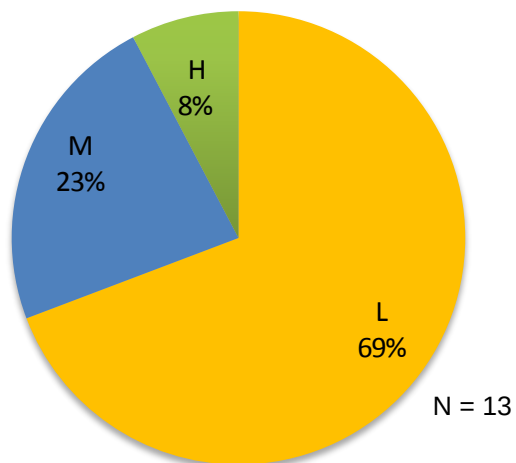
Figure 2. — Importance rating of management questions for **resident fish** (continued)



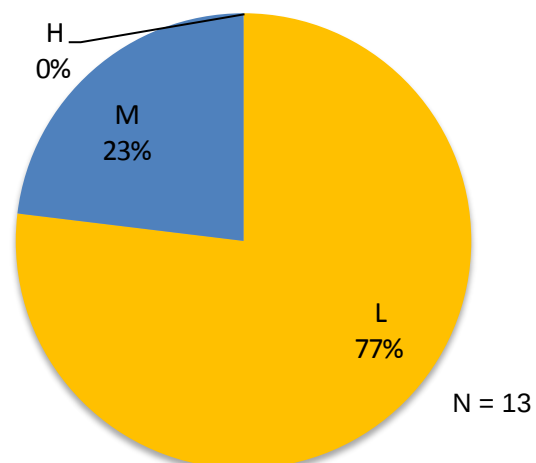
Q13. To what extent can hatcheries be used to assist in meeting harvest management goals or maintain the viability or conserve the genetic legacy of natural fish populations?



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

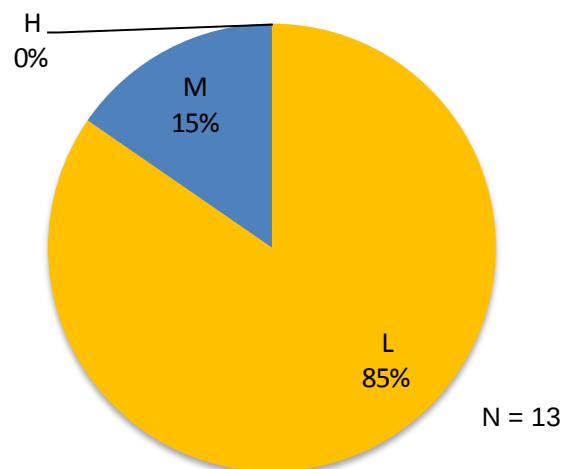


Q15. What are the harvest rates on wild and hatchery harvest management groups?

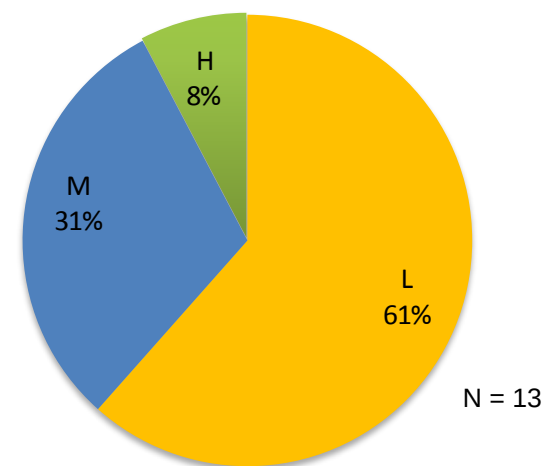


Q16. Are new selective gear types effective at harvesting?

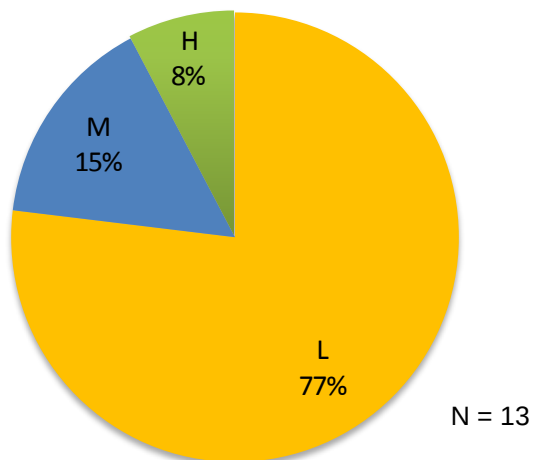
Figure 2. — Importance rating of management questions for **resident fish** (continued)



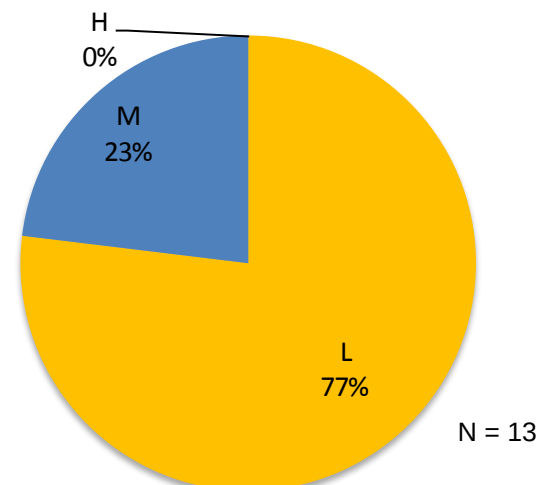
Q17. Are there delayed or incidental mortality effects associated with fish harvest?



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>

		BPA	CCT	CDFG	IDFG	NPT	ODEQ	ODFW	USACE	USBLM	USBR	USFS	WDE	WGSRO	WIAC	YN
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

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 no later than March3, 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 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?
<i>Tributary Habitat Management</i>					
Q1. Are fish populations meeting population level objectives under federal or state mandates?	Indicators of fish abundance, productivity, spatial distribution, and genetic diversity in spawning and rearing areas	Anadromous			
a. What is the size of adult anadromous and resident fish populations?	Numbers of adult fish	Resident 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			
Q2. Are aquatic, riparian, and upland ecosystems being degraded, restored or unchanged relative to desired conditions or objectives?	Indicators of aquatic, riparian, and upland ecosystem conditions	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			
Q3. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives?	Habitat actions and indicators of habitat and fish conditions	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

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?
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			
Q4. What are the limiting factors or threats preventing the achievement of desired habitat or fish performance objectives?	Indicators of habitat and fish conditions	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?
Hydro System Management					
Q5. Are salmon and steelhead meeting juvenile and adult hydro passage performance objectives?	Indicators of fish and habitat conditions within the hydro system	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			
Q6. What is the magnitude of post release mortality or stress associated with transporting smolts?	Indicators of transportation, and pre and post-transportation fish and habitat conditions and mortality	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			
Q7. Do fish migrating in-river through the hydro system incur delayed mortality?	Indicators of in-river, and pre- and post-in-river fish and habitat conditions and mortality	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:					
Estuary and Ocean Management					
Q8. Are aquatic, riparian, and upland ecosystems of the estuary being degraded, restored or unchanged relative to desired conditions or objectives?	Indicators of aquatic, riparian, and upland ecosystem conditions of the estuary	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			
Q9. What are the status/trends in attributes of the estuary, plume, and ocean ecosystems?	Indicators of fish and habitat conditions in the estuary, plume, and ocean	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. Barriers – 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			
Q10. What actions are most effective at addressing the limiting factors preventing achievement of habitat or fish performance objectives in the Estuary or Ocean?	Actions and associated habitat and fish responses in the estuary and ocean	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			
Q11. What are the limiting factors or threats in the estuary preventing the achievement of desired habitat or fish performance objectives?	Indicators of habitat and fish conditions in the estuary	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

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?
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:					
Hatchery Management					
Q12. What effect do hatchery programs have on natural ecosystem and native fish health?	Hatchery production and indicators of ecosystem and native fish health	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			
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?	Indicators of hatchery and wild fish production and harvest rates	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			
Q14. What is the reproductive success of hatchery fish spawning in the wild	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

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?
relative to the reproductive success of wild fish?	matings in natural spawning areas and subsequent adult returns from each type of cross	Resident Fish			
Additional Hatchery Management Questions:					
Harvest Management					
Q15. What are the harvest rates on wild and hatchery harvest management groups?	Numbers of adult fish harvested and numbers of adult fish escaping	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			
Q16. Are new selective gear types effective at harvesting?	Catch per unit of effort; catch related to capital and operating expense	Anadromous Resident Fish			
Q17. Are there delayed or incidental mortality effects associated with fish harvest?	Harvest and subsequent life stage survival rates	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:					
Predator and Invasive Species Management					
Q18. What is the impact of predators on juvenile fish?	Indicators of predator populations and fish conditions or mortality	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?
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			
Q19. What is the impact of predators on adult fish?	Indicators of predator populations and adult fish conditions or mortality	Anadromous Resident Fish			
a. What are the consumption rates of mammalian predators (marine)?	Abundance, distribution, consumption rates, diet composition	Anadromous Resident Fish			
Q20. What are the most effective management alternatives/actions that could be used to reduce the impact of predators?	Actions and predator or fish responses	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			
Q21. What are the most effective management alternatives/actions that could be used to reduce the impact of predators?	% 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.

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 estimates⁶, depensation thresholds⁷, or natural return ratio⁸?

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?

⁶ Intrinsic Capacity: An estimate of the historical abundance/productivity of a specific population.

⁷ 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.

⁸ 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?