

## **Staff summary of Issues & Recommendations**

### **Research/Monitoring/Evaluation/Data Management/ Reporting**

\*preliminary draft, please refer to full recommendations for complete review

10/29/2013 10:06 AM

#### **2009 Fish and Wildlife Program Section**

Section D. 9 Title: Monitoring, Evaluation, Research, and Reporting Strategies (pg 24-26)

Section VI D Title: Mainstem Plan – Juvenile Fish Transportation (pg 45)

Section VI D Title: Mainstem Plan – Adult Fish Passage (pg 46 )

Section VI D Title: Mainstem Plan – Mainstem Monitoring and Evaluation, and Research (pg 53)

Section VIII H Title: Implementation Provisions, Independent Scientific Review (pg.65 )

#### **Overview**

The recommendations receive generally support providing clear linkages between the program biological objectives, monitoring conducted, data managed for sharing, and using indicators to report about the Program. Related to this improvement, there is support to reorganize, restructure the guidance under these Program sections so that they are more clearly defined. There are also recommendations to modify the content of these sections by specifying priorities, incorporating recommendations from Council forums/workgroups, and addressing monitoring gaps (e.g. eulachon) and reporting needs. There is support to incorporate as appropriate the draft council guidance for monitoring and research, and one entity specifically highlight the matrix balancing risk-effort. Similarly, there is support to incorporate the draft council guidance for information management, evaluation and reporting, the ISAB recommendations, and BPA data management framework.

Some recommend better integrating monitoring projects, splitting research from monitoring, prioritizing projects that address multiple questions and produce scalable results, inventory existing projects to understand what monitoring they are conducting where and when, and to build off of existing monitoring efforts. There is support to increase funding of IMWs and to fund monitoring needed to inform models such as the lifecycle model that can explain population level response. There are recommendations to improve hatchery effectiveness monitoring by providing more guidance, such as minimum indicators to report, establishing non-hatchery watersheds, and implementing CHREET. Several entities provide critical research uncertainties to be included as part of the Program (e.g., acidification, invasive species, toxics, white sturgeon, eulachon, estuary action effectiveness, effects energy sources, and effects of the hydrosystem on marine attributes). There is a request to have research projects be better defined with specific end dates. Also there is support to have a regular solicitation of research projects to replace those that sunset and to facilitate addressing critical uncertainties.

There are recommendations focused on improving the Council's reporting about Program progress and effectiveness to inform adaptive management of the Program. This includes support for Bonneville funding of Council level reporting. Recommendation to incorporate HLIs into the Program, develop HLIs that represent all Program objectives, develop HLIs for resident fish, pacific lamprey, eulachon, wildlife and the lower Columbia River; using CA indicators to report, and to align indicators with existing HLIs used by BPA and other agencies in the Basin such as by using performance metrics from the FCRPS BiOp and Accords. Suggest including data from the Willamette (e.g. Minto Adult Collection facility) and to develop province level HLIs to link to Province level objectives. Some examples of what could be reported are provided, such as what data to graph.

To achieve a more streamlined approach to sharing data needed for program reporting, most support fully funding the Coordinated Assessment for data sharing of salmon and steelhead indicators (and data), and support expanding this effort to include resident fish and wildlife. Recommendations also specify the need to fund state and tribal data management needs for information required by Program and regional reporting. Some remark the need for data sharing agreements to insure the information is properly used. Some recommend that the Council rely on products developed and services provided by PNAMP and StreamNet to assist with data sharing and for informing Council reporting needs. Other entities suggest that their 'report card' could link to and inform Council HLIs. There is support for Bonneville to fund Council level reporting (or reporting by the Council) annually on Basinwide objectives, and annually/periodically on program actions and effectiveness to inform adaptive management.

Some recommendations suggest a forum, or forums, could be established to reach regional agreement on priority questions, highest priorities for ecosystem health, status and trend of fish and wildlife, and recommendation of specific data types. This could facilitate identifying priority indicators, data sharing, conducting needed evaluation to inform Program reporting, identification and prioritization of research uncertainties. A forum could also bring database projects together to facilitate coordination. In some situations the Council could make formal requests to existing forums (e.g. PNAMP) to conduct some of the work and to provide recommendations to the Council.

Some caution that the Council must remember that although standardization is appealing, a one size fits all approach doesn't always work. That instead the Council should focus on problem areas. Some caution about using fish marking and suggestion to only mark fish when needed to provide information to measure Program progress. Others suggest that there is need to reduce the cost of RME and to determine how much is needed (e.g. how much more HEP is needed). Other suggest using an independent approach for compliance monitoring, implementing CHAP, continuing CHaMP for 3-years, and continuing to track status and trend of terrestrial vegetation / land use / land cover as recommended by the ISAB. Others suggest the Council should monitor and report on economic benefits of fish activities including hatchery fish for harvest. Some recommend discontinuing monitoringmethods.org.

## **I. Summary**

### **1. Review, reorganization and refocus of RM&E language**

- IDFG (1) WDFW (4) Bonneville Customers (44) reorganizing the components of monitoring, evaluation and research

### **2. Framework / Approach**

- ODFW (3) WDFW (4) WAGSRO (5) UCSRB (7) CRITFC (14) Cowlitz I.T. (22) USRTF (28) NOAA-F (30) clear set of measurable biological objectives at various scales within the Program (high level indicators) could provide a top-down monitoring framework with which to guide data management infrastructure. A plan and process for reporting against those objectives could serve as an adaptive management tool for evaluating success of strategies and actions within the Program at each level.
- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67), per ISAB 2013-1, recommend a 5-part monitoring strategies to measure success
- WAGSRO (5) USGS-NW (38) recommend developing a framework / plan to track status and trend of limiting factors, to reduce uncertainties, and USGS-NW (38) include an ecological monitoring component
- WAGSRO (5) recommends continuing with the existing monitoring approach

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### **3. Priorities**

- IDFG (1) recommends better reflecting priorities for Status and trend monitoring , include priorities from Anadromous Salmonid Monitoring Strategy and NOAA’s ESA population monitoring
- WDFW (4) prioritize programs that address many questions, at many spatial and temporal scales, that are relevant for recovery
- CBWTP (40) prioritizing flow restoration activities
- Bonneville Customers (44) The Council should. • Establish a policy framework to prioritize and recommend RM&E projects based on an evaluation of cost, risk, and certainty as developed by your staff.

### **4. Cost**

- Bonneville Customers (44) The Council should ensure a robust and efficient RM&E Program but needs to reduce the overall costs; clearly define and estimate the costs of current RM&E efforts

### **5. Standardization**

- MFWP (2) Kootenai T.I. (24) council’s efforts to standardize RM&E and data sharing should recognize that needs differ throughout the Columbia Basin, do not to apply “one size fits all” strategies
- BPA (35) support on-going efforts to take a standardized, programmatic approach to habitat monitoring, analysis and reporting, while providing for collection of information that individual co-managers may need.

### **6. Participation**

- LCFRB (6) active participation and support of Lower Columbia monitoring initiatives
- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67), per ISAB 2013-1, recommend a comprehensive citizen science program, a “communities of practice” and support technology transfer and education

### **7. Uncertainty and level of evidence**

- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67), per ISAB 2013-1, recommend that the Program require all project proposals to acknowledge uncertainty

### **8. MonitoringMethods.org**

- MFWP (2) Kootenai T.I. (24) recommend that monitoringmethods.org be discontinued.

### **9. Coordination**

- IDFG (1) WAGSRO (5) LCFRB (6) UCSRB (7) NOAA-F (30) coordination of basinwide monitoring and IDFG (1) data programs and CRITFC (14) coordinating data sharing
- WAGSRO (5) and CRITFC (14) support the leveraging of existing projects

## **10. Consider including existing and developing new methods**

- MFWP (2) describes its method for assess fish biological responses to dam operations, potential use of non-lethal sampling of genetics and geochemical signatures in scales and otoliths
- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) , per ISAB 2013-1, requests developing methods to measure the potential increase in Chinook and steelhead survival from estuary restoration, and to monitor diversity .

## **11. Update information**

- WAGSRO (5) recommends, that the Program update the current status and trends of the fish and wildlife resources the Program
- NOAA-F (30) Update the Anadromous Salmonid Monitoring Strategies (ASMS)

## **12. RME Guidance, Concepts**

- IDFG (1) ODFW (3) WDFW (4) WAGSRO (5) CRITFC (14) Cowlitz I.T. (22) USRTF (28) NOAA-F (30) recommends incorporating concepts of the Guidance for a Balanced and Coordinated Approach for Conducting Monitoring and Research Activities and, all but IDFG (1), also the Council staff Draft Guidance for Information Management, Evaluation and Reporting
- CRITFC (14) Integrate the recommendations of the ISAB Food Web report into the overall monitoring program, and support monitoring of all life cycle impacts
- NOAA-F (30) clarify that monitoring efforts should be guided by key information needs
- WAGSRO (5) Project effectiveness monitoring information should lead to project selection that benefits target species and lifestages

## **13. Monitoring**

### **a. Status and Trend Monitoring**

- Some suggest language to guide the allocation of Council/Bonneville resources (IDFG (1)) , STI (26) suggest adequate funding for long-term based monitoring and evaluation for Upper Columbia Ecoregional
- USGS-NW (38) a monitoring plan using unmanned aircraft systems (UAS) technology

### **b. Habitat Effectiveness**

- WDFW (4) Kootenai T.I. (24) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) support monitoring of the effectiveness of the habitat restoration projects; WDFW (4) specifies at project-scale; WDFW (4) WAGSRO (5) specifies watershed/population scale, and WDFW (4) water transactions monitoring
- IDFG (1) referencing BPA's draft Action Effectiveness Framework

### **c. Habitat Status and Trend**

- CRITFC (14) Continue the CHaMP program for three more years then incorporate into an overall habitat monitoring program
- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) , per ISAB 2013-1, recommend developing a comprehensive plan for monitoring estuary restoration.

- CdA (13) UCUT (27) Kootenai T.I. (24) STU (26) recommend monitoring habitat changes and management using UWMEP, and CdA (13) and UCUT (27) also recommend monitoring using other ISRP endorsed methods and protocols
- d. Wildlife Monitoring**
- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67), per ISAB 2013-1, recommend Validate the relationship between the HEP habitat units and some real measure of value of the habitat,
  - Cowlitz I.T. (22), USRTF (28) The Council, through Wildlife Advisory Committee, should identify specific reporting requirements for wildlife and wildlife projects
  - Cowlitz I.T. (22) USRTF (28) continue funding HEP surveys to track mitigation progress
  - IDFG (1) recommends basinwide monitoring and evaluation program to measure effectiveness and outcomes of wildlife mitigation
  - STI (26) support annual wildlife monitoring and evaluation activities
  - BPA (35) adopt conclusions and recommendations from the Wildlife Crediting Forum closeout report
  - BPA (35) support flexible negotiated resolutions for wildlife habitat mitigation tracking.
  - BPA (35) For tracking Program accomplishments after construction and inundation mitigation is completed, the Council should consider retiring habitat units, and using acres.
  - NHI (42) recommends: 1) independent compliance, 2) CHAP approach to establish baseline conditions and habitat enhancements, and 3) continue mapping riparian habitat condition and land cover/use
- e. Hatchery Monitoring**
- ODFW (3) WDFW (4) LCFRB (6) CRITFC (14) Cowlitz I.T. (22) USRTF (28) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) recommends hatchery effectiveness monitoring, suggests language, and WDFW (4) recommends CRHEET
  - PFMC (34) NSIA and ANWS (62) recommend the Program supports hatchery program reviews to ensure compliance
  - ODFW (3), CRITFC (14), Cowlitz I.T. (22), USRTF (28) recommend a minimum set of hatchery indicators
  - CRITFC (14) collaborative efforts to address critical uncertainties and measure the impacts of mass marking and mark selective fisheries
- f. Harvest Monitoring**
- NOAA-F (30) define objectives for the harvest monitoring program
- g. Predator monitoring**
- WDFW (4) USRTF (28) evaluate the effectiveness of focused pikeminnow removals
  - Cowlitz I.T. (22) USRTF (28) evaluate the extent of pinniped predation
  - USFWS (33) determining predation on adult and juvenile lamprey during migration

**h. Ecosystem Functions, Foodweb Monitoring**

- USGS-NW (38) include assessments of how streamflow, sediment, and large woody debris interact; assess foodweb transfer, sediment transport, and biological effects of emerging and legacy organic contaminants on species and restoration projects ; and track trends in food web dynamics

**i. Freshwater Mussels Monitoring**

- CTUIR (19) and STI (26) monitoring and (CTUIR (19)) research related to western freshwater mussels

**j. Lamprey Monitoring**

- CTUIR (19) USFWS (33) monitoring for pacific lamprey; and USFWS (33) recommends the Pacific lamprey Conservation Initiative , developing a regional tagging and monitoring strategy, and other aspects to monitor .

**k. Salmon and Steelhead Monitoring**

- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67), per ISAB 2013-1, recommend developing the capability to monitor hatchery and natural-origin fish separately

**l. Sturgeon Monitoring**

- Cowlitz I.T. (22) USRTF (28) recommends monitoring and evaluating white sturgeon mitigation effort consistent with the Columbia Basin White Sturgeon Planning Framework, and WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67), monitor and improve white sturgeon passage through lower mainstem dams

**m. Eulachon Monitoring**

- CSKT (18) Cowlitz I.T. (22) USRTF (28) NOAA-F (30) recommends monitoring for Eulachon

**n. Climate Change Monitoring**

- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) USGS-NW (38) recommend monitoring to inform about climate change impacts, including species responses, interactions and production, river hydraulics, temperature, and sediment movement.

**o. Blooms, Invasive, Non-Native Species Monitoring**

- MFWP (2) quantify *Didymosphenia geminata* (Didymo) distribution
- WDFW (4) NOAA-F (30) USGS-NW (38) Native Fish Society (60) Trout Unlimited (67), UCUT (27) Kootenai T.I. (24) track and monitor data on existing non-native invasive species

**p. Contaminant Monitoring**

- CRITFC (14) USRTF (28) USEPA (37) map footprint of existing contamination and toxic discharge location

- CTUIR (19) NOAA-NW (31) USEPA (37) recommends conducting monitoring of contaminants; CTUIR (19) NOAA-NW (31) assessing effects on fish and USEPA (37) characterizing the contaminants.
- q. Monitor Impact of Energy Sources and Infrastructure**
- WDFW (4) recommends evaluating the impacts on fish and wildlife resources of all renewable energy sources and associated transmission infrastructure
- r. Monitor Reintroduction of anadromous fish in blocked areas**
- STI (26) UCUT (27) Kootenai T.I. (24) USFWS (33) support evaluating reintroduction efforts in blocked areas, and STI (26) UCUT (27) Kootenai T.I specifically mentions above Grand Coulee Dams.
  - WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) adopt guidelines, benchmarks, and a basin-level experimental framework for reintroduction.

## 14. Research

### a. Research Plan and Resolving Research Uncertainties

- IDFG (1) NOAA-F (30) WDFW (4) develop, update, finalize the Council's draft Research plan, use it to identify priorities , and IDFG (1) suggests adding timeline and defining a collaborative process
- MFWP (2) commit to resolving critical ecosystem or biological uncertainties
- WDFW (4) Fund research needs separate from M&E needs and funding
- WDFW (4) Develop a model that encourages completing research projects with clear reporting requirements and that encourages new projects to be developed to establish a rotating research fund
- WDFW (4) recommends that research hypothesis should connect to Program and tie to outstanding policy questions or concerns
- WDFW (4) WAGSRO (5) LCFRB (6) suggests relying on science/management forums to establish research priorities
- CRITFC (14) recommends that research proposals should be reviewed and coordinated by a group of regional experts
- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67), per ISAB 2013-1, recommend an active program of research through focused RFPS
- CRITFC (14) and USFWS (33) USGS-NW (38) recommend the ISAB Foodweb recommendations be addressed and USGS-NW (38) support those beyond what ISAB identified.

### b. Innovative (tools/methods) Research

- Council continues to develop and fund new approaches to : WASGRO (5) determine effectiveness of salmon habitat restoration projects; USGS-NW (38) control or eradicate new and existing infestations of invasive species; NOAA-NW (31) predict the cumulative and interrelated impacts of regional human population growth, land use change, toxic terrestrial runoff, and climate change; and USGS-NW (38) support new topics [omitted text] and technologies beyond those identified by the

### c. Fish Research Uncertainties

- Some recommend critical research uncertainties MFWP (2) Kootenai T.I. (24), such as CdA (13) anadromous fish passage feasibility; Cowlitz I.T. (22) USRTF (28) improve survival of anadromous fish; WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67), feasibility and cost-effectiveness of steelhead kelt reconditioning; and NOAA-F (3) research and life cycle modeling to inform decision makers of the biological benefits they could expect from implementing or synchronizing different suites of actions across the life cycle.
- USFWS (33) USGS-NW (38) recommends research topics for lampreys related to hydrosystem operations, passage, tagging technology, contaminants, aquaculture, etc.

**d. Hatchery Research Uncertainty**

- WDFW (4) WAGSRO (5) UCSRB (7) recommends research questions related to hatchery, carrying capacity; Cowlitz I.T. (22) hatchery fish; CRITFC (14) tagging release mortality rate; and NOAA-F (30) effect of artificial propagation on the viability of listed species.

**e. Habitat Research Uncertainty**

- USGS-NW (38) Research uncertainty regarding the types of habitat needed for juvenile salmon survival, the effectiveness of estuarine projects; and develop the capabilities necessary to estimate the carrying capacity of the system

**f. Invasive , Non-Native Species Research Uncertainty**

- CSKT (16) USRTF (28) USGS-NW (38) effects of existing invasive species and non-natives ; WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67), trophic interactions involving non-native species in hybrid and novel ecosystems; and WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) develop bioenergetic models to estimate trophic demands on food supplies

**g. Contaminants Research Uncertainty**

- CRITFC (14) CTUIR (19) Cowlitz I.T. (22) USRTF (28) NOAA-F (30) USGS-NW (38) provides a list of critical uncertainties in understanding impacts of contaminants ; and CdA (13) Cowlitz I.T. (22) UCUT (27) Kootenai T.I. (24) USRTF (28) NOAA-F (30) USEPA (37) assess relationship between hydropower projects and toxins

**h. Climate Change Research Uncertainty**

- USGS-NW (38) recommends Critical uncertainties in understanding future impacts of climate change on target aquatic species such as USFG-NW (38) WSFWS (33) lamprey; and WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) initiating modeling of climate-temperature effects for all parts of the Basin

**i. Hydrosystem, harvest and other anthropogenic Research Uncertainty**

- USGS-NW (38) passage and survival in the hydro system; efficiencies in water use; Cowlitz I.T. (22) USRTF (28) NOAA-F (30) effects of anthropogenic freshwater management; WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) ecological changes created by the hydrosystem that benefited predator



- populations ; WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) assessing hydrosystem operation impacts; WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) impacts of short-term fluctuations in water releases and of reservoir habitat and water levels; WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67), factors in the mainstem hydrosystem (including aspects of reservoirs) affecting natural spawning, reproduction, and recruitment success; PFMC (34) NSIA and ANWS (62), a study of higher spill levels.
- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) assessing harvest related uncertainties, including impact of harvesting hatchery fish
  - NOAA-F (30 ) catch-and-release mortality.
- j. Estuary, Plume, Near Ocean Research Uncertainties**
- WDFW (4) WASGRO (5) USRTF (28) estuary, plume near shore ocean research questions ; Cowlitz I.T. (22) USRTF (28) NOAA-F (30) effectiveness of estuarine restoration projects and different types of habitat; general understanding of the quantity and quality of fish habitat and fish usage; status and trends of the ecosystem processes; and forage fish.

## 15. Evaluation

### a. Program Level – Effectiveness Evaluation

- WAGSRO (5) UCSRB (7) evaluate program effectiveness and progress toward recovery
- WAGSRO (5) recommends document gaps between Program objectives and FW status
- WAGSRO (5) recommends implementing program evaluation step of the adaptive management process

### b. Habitat – Fish Effectiveness Evaluation

- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67), detailed evaluations, or formal reviews, to evaluate effectiveness of habitat restoration efforts
- Bonneville Customers (44) The Council should conduct an evaluation of the habitat monitoring efforts to date and determine how much is necessary
- Kootenai T.I. (24) BPA shall provide sufficient monitoring and evaluation funding to support science-based analysis of the effectiveness of the Tribe’s integrated fish and wildlife program and that of its partners

### c. Evaluate Anadromous fish Migration and Survival

- NPT (25) Evaluate salmon, steelhead and Pacific lamprey migration and survival rates in the lower Columbia River, the estuary, and the marine environment

### d. Evaluate Wildlife Section of the program

- ODFW (3) Cowlitz I.T. (22) USRTF (28) A programmatic evaluation of the Wildlife Section of the Program should occur preceding Program amendments

### e. Evaluate long term data sets

- WDFW (4) Fund synthesis of long term data sets to understand change over time.

**f. Evaluate min set of data for specific types of projects**

- UCSRB (7) The Council should take the lead in articulating a minimum set of data for specific types of projects for evaluation

**g. Evaluate High Level Indicators**

- UCSRB (7) develop and routinely evaluate High Level Indicators

**h. Develop models to inform evaluation**

- UCSRB (7) develop models informed by various monitoring results (e.g. Life Cycle Models) and are scalable; CTGR (18) Cowlitz I.T. (22) NOAA-F (30) Develop an oceanographic indicators ecosystem conditions model for eulachon research; NOAA-NW (31) develop models to extrapolate sub-organismal toxicity to the population-scale

**16. Data Management**

**a. Guidance**

- IDFG (1) recommends formally referencing Bonneville's Data Management Framework

**b. Data sharing**

- ODFW (3) WDFW (4) CRITFC (14) Cowlitz I.T. (22) USRTF (28) NOAA-F (30) use the updated Program as the starting point for developing a coordinated data management system based on explicit reporting requirements
- IDFG (1) ODFW (3) WDFW (4) WAGSRO (5) BPA Cowlitz I.T. (22) NPT (25) USRTF (28) NOAA-F (30) STI (26) provide funding for collaborative and networked support for states and tribes to inform regional reporting requirements for evaluation of Program activities
- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) accelerate efforts to improve data availability and sharing

**c. Coordinated Assessments**

- NOAA-F (30) add a strategy for coordinated assessment
- ODFW (3) WDFW (4) WAGSRO (5) CRITFC (14) Cowlitz I.T. (22) NPT (25) USRTF (28) NOAA-F (30) recommends that the Council should adopt and BPA should fund full implementation of the Coordinated Assessments project; and some support its expansion to include, ODFW (3) WDFW (4) WAGSRO (5) CRITFC (14) Cowlitz I.T. (22) NPT (25) USRTF (28) indicators for resident fish and wildlife ; NPT (25) non-salmonid anadromous fish ; ODFW (3) WDFW (4) WAGSRO (5) WAGSRO (5) CRITFC (14) Cowlitz I.T. (22) USRTF (28) to support ESA and Fish and Wildlife Program reporting needs

**d. Database Maintenance and updates**

- IDFG (1) provide maintenance and updates to state databases of wildlife, fish and habitat data; and CRITFC (14) for CA

- IDFG (1) recommends regular updates of data on fish and wildlife information needs
- e. New databases**
  - ODFW (3) Cowlitz I.T. (22), USRTF (28) recommend a reporting database for hatchery indicators; CRITFC (14) USFWS (33) for fish and wildlife genetic data; USFWS (33) for Pacific Lamprey; USGS-NW (38) for sturgeon
- f. Data management for HLIs**
  - CRITFC(14) recommends development of data streams to support the Council's High Level Indicators
  - UCUT (27) Kootenai T.I. (24) connect Upper Columbia Data Management Program with the Council's HLIs.
- g. Data Priorities**
  - StreamNet (42) recommends addressing the need for a means to clearly establish and articulate regional scale monitoring questions and their related data priorities, along with a mechanism to assure coordination among regional-scale database projects to avoid duplication of effort and/or to encourage supportive interactions among projects
- h. Data Sharing Agreements**
  - YN (17) include language acknowledging the need to establish data sharing agreements

## **17. Reporting**

### **a. Guidance**

- ODFW (3) WDFW (4) Cowlitz I.T. (22) USRTF (28) NOAA-F (30) recommends incorporating concepts consistent with the Council staff Draft Guidance for Information Management, Evaluation and Reporting
- ODFW (3) WDFW (4) WAGSRO (5) Cowlitz I.T. (22) USRTF (28) NOAA-F (30) recommend how to rectify the oversight of data management needed to inform adaptive management

### **b. Program Information and Reporting**

- ODFW (3), WDFW (4) Cowlitz I.T. (22), USRTF (28) recommend that BPA shall fund adequate monitoring, data management, and reporting
- ODFW (3) WDFW (4) WAGSRO (5) Cowlitz I.T. (22) NPT (25) USRTF (28) NOAA-F (30) BPA should fund adequate reporting at the Council level to provide annual, and periodic, reporting of Program actions and effectiveness.
- WAGSRO (5) Cowlitz I.T. (22) NPT (25) The Council should report annually on progress towards achieving the Basin-Level Biological Objectives
- CSKT (16) work with fish and wildlife managers and partners to provide a periodic review of implementation of Fish and Wildlife Program measures

and provide an annual implementation status report of these measures; and progress towards implementation of these subbasin plans

- WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) use HLIs and information from other monitoring programs to engage the public and develop a common Program vision. Conduct regular press and other briefings; use fact sheets and message boxes to define the issues. Use of “mobile apps” is one example of effective information sharing
- BPA (35) the Program’s High Level Indicators (HLIs) should employ the data (metrics) rolled up to report on the Action Agencies’ progress under the FCRPS BiOp, as well as performance metrics used by other federal and state.
- UCUT (27), Kootenai T.I. (24) interim use of a UCUT report card to report on population performance relative to program objectives
- WAGSRO (5) recommends, as part of the adaptive management steps, that the Program Share through reports, web tools, and other sources the accumulated monitoring and research data and information which will be used to carry out steps 7 and 8 of the adaptive management process;

**c. HLIs and Graphics**

- ODFW (3) WASGRO (5) UCSRB (7) Cowlitz I.T. (22) NPT (25) USRTF (28) WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) integrate biological objectives and Council HLIs for reporting; these 10 entities and CTGR (18) also recommend expanding HLIs, such as for representing program objectives, diversity, lower Columbia, resident fish, pacific lamprey.
- ODFW (3) WASGRO (5) Cowlitz I.T. (22) USRTF (28) recommends specific data to report on a regular basis providing example graphics
- Snake River Salmon Solutions (65) recommends an accurate accounting and reporting system to enumerate by species and ESU wild/natural and hatchery origin salmon and steelhead returning to the Columbia River for public consumption. . Graphics need to include earlier (1960s) returns rather than using NOAA's 1990s baseline.
- ODFW (3) CRITFC (14) Cowlitz I.T. (22) recommend including new language to guide reporting indicators for Hatchery Effectiveness Monitoring

**d. Wildlife Reporting**

- ODFW (3), WDFW (4) support specific reporting requirements for wildlife and wildlife projects; and a designated project to perform the summary, analysis and reporting.
- ODFW (3) WDFW (4) Cowlitz I.T. (22) USRTF (28) the wildlife managers are prepared to build upon the WMIS and engage with the Council and BPA to develop biological and environmental performance objectives for the wildlife portion of the Program and ODFW (3) WDFW (4) USRTF (28) recommend establishing [using the above work] an annual and five-year reporting process for evaluating implementation success.

**e. Economic Benefits of Fishing**

- NSIA and ANWS (62) collect and develop information concerning the economic benefits of fishing activities.

**f. Project Information**

- CRITFC (14) Produce inventory of existing projects, collecting what, for what purpose, and when.

**18. Workshops and forums**

- USFWS (33) conduct Pacific lamprey workshops to provide guidance on the sampling methodology and study design for occupancy and distribution surveys.
- IDFG (1) WDFW (4) recommends including recommendations from collaborative processes such as Ocean Forum, Tagging Forum, Estuary Workshop; and IDFG (1) adding timelines to unfinished work.
- ODFW (3) WDFW (4) WAGSRO (5) Cowlitz I.T. (22) USRTF (28) use a Regional Coordination forum to develop, review, improve regional restoration progress reports, and provide policy guidance for data management efforts;
- ODFW (3) WDFW (4) WAGSRO (5) Cowlitz I.T. (22) USRTF (28) NOAA-F (30) recommends using the StreamNet and Pacific Northwest Aquatic Monitoring Partnership (PNAMP) forums for development of the technical issues and tools necessary for coordinated data management; and extending to include other data such as wildlife and terrestrial habitat data
- ODFW (3) WDFW (4) WAGSRO (5) Cowlitz I.T. (22) StreamNet (42) utilize existing programs or projects to carry out some of the work on behalf of the Council, e.g. PNAMP for monitoring and data priority tasks
- CRITFC (14) a data analyst work group should be formed to review the existing and expanded data management efforts and recommend improvements
- CRITFC (14) recommends that PNAMP should convene a small work group of geneticists and policy representatives to design needed structures and processes to manage, share and apply fish and wildlife genetic data to programs under its Fish and Wildlife Program

## II. Framework Recommendations

### State F&W Agencies/other state agencies/state supported agencies

#### 1. Idaho Department of Fish and Game, IDFG (1) (submitted by Paul Kline )

- Research Monitoring and evaluation (RM&E) Recommendations: Idaho supports a review, reorganization and refocus of language in the current Program document related to RM&E. Currently, sections of the Program that include major references to RM&E include Section II D9, VI D, and VIII H.
  - while references to RM&E in the mainstem plan do a good job of referring the reader to the Basinwide Strategies section for detail, the disperse nature of guidance in this area is still confusing
  - Idaho supports the continued division of definitions, priorities, and plans for Research to remain distinct from Monitoring and evaluation (as presented in the Basinwide Strategies section of the Program)
  - Language in the current plan directed at finalizing the Council’s draft Research plan and using it to identify and prioritize research needs is good and should remain in the new program. New language could define the timeline and collaborative process needed to meet this objective.
  - A new concept we hope Council will consider would be to redefine Monitoring and Evaluation into its principle components (Habitat Action Effectiveness Monitoring, Status and Trend Monitoring, and monitoring specifically associated with focused research efforts). Council has invested considerable resources in this areas. The condensed MERR Document (Columbia River Basin Fish and Wildlife Program Draft Guidance for a Balanced and Coordinated Approach for Conducting Monitoring and Research Activities) is a good start and captures the essence of the original MERR document but could be reorganized to define the principal components of Monitoring and Evaluation. We believe this would help the Council capture momentum recently gained towards identifying efficiencies (and savings) in Action Effectiveness Monitoring. This is the culvert/fence-line discussion that has been going on for some time that has focused appropriate concern on current monitoring and evaluation that may be redundant and unnecessary. If addressed separately from Status and Trend Monitoring we believe the discussion will be more effective.
  - The Council may also want to consider formally referencing the draft Action Effectiveness Framework being developed by BPA as an additional guide to consider when identifying efficiencies in this area
  - Status and trend monitoring is distinct from action effectiveness monitoring. While it is true that monitoring every culvert or fence-line may not be necessary, it does not hold that status and trend (VSP) data collected for one population of anadromous fish applies to other populations. This information is not “transferrable.” Here language in the Program could be refocused to better reflect Council, Bonneville and Manager Priorities. Importantly, priorities identified in the Anadromous Salmonid Monitoring Strategy (Skamania outcome) and NOAA’s ESA population monitoring vision need to be captured and used to shape this section. The goal is to develop Program language to guide the allocation of Council/Bonneville resources for status and trend monitoring actions. Again this discussion would be more efficient if conducted separately from the “grand discussion that includes action effectiveness monitoring.
  - We also recommend that Council consider formally referencing the recently completed Bonneville Data Management Framework in the Program. We believe this document is sound and generally vetted among Managers.
  - Similarly, recommendations that have come from different collaborative processes such as the Estuary/Plume workshop and the Fish Tagging Forum could be referenced in the new Program. Follow up recommendations and unfinished work should be identified and time-bound.
- Wildlife

- Incorporate and fund basinwide monitoring and evaluation program to measure effectiveness and outcomes of wildlife mitigation in terms of species and habitat response and trend at the project, subbasin, province, and CRB level scales.
- Data management Recommendations
  - We recommend that Council consider formally referencing the recently completed Bonneville Data management Framework in the Program. We believe this document is sound and generally vetted among managers.
  - Additionally we recommend the development of Program language to provide:
    - Funding for collaborative and networked support for states and tribes to edge-match data, models, and protocols across administrative boundaries and to support an ecological basis of mapping and providing fish and wildlife data that is geospatially explicit.
    - Maintenance and updates to state databases of wildlife, fish and habitat data at both fine and coarse scales including geospatially explicit and regularly updated data on fish and wildlife distribution, abundance, aquatic and terrestrial habitat layers, hatchery releases, hatchery returns, dams and fish passage facilities, hatchery facilities, harvest, mitigation and management actions and projects, climate data, subbasin planning data, program measures, and federal, state, NGO, university, and independent data sets related to fish and wildlife resources
    - Coordination of basinwide monitoring and data programs through interagency forums, including habitat and climate change information

## 2. Montana Fish Wildlife and Parks, MFWP (2) (submitted by Brian Marotz )

- Page 24. Part 9. Monitoring, Evaluation, Reporting, Research and Data Management. The Council's efforts to standardize RM&E and data sharing should recognize that needs differ throughout the Columbia Basin. Whereas anadromous fish migrate through multiple states and jurisdictions, resident fish typically reside between and or above dams and management agencies are often coordinated by other existing forums.
- Be vigilant not to apply "one size fits all" strategies, and instead focus on specific problem areas where coordination is currently lacking or has room for improvement.
- We recommend that monitoringmethods.org be discontinued. This process has not proven useful or cost-effective.
- Page 25. Section b. Research : The Council should continue its commitment to research to resolve critical ecosystem or biological uncertainties. Examples of critical ecosystem or biological uncertainties we have identified include:
  - • The need to understand the persistence of geochemical signatures in fish scales (a non-lethal sampling technique).
  - • The need to understand the relation between genetic differences and fish (species) performance (e.g. survival, growth, fecundity, phenotype) in various environmental settings (elevation, aspect, gradient etc.).
  - • The need to understand parentage (genetic sampling of progeny to determine relative number of successful redds) in bull trout populations as a measure of population resiliency (added benefit to red counts or escapement). The long-term data base on bull trout redd counts in South Fork Flathead River tributaries upstream of Hungry Horse Dam, makes this location ideal for this research.
- Page 53. Mainstem Monitoring and Evaluation : Monitoring and research in the Flathead and Kootenai river systems has used several strategies to assess biological responses to dam operations in these partially impounded drainages. Ongoing investigations are attempting to relate fish growth and survival, at the population level, under various operating strategies. This requires studying fish that reside in waters influenced by dam operation, which can be problematic where fish are migratory and move into and out of the affected area. We used natural marks (signatures in fish otoliths created by changing isotopic ratios in ambient water as fish migrate), paired with genetic information, to describe the movement patterns of native westslope cutthroat trout, bull trout and mountain whitefish. We are currently expanding this method for non-lethal sampling (e.g. in fish scales) to reduce sampling mortality on sensitive fish species of concern. Recent evaluations have begun to describe how *Didymosphenia geminata* (Didymo) responds to dam operation, discharge, water temperature, and water chemistry. Nuisance growth of Didymo

downstream of Hungry Horse and Libby dams has clogged river substrate and smothered insect production since the early 2000s, which impacts fish food availability. Evidence suggests that seasonally low phosphorus and nitrate levels, and periods of lower discharge (i.e., winter and early spring) increase *Didymo* growth and associated problems. Expanding investigations to quantify distribution throughout the drainages while continuing to monitor dam-influenced reaches over time is important to understanding how to control nuisance blooms.

- In addition to the foregoing specific comments, the MFWP offers the following general comments to be considered when drafting a new Fish and Wildlife Program. (2). Enhance the effectiveness of monitoring and evaluation. MFWP and our partner agencies have made recent advances in non-lethal sampling for genetics (e.g. parentage to assess population stability) and geochemical signatures in scales and otoliths (e.g. stock identification and natal stream of origin) to identify the contribution of fish from restored areas (accountability). New techniques are more cost-effective than traditional methodologies, because all fish are marked by their environment or parentage, so that artificial marking is not needed to identify stocks for experimental comparisons.

### 3. Oregon Department of Fish and Wildlife , ODFW (3) (submitted by Tom Rien)

- **[reporting]** Add explicit measurable biological objectives to support the more general Program goals consistent with ISAB recommendations (ISAB 2013-1). Also refer to Section 5 of this document, Species Focused Recommendations. These should integrate with the current Council high level indicators and would clarify how to report against current biological objectives:
  - o Halt declining trends in salmon and steelhead populations
    - Graph trends in representative populations' abundance over time and determine whether populations are increasing, decreasing, or stable
    - o Increase total populations of native anadromous and resident fish that support tribal and non-tribal harvest
      - Report abundance of fish runs annually
      - Report tribal and non-tribal harvest in all fisheries annually
    - o Achieve 5 million fish above Bonneville dam and 75 percent of recovery goals for LCR ESUs by 2025
      - Report annually total abundance by ESU for salmon and steelhead populations including harvest and other mortality
    - o Achieve SARs of 2-6% with an average of 4% for Snake River and Upper Columbia River populations
      - Report annually appropriate dam to dam SARs for representative populations to determine if cumulative hydrosystem actions are achieving the targeted level of survival
    - o Restore the widest set of salmon and steelhead populations in each province
      - Report population status by province including reintroduction goals
    - o Restore lamprey, sturgeon and eulachon
      - Create a monitoring framework and report status of lamprey, sturgeon, and eulachon across the Columbia River Basin on a regular basis
    - o Restore lamprey, sturgeon and eulachon production, passage and habitat
      - Report passage counts at dams annually and map distributions every 5 Years.
- Rationale: The current Program, on page 11, calls for a process to assess the value of these goals. This should be implemented as called for. The Program should restate the call to assess the value of quantitative biological objectives and to develop an updated and scientifically rigorous set of such quantitative objectives. Reviewing and refining the adult fish return and SAR goals is appropriate to assure that these are correctly scaled to evaluate the Program. Measureable objectives provide: • Quantitative targets to support the Program vision, moving the program from the abstract to the concrete; • A method to track program progress (a report card); and • A measure of improvement needed in the program. The above actions and metrics along with importance, feasibility, and cost components, help inform future funding priorities to achieve specific goals. This contributes to policy discussions to prioritize funding to achieve specific goals. It is currently possible to report progress against the basin-level biological objectives that are stated in the Program. Establishing a consistent, transparent, reliable report using metrics to demonstrate progress of Program implementation is required to support true adaptive management at the basin-wide



scale. The data currently exists to report against the objectives; however, the data management capacity and practices are not in place to support efficient, cost effective reporting.

- **2.3 Coordinated Assessments Monitoring and Reporting** (Attachment 2, Section 2.3) Current Program: Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
  - Measure 1: The Council should adopt and BPA should fund full implementation of the Coordinated Assessments project to **report** on the indicators of natural origin spawners (NOR), smolt to adult return (SAR), adult to adult recruitment (AAR), and juveniles per spawner (JpS) for Columbia River salmon and steelhead populations.
  - Measure 2: BPA should fund expansion of the Coordinated Assessments project to include indicators for resident fish and wildlife.
- Rationale: Approximately 78 million dollars are spent annually on anadromous monitoring in the Columbia Basin. This information is used to determine a population status and trend, effectiveness of habitat restoration, and for many other purposes. A variety of anadromous population data has been collected across various life stages and is reported by individual project sponsors in their annual reports. While this reporting is valuable at the project reporting scale, it is difficult to synthesize for reporting at the larger geographic scales such as the population, subbasin, province, major population, DPS/ESU, or Columbia Basin scales. In addition, there are many possible indicators that could be used for reporting. In 2010, fisheries agencies and tribes started the Coordinated Assessments (CA) project to standardize indicators for reporting across spatial scales and a data exchange standard to facilitate the associated data sharing. This was followed up with a pilot project that successfully demonstrated the proof of concept for this project. The CA project has now moved to the implementation phase, which includes modifying and developing new agency databases for storing raw and summarized data, analysis tools, and reporting databases. The agreed upon CA indicators track specific life stage survival and/or abundance of salmon and steelhead to provide the information needed for adaptive management process in the Columbia Basin and provide the necessary data for the FCRPS BiOP. These are the key indicators used for population status and trend analysis and for NOAA to determine population status under the ESA. The Program should continue to support this successful effort and expand the CA process to develop data sharing standards for resident fish and wildlife data.
- **2.4 Data Management** (Attachment 2, Section 2.4) Current Program: Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
  - Measure 1: BPA should fund adequate data management projects with the agencies and tribes to support regional reporting requirements for evaluation of Program activities that are additional to the agencies' and tribes' routine data management activities. There are data specifically collected, managed, and analyzed due to the existence and operation of the FCRPS and its impact on fish and wildlife.
  - Measure 2: BPA should fund adequate reporting at the Council level to provide annual, and periodic, reporting of Program actions and effectiveness which supports Program scale adaptive management.
- Rationale: The Council, tribal, state and federal natural resource managers agree that an information feedback process is required to inform management decisions about the use of fish and wildlife resources. Often this feedback process is characterized as "Adaptive Management," but this activity has not been funded or implemented. A clear set of measurable biological objectives at various scales within the Program (high level indicators) could provide a top-down monitoring framework with which to guide data management infrastructure. A plan and process for reporting against those objectives could serve as an adaptive management tool for evaluating success of strategies and actions within the Program at each level. A critical part of an adaptive management process is the collection, storage and analysis, and presentation of information about natural resources in a way that is useful to decision makers. Yet this critical activity has received little recognition and even less support in the Fish and Wildlife Program. The following actions are needed to rectify this oversight: • Restructure and simplify the Program to provide Goals, Measurable Objectives, Strategies and Measures at the Basinwide, Province and Subbasin scale. All measures should be linked back to specific measurable objectives. The goals and objectives should then guide the development of a data management framework to support specific annual, bi-annual, and five year reporting requirements; • Use a Regional Coordination forum including BPA, Council, tribal, state, and federal resource managers, and data management leaders to develop and review regional restoration progress reports, discuss options to improve reporting, and provide policy guidance for data management efforts; • Use the StreamNet and Pacific Northwest Aquatic Monitoring Partnership (PNAMP) forums for

development of the technical issues and tools necessary for coordinated data management. Extend this forum over time to include wildlife and terrestrial habitat data and other key sources of fish and wildlife related data sources (especially the Corps and LSRCP, but others such as the USFS, BLM, BOR, NRCs, etc.); • Use the updated F&W Program as the starting point for developing a coordinated data management system based on explicit reporting requirements adopted by the Council. • Expand the Coordinated Assessment Project effort (under StreamNet and PNAMP) to develop data standards and sharing processes for derived data to support ESA and Fish and Wildlife Program reporting needs; • Incorporate concepts consistent with the Council staff Draft Guidance for Information Management, Evaluation and Reporting; and • Incorporate concepts consistent with the Council staff Draft Guidance for a Balanced and Coordinated Approach for Conducting Monitoring and Research Activities.

- **2.5 Hatchery Effectiveness Monitoring** (Attachment 2, Section 2.5) Current Program: Pages 18-19, Artificial Production Strategies, and Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
  - Measure: The Council should adopt and BPA should fund hatchery effectiveness monitoring and reporting for Columbia Basin hatcheries.
- **Recommendation:** Insert a new bullet under *Artificial Production Strategies* (page 19), or under *Reporting and Data Management* (page 25) as follows: ***“Hatchery Effectiveness Monitoring: The minimum reporting indicators for successful hatcheries to meet the Council’s Artificial Production Review are: 1) the number of juveniles released by life stage, and 2) the components of total adult hatchery production, which include the number of hatchery adults returning to the hatchery, spawning in rivers, and caught in fisheries. These indicators can be used to assess the conservation and/or harvest benefits common of all hatchery programs. In addition to compiling this information for reporting, we also recommend a reporting database for these hatchery indicators be developed and funded to allow tracking of hatchery performance.”***
- **Rationale:** Currently, approximately 26 million dollars are spent annually on hatcheries in the Columbia Basin to mitigate for losses cause by the FCRPS and it is important for the Council to track the effectiveness of hatchery programs. Hatcheries and individual hatchery programs in the Columbia River have been reviewed by NOAA through the Columbia Basin Hatchery Environmental Impact Statement and Hatchery Genetic Management Plans, the Hatchery Science Review Group, and Independent Science Review Panel. In addition, the Council has developed an Artificial Production Review (ARP) Process (NPCC 1999). The NPCC (2004) judged a hatchery program to be successful if it met the following conditions: 1) it must produce a healthy and viable hatchery population; 2) it must make a sustainable contribution of adult returns to conservation and/or harvest; 3) its potential effects on wild and native populations and the environment must be understood, and 4) it must collect, record, evaluate, and disseminate information pertaining to the first three conditions so that decision-makers may be informed about the benefits and risks of the program relative to other means of achieving similar conservation and harvest goals. While it is the responsibility of hatchery operators and funders to develop specific hatchery goals, the purpose of this amendment is to develop interim indicators that provide measures hatchery performance for the Council’s role in hatchery oversight and to meet its reporting requirements. The minimum reporting indicators for successful hatcheries are 1) the number of juveniles released by life stage, and 2) the components of total adult hatchery production, which include the number of hatchery adults returning to the hatchery, spawning in rivers, and caught in fisheries as these can be used to assess the conservation and harvest benefits of all hatchery programs. In addition, to compiling this information in a report (see Roler 2012 for an example of total adult production report), we recommend a reporting database for these hatchery indicators be funded possibly through StreamNet.
- **3.3 Adequately Fund Wildlife M&E** (Attachment 2, Section 3.3) Current Program: Pages 20-22, Wildlife Strategies, and Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
  - Measure: BPA shall fund adequate monitoring, data management, and reporting to answer the following questions in an annual report to Council and the region - • How many habitat units have been mitigated for FCRPS construction and inundation caused losses of wildlife? • How many of those habitat units are secured through long term funding? How are wildlife species and habitats responding to FCRPS mitigation actions? • What is the FCRPS mitigation responsibility for wildlife operational impacts?
  - **Recommendation:** The Council, through their Wildlife Advisory Committee, should identify and support specific reporting requirements for wildlife and wildlife projects for the Program. **Rationale:** It is appropriate for BPA to fund research, monitoring and evaluation of wildlife

mitigation projects adequately to assure tracking of crediting, to evaluate trends in ecological functions of managed ecosystems, and provide managers the ability to assess the effectiveness of their mitigation strategies by evaluating species and habitat responses that contributes to broader monitoring efforts. BPA should continue funding HEP surveys on acquired land in support of the Wildlife Advisory Committee to track mitigation implementation progress.

- **Recommendation:** A programmatic evaluation of the Wildlife Section of the Program should occur preceding Program amendments, to determine whether wildlife measures are moving the Program towards its biological objectives for performance.
- **Rationale:** Reporting high level indicators for wildlife, at the scale of the Columbia River Basin, is a daunting challenge. The impact of the BPA funded wildlife mitigation projects, while significant, may not be detectable within the environmental noise of such a large landscape. Individual wildlife populations are generally highly migratory, and trends in population size is not an appropriate indicator of Program success as species ranges are far greater than the individual project areas, and in many cases far greater the Columbia River Basin. Habitat quantity and quality is the currency for implementation of the BPA funded wildlife mitigation program and should be taken into account when developing HLIs for areas within the Program influence. In 2010, the Council chartered the Wildlife Crediting Forum to provide advice on the quantifying and accounting system (informally known as the Ledger) for the wildlife habitat mitigation credits associated with the construction and inundation impacts of the Federal Columbia River Power System (FCRPS) within the Columbia River Basin. The database that currently houses the Ledger is called Pisces (BPA project accounting and management program/software). The Forum consisted of wildlife co-managers representing the 14 tribes and 3 state fish and game departments (Oregon, Washington, Idaho) impacted by the FCRPS; and representatives of the U.S. Fish and Wildlife Service (USFWS), BPA, and BPA Customers. The State of Montana was not a Forum participant, as wildlife mitigation issues relating to FCRPS losses from construction and inundation have been settled by prior agreement between BPA and that state. Following the Wildlife Crediting Forum, the co-managers developed a working draft for a reporting framework called the Wildlife Monitoring Implementation Strategy based on three categories of HLIs as determined by the Council. Further work is required to fully develop a reporting mechanism for the Council's needs. The Council identified the following three categories of HLIs: 1) Habitat and Vegetation Types – several metrics would be reported for each cover type that represents status and trend in quality and quantity of the cover type, which can infer benefits to focal species or guilds. While this data is collected by individual wildlife projects within the Program, compilation and reporting will be required at a scale larger than any individual project. Reporting this information would require a designated project to perform the summary, analysis and reporting necessary to provide useful and timely indicators for Council reports. 2) Focal Species – several national/state level data sets could be used to represent relative status of wildlife species in this area. This level of data would be retrieved from national or state databases, and not from the individual projects; however, most of the data is initiated at the project level. Reporting this information would require a designated project to perform the summary, analysis and reporting necessary to provide useful and timely indicators for Council reports. 3) Habitat Units – the BPA HU ledger would continue to be reported as a measure of mitigation actions implemented specific to the Fish and Wildlife Program. The recent completion of the Wildlife Crediting Forum has provided a clean slate for reporting HUs at the project scale, a project may be needed to provide the high level summary of this information similar to the CBFWA Status of the Resource Report and website. In developing the Wildlife Monitoring Implementation Strategy (WMIS), wildlife managers considered the following concepts: - Scale integration: data collected can be used at multiple scales of interest for decisions - Integration across separate monitoring programs: information gathered serves multiple functions and thus reduces costs - Integration of policy and technical domains: precision of data fits time frames and acceptable risks for decisions - Species integration: collection of data for multiple species in an efficient manner - Adequate sample size: sample sizes are statistically adequate to discern differences among populations, across spatial distributions, and across temporal scales relative to varying human-induced and natural environmental stressors Based on this effort, the wildlife managers are prepared to engage with the Council and BPA to develop biological and environmental performance objectives for the wildlife

portion of the Program and establish an annual and five-year reporting process for evaluating implementation success.

4. **Washington Department of Fish and Wildlife, WDFW (4) (submitted by Amy Windrope)**

- **3.3 Adequately Fund Wildlife M&E** (Attachment 2, Section 3.3) Current Program: Pages 20-22, Wildlife Strategies, and Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
  - Measure: BPA shall fund adequate monitoring, data management, and reporting to answer the following questions in an annual report to Council and the region - • Clarify How many habitat units have been mitigated for FCRPS construction and inundation caused losses of wildlife? • Identify How many of those habitat units are secured through long term funding? Clarify How are wildlife species and habitats responding to FCRPS mitigation actions? • Clarify What is the FCRPS mitigation responsibility for wildlife operational impacts?
  - **Recommendation:** The Council, through their Wildlife Advisory Committee, should identify and support specific reporting requirements for wildlife and wildlife projects for the Program. Rationale: It is appropriate for BPA to fund research, monitoring and evaluation of wildlife mitigation projects adequately to assure tracking of crediting, to evaluate trends in ecological functions of managed ecosystems, and provide managers the ability to assess the effectiveness of their mitigation strategies by evaluating species and habitat responses that contributes to broader monitoring efforts. BPA should continue funding HEP surveys on acquired land in support of the Wildlife Advisory Committee to track mitigation implementation progress. ....
  - Following the Wildlife Crediting Forum, the co-managers developed a working draft for a reporting framework called the Wildlife Monitoring Implementation Strategy based on three categories of HLIs as determined by the Council. Further work is required to fully develop a reporting mechanism for the Council's needs. The Council identified the following three categories of HLIs: 1) Habitat and Vegetation Types – several metrics would be reported for each cover type that represents status and trend in quality and quantity of the cover type, which can infer benefits to focal species or guilds. While this data is collected by individual wildlife projects within the Program, compilation and reporting will be required at a scale larger than any individual project. Reporting this information would require a designated project to perform the summary, analysis and reporting necessary to provide useful and timely indicators for Council reports. 2) Focal Species – several national/state level data sets could be used to represent relative status of wildlife species in this area. This level of data would be retrieved from national or state databases, and not from the individual projects; however, most of the data is initiated at the project level. Reporting this information would require a designated project to perform the summary, analysis and reporting necessary to provide useful and timely indicators for Council reports. 3) Habitat Units – the BPA HU ledger would continue to be reported as a measure of mitigation actions implemented specific to the Fish and Wildlife Program. The recent completion of the Wildlife Crediting Forum has provided a clean slate for reporting HUs at the project scale, a project may be needed to provide the high level summary of this information similar to the CBFWA Status of the Resource Report and website. In developing the Wildlife Monitoring Implementation Strategy (WMIS), wildlife managers considered the following concepts: - Scale integration: data collected can be used at multiple scales of interest for decisions - Integration across separate monitoring programs: information gathered serves multiple functions and thus reduces costs - Integration of policy and technical domains: precision of data fits time frames and acceptable risks for decisions - Species integration: collection of data for multiple species in an efficient manner - Adequate sample size: sample sizes are statistically adequate to discern differences among populations, across spatial distributions, and across temporal scales relative to varying human-induced and natural environmental stressors Based on this effort, the wildlife managers are prepared to engage with the Council and BPA to develop biological and environmental performance objectives for the wildlife portion of the Program and establish an annual and five-year reporting process for evaluating implementation success.
- **7.3 Implement Predator Control** Current Program: Page 52, Piscivorous predator control .... The action agencies should evaluate the effectiveness of focused pikeminnow removals for these expanded efforts and implement as warranted.
- **7.4 Salmon Habitat Restoration Monitoring** Measure: Council will continue to fund restoration action effectiveness monitoring to understand the site-scale fish and habitat response. Council will increase

funding for watershed-scale monitoring of fish and habitat to inform life-cycle models that identify survival bottlenecks, prioritize actions accordingly, and evaluate population-level responses to restoration actions.

- Recommendation: Council should continue to articulate that the most central question for restoring salmon habitat is: “What is the population response to salmon habitat restoration and what are the most effective ways of prioritizing and evaluating restoration actions?” In areas of supplementation, an additional critical question is: “What are the effects of supplementation on freshwater productivity and capacity, and how do these effects interact with habitat restoration efforts?”
- Rationale: Existing fish and habitat monitoring programs could be improved so that their products are directly applicable to multiple aspects of recovery and mitigation (e.g., habitat restoration, artificial propagation, life-cycle models, etc.). The utility of monitoring programs that do not contribute to the evaluation, adaptive management, or prioritization of restoration or management actions that may benefit populations is minimal. New programs that are capable of answering many questions simultaneously at spatial and temporal scales that are relevant for recovery should be prioritized. Although these are long term commitments, they are essential to understanding the value of investment made by BPA and regional partners in a process that is also long term. For instance, action effectiveness monitoring at the restoration project scale (i.e., site of treatment) is a cost effective way to deliver unbiased information about how the project affects local or site scale attributes such as changes in habitat and use by fish, but by itself, does not provide information about population level response, and is therefore an incomplete answer to the question. In other words project-scale effectiveness monitoring is not designed to answer the question “how is the population affected by restoration”? This question requires information at broader spatial, and longer temporal scales, than action effectiveness monitoring is designed to provide. Project effectiveness monitoring information should lead to project selection that benefits target species and life stages, but the most critical gap in project prioritization is identifying which life stages to target to achieve population recovery. This requires a different monitoring approach that broadens the spatial and temporal monitoring of fish populations such that survival and movement data can be used to focus restoration actions appropriately. Information from project-scale monitoring will compliment this information by identifying specific locations and appropriate project types within target areas. This new approach monitors habitat conditions and the fish population throughout its freshwater life cycle in an attempt to understand what life stage is limiting and why and then link those pattern to aquatic habitat conditions. In addition to fish in/fish out monitoring, this approach requires monitoring of incubation survival, parr distribution and survival, and habitat affecting freshwater life stages. Additionally, some areas may require investigation of incubation survival if parr-to-smolt survival is adequate, but spawner-to-parr productivity is low. Population response monitoring should occur year-round with PIT technology and smolt traps, and at spatial scales that are relevant for quantifying population dynamics (e.g., assessment units). These population-scale monitoring data provide a framework for informing life-cycle models that identify survival bottlenecks, prioritize restoration actions, and evaluate population-level responses to restoration actions. Additionally, initiating spatially-continuous census surveys of aquatic habitat and fish would provide critical information for identifying restoration areas, quantifying changes in fish distribution associated with restoration actions and climate change, and population-specific data to develop fish-habitat relationships for modeling. Council should support the leveraging of existing projects and funding to ensure coordination between life cycle models, habitat monitoring and habitat restoration, and fish monitoring data including fish in/fish out data. Understanding population level response from restoration actions must consider the combined effects of habitat actions and artificial propagation on listed populations. Where restoration actions coincide with artificial propagation either intentionally or unintentionally, it is critical that monitoring be established or expanded to determine what impact artificial propagation may be having on the population. The monitoring additions and modifications described above can also be used to address habitat use by hatchery- and wild-origin fish and the spatial and temporal overlap of hatchery- and wild-origin fish in freshwater habitats. Suggested Language: The council will fund fish population monitoring designed to detect population-level responses to habitat restoration actions. The council will also fund habitat monitoring (eg., rivescape surveys, bathymetric LiDAR, etc.) that produces information about the distribution of priority habitats for restoration or protection, fish distribution, and the data needed to develop functional fish-habitat relationships to maximize the efficiency of restoration actions. The Council will continue to fund research to determine impacts of artificially propagated populations in areas of restoration. The spatially and temporally continuous monitoring of fish populations and their response to restoration is valuable for emerging life-cycle models as a means to identify life-stage-specific survival bottlenecks, prioritize



restoration and management actions, and evaluate progress of listed populations towards recovery or extinction.

- **8. Renewable Energy Integration into the Fish and Wildlife Program** Measure: The Council should develop, and BPA should fund: 1) Programs and processes to evaluate the impacts on fish and wildlife resources of all renewable energy sources (past, proposed and potential) and associated transmission infrastructure which includes the impacts from electrical infrastructure; .....
- **10. Data Management** Current Program: Pages 24-26, Monitoring, Evaluation, Research, and Reporting  
**10.1 Support Data Management for Regional Reporting** Recommendation: Separate monitoring and evaluation from research in the Fish and Wildlife Program. Fund synthesis of long term data sets to understand change over time.
- Measure 1: BPA should fund adequate data management projects with the agencies and tribes to support regional reporting requirements for evaluation of Program activities that are additional to the agencies' and tribes' routine data management activities. There are data specifically collected, managed, and analyzed due to the existence and operation of the FCRPS and its impact on fish and wildlife.
- Measure 2: BPA should fund adequate reporting at the Council level to provide annual, and periodic, reporting of Program actions and effectiveness which supports Program scale adaptive management.
- Rationale: The Council, tribal, state and federal natural resource managers agree that an information feedback process is required to inform management decisions about the use of fish and wildlife resources. Often this feedback process is characterized as "Adaptive Management," but this activity has not been funded or implemented. A clear set of measurable biological objectives at various scales within the Program (high level indicators) could provide a top-down monitoring framework with which to guide data management infrastructure. A plan and process for reporting against those objectives could serve as an adaptive management tool for evaluating success of strategies and actions within the Program at each level. A critical part of an adaptive management process is the collection, storage and analysis, and presentation of information about natural resources in a way that is useful to decision makers. Yet this critical activity has received little recognition and even less support in the Fish and Wildlife Program. The following actions are needed to rectify this oversight:   Restructure and simplify the Program to provide Goals, Measurable Objectives, Strategies and Measures at the Basinwide, Province and Subbasin scale. All measures should be linked back to specific measurable objectives. The goals and objectives should then guide the development of a data management framework to support specific annual, bi-annual, and five year reporting requirements;   Use a Regional Coordination forum including BPA, Council, tribal, state, and federal resource managers, and data management leaders to develop and review regional restoration progress reports, discuss options to improve reporting, and provide policy guidance for data management efforts;   Use the StreamNet and Pacific Northwest Aquatic Monitoring Partnership (PNAMP) forums for development of the technical issues and tools necessary for coordinated data management. Extend this forum over time to include wildlife and terrestrial habitat data and other key sources of fish and wildlife related data sources (especially the Corps and LSRCP, but others such as the USFS, BLM, BOR, NRCPS, etc.);   Use the updated F&W Program as the starting point for developing a coordinated data management system based on explicit reporting requirements adopted by the Council.   Expand the Coordinated Assessment Project effort (under StreamNet and PNAMP) to develop data standards and sharing processes for derived data to support ESA and Fish and Wildlife Program reporting needs;   Incorporate concepts consistent with the Council staff Draft Guidance for Information Management, Evaluation and Reporting; and   Incorporate concepts consistent with the Council staff Draft Guidance for a Balanced and Coordinated Approach for Conducting Monitoring and Research Activities.
- **10.2 Coordinated Assessments Monitoring and Reporting** Current Program: Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
- Measure 1: The Council should adopt and BPA should fund full implementation of the Coordinated Assessments project to **report** on the indicators of natural origin spawners (NOR), smolt to adult return (SAR), adult to adult recruitment (AAR), and juveniles per spawner (JpS) for Columbia River salmon and steelhead populations.
- Measure 2: BPA should fund expansion of the Coordinated Assessments project to include indicators for resident fish and wildlife.
- Rationale: Approximately 78 million dollars are spent annually on anadromous monitoring in the Columbia Basin. This information is used to determine a population status and trend, effectiveness of habitat restoration, and for many other purposes. A variety of anadromous population data has been collected

across various life stages and is reported by individual project sponsors in their annual reports. While this reporting is valuable at the project reporting scale, it is difficult to synthesize for reporting at the larger geographic scales such as the population, subbasin, province, major population, DPS/ESU, or Columbia Basin scales. In addition, there are many possible indicators that could be used for reporting. In 2010, fisheries agencies and tribes started the Coordinated Assessments (CA) project to standardize indicators for reporting across spatial scales and a data exchange standard to facilitate the associated data sharing. This was followed up with a pilot project that successfully demonstrated the proof of concept for this project. The CA project has now moved to the implementation phase, which includes modifying and developing new agency databases for storing raw and summarized data, analysis tools, and reporting databases. The agreed upon CA indicators track specific life stage survival and/or abundance of salmon and steelhead to provide the information needed for adaptive management process in the Columbia Basin and provide the necessary data for the FCRPS BiOP. These are the key indicators used for population status and trend analysis and for NOAA to determine population status under the ESA. The Program should continue to support this successful effort and expand the CA process to develop data sharing standards for resident fish and wildlife data.

- **10.3 Research Plan Recommendation:** Develop a Fish and Wildlife Program Research Plan that prioritizes high priority research needs, critical uncertainties, and knowledge gaps. To be effective, this plan needs to engage both technical experts and policy makers.
- **Measure:** Fund research needs separate from M&E needs and funding. Develop a model that encourages completing research projects with clear reporting requirements and that encourages new projects to be developed. The establishment of a rotating research fund for projects would assist the Region in moving from the current approach to a new model.
- **Rationale:** The current F&W Program is based on a combined Research, Monitoring, and Evaluation (RME) program from Monitoring Evaluation Research and Reporting (MERR) Plan. The current F&W Program supports routine monitoring for tracking implementation measures, status and trends of species and limiting factors, and project effectiveness. While it is important to monitor, it is also very important to address uncertainties and knowledge gaps through science-based research. Splitting research and monitoring/evaluation may lead to better focus on addressing critical uncertainties that delay or postpone management decisions, and better allow accountability of research funding. In addition, research hypothesis should connect to Fish and Wildlife Program and tie directing to outstanding policy questions or concerns. In addition to recognizing research in the program, the Council created the Ocean and Plume Science and Management Forum to engage researchers and fisheries managers to better understand the in river management applications of ocean research and identify future research priorities. One of the proposed products for this forum is to develop and recommend to the Council a prioritized list of studies to address the management questions to inform future needs. A natural place for this information is the Council's Research Plan.
- **Suggested Language:** Maintain current language with emphasis on the use of science/management forums to establish research priorities. *The Council shall establish a process to address current concerns that research projects lack a sunset or a date by which the research must report on results. The Council shall develop a rotating research fund to encourage the completion of projects and the generation of new projects to find answers to management questions outstanding in the current Fish and Wildlife Program. Review current projects for opportunities to expand certain elements to address critical uncertainties.*
- **Research:** *The Council, in collaboration with the parties listed above, will identify research priorities to resolve critical ecosystem or biological uncertainties through the use of science/management forums or other outreach programs. Research will focus on those areas where, in a reasonable amount of time, results could be generated or tools developed to better inform management decisions and to more efficiently deploy Program mitigation resources.*
- **Research plan:** *The Council, with assistance from tribal and state managers, will update its research plan within one year of adoption of this program, which identifies major research topics and establishes priorities for research funding.*
- **13. Artificial Production Current Program:** page 19 Recommendation: Adopt the HSRG recommendations to clearly define hatchery goals, and metrics to assess hatchery performance. Adopt language from ISRP 2011 Retrospective Report to include but not limited to: 1. For supplementation programs include BACI design (supplemented versus unsupplemented populations) for abundance and productivity controlling for carrying capacity and spawner abundance (i.e., density dependence) 2.

Determine if life stage specific density dependence is limiting the success of hatchery supplementation programs. If so, correct limiting factors.

- Measure: Fund CRHEET to establish basin wide monitoring and evaluation standards to include effectiveness monitoring. [rationale ... ]
- **13.2 Hatchery Effectiveness Monitoring** Current Program Location: Artificial Production Strategies, page 19 Measure: Provide funding to measure hatchery effectiveness through monitoring [...rationale...]
- Recommended Language: This should be a new bullet f. under Artificial Production Strategies. f. *“The Council should adopt and BPA should fund hatchery effectiveness monitoring and reporting for Columbia Basin hatcheries. The minimum reporting indicators for successful hatcheries to meet the Council’s APR are: 1) the number of juveniles released by life stage, and 2) the components of total adult hatchery production, which include the number of hatchery adults returning to the hatchery, spawning in rivers, and caught in fisheries. These indicators can be used to assess the conservation and/or harvest benefits common of all hatchery programs. In addition to compiling this information for reporting, we also recommend a reporting database for these hatchery indicators be developed and funded to allow tracking of hatchery performance.”*
- **14. Fully Incorporate Estuary, Plume and Nearshore Ocean in Program** Current Program: various sections
- Measure 1: Fund a collaborative forum of scientists and managers to: 1) identify key management questions related to the estuary, plume, and nearshore ocean environments; 2) identify what research and monitoring has already been done that addresses these management questions; 3) identify ongoing baseline monitoring and research priorities; 4) identify opportunities for information sharing between scientists and managers and 5) recommend to the Council ways to improve the utility and in-river freshwater resource management benefits of both ongoing and proposed ocean, estuary and plume research conducted under the Program.
- Measure 4: Explore and implement adaptive management experiments to improve survival of anadromous fish.
- Measure 5: Continue to research direct and indirect effects of anthropogenic freshwater management on marine ecological attributes affecting anadromous fish habitat, life histories and productivity.
- Measure 6: The Program should address the uncertainty regarding the effectiveness of estuarine restoration projects and different types of habitat and whether they contribute to increased juvenile survival and hence increased adult returns.
- Measure 7: Research is needed on forage fish in the lower estuary and nearshore area. The Fish and Wildlife Program should promote projects on forage fish in the lower estuary and nearshore area through the following measures:
  - Identify spawning and rearing life history attributes of forage fish in the estuary
  - Determine the role of forage fish as alternate prey for birds in the lower estuary
  - Elucidate the role eulachon may have as an alternative prey for sea lions
  - Determine how restoration projects in the estuary may contribute to reproductive success and rearing of forage fish
  - Identify the relation between Columbia River flow and forage fish abundance in the estuary
  - Identify role forage fish have in survival of juvenile Chinook salmon, coho, and steelhead
  - Determine how climate change, ocean acidification, salinity, estuary turbidity maximum (ETM), and localized hypoxia are likely to affect forage fish in the coming decades
- **16. Columbia Basin Water Transaction Program** Not in current Program
  - Measure: Ensure adequate funding to evaluate the biological effectiveness of water transactions.

5. **Washington State Governor’s Salmon Recovery Office, WAGSRO (submitted by Brian Abbott )**

- Restructure the program to support implementation of adaptive management, page 3-program framework and throughout, Background .... Recommendation 2: Restructure the Fish and Wildlife Program to contain or have provisions to explicitly develop or track the following essential adaptive management steps:
  - Update the current status and trends of the fish and wildlife resources the Program



- is intended to protect, mitigate, and enhance;
  - Adopt biological objectives and document the current gaps between Program objectives and status for the fish and wildlife resources identified in step 1;
  - Quantify the limiting factors and threats, in terms of their relationship to the biological objectives with associated assumptions, hypotheses and critical unknowns;
  - Adopt strategies and measures linked to limiting factors and threats with a quantification of expected outcomes toward the filling of the gaps identified in step 2;
  - Develop and maintain Research, Monitoring, and Evaluation Plans that will track the status and trends of focal species and their threats and limiting factors, collect the information necessary to test assumptions and hypotheses, address critical uncertainties, and evaluate the implementation of measures;
  - Share through reports, web tools, and other sources the accumulated monitoring and research data and information which will be used to carry out steps 7 and 8;
  - Develop an evaluation process that deliberately contemplates the information from steps 1–6 to verify or adjust assumptions and hypotheses, adjusts biological objectives, and adjusts strategies and measures; and,
  - Establish a process for adjusting the implementation of the Program to align with the changes identified in step 7.
- Coordinated Assessment Monitoring and Reporting, Page 24-26, Monitoring, evaluation, Research, and Reporting Strategies. Background . . . Recommendation, The Council should continue its monitoring approach and look for ways to more closely coordinate with regional monitoring entities to share protocol, resources, and results. The program also should expand the CA process to develop data sharing standards for resident fish and wildlife data. The SRFB has developed a comprehensive effectiveness monitoring program and IMW approach. These efforts could benefit from additional resources and larger sample-candidate pools, thereby enjoying economies of scale. Please consider opportunities for sharing resources. The SRFB also is completing a comprehensive review of its monitoring program,. The review will be completed in December and any new program adoption or direction will begin in 2014.
    - Measure 1 : The council should adopt and BPA should fund full implementation of the Coordinated Assessments project to report on the indicators of natural origin spawners (NOR) smolt to adult return (SAR), adult to adult recruitment (AAR), and juveniles per spawner (JpS) for Columbia River salmon and steelhead populations.
    - Measure 2: BPA should fund expansion of the CA project to include indicators for resident fish and wildlife
- Data management pages 24-26, Monitoring, evaluation, Research, and Reporting Strategies Recommendation:
    - Measure 1: BPA should fund adequate data management projects with the agencies and tribes to support regional reporting requirements for evaluation of Program activities that are additional to the agencies' and tribes' routine data management activities. There are data specifically collected, managed, and analyzed due to the existence and operation of the FCRPS and its impact on fish and wildlife.
    - Measure 2: BPA should fund adequate reporting at the Council level to provide annual, and periodic, reporting of Program actions and effectiveness which supports Program scale adaptive management.
    - Rationale: The Council, tribal, state and federal natural resource managers agree that an information feedback process is required to inform management decisions about the use of fish and wildlife resources. Often this feedback process is characterized as “Adaptive Management,” but this activity has not been funded or implemented. A clear set of measurable biological objectives at various scales within the Program (high level indicators) could provide a top-down monitoring framework with which to guide data management infrastructure. A plan and process for reporting against those objectives could serve as an adaptive management tool for evaluating success of strategies and actions within the Program at each level. A critical part of an adaptive management process is the collection, storage and analysis, and presentation of information about natural resources in a way that is useful to decision makers. Yet this critical activity has received little recognition and even less support in the Fish and Wildlife Program. The following actions are needed to rectify this oversight: □□ Restructure and simplify the Program to provide Goals, Measurable Objectives, Strategies and Measures at the Basinwide, Province

and Subbasin scale. All measures should be linked back to specific measurable objectives. The goals and objectives should then guide the development of a data management framework to support specific annual, bi-annual, and five year reporting requirements; □□Use a Regional Coordination forum including BPA, Council, tribal, state, and federal resource managers, and data management leaders to develop and review regional restoration progress reports, discuss options to improve reporting, and provide policy guidance for data management efforts; □□Use the StreamNet and Pacific Northwest Aquatic Monitoring Partnership (PNAMP) forums for development of the technical issues and tools necessary for coordinated data management. Extend this forum over time to include wildlife and terrestrial habitat data and other key sources of fish and wildlife related data sources (especially the Corps and LSRCP, but others such as the USFS, BLM, BOR, NRCs, etc.); □□Use the updated F&W Program as the starting point for developing a coordinated data management system based on explicit reporting requirements adopted by the Council. □□Expand the Coordinated Assessment Project effort (under StreamNet and PNAMP) to develop data standards and sharing processes for derived data to support ESA and Fish and Wildlife Program reporting needs; □□Incorporate concepts consistent with the Council staff Draft Guidance for Information Management, Evaluation and Reporting; and □□Incorporate concepts consistent with the Council staff Draft Guidance for a Balanced and Coordinated Approach for Conducting Monitoring and Research Activities

- Integrated Recovery (All-H) Background ... Recommendation: specific to hatchery programs, the Council should work with all partners to assess the carrying capacity that will include recommendations for artificial production strategies. As noted in the 2013 ISAB review, there are many critical uncertainties related to the cumulative impacts of artificial production on natural production and ecosystem processes at population, sub-basin, and basin scales. Given the number of tributary hatchery programs in the region, and the limited ability to control hatchery fish on the spawning grounds, hatchery production may have a major impact on naturally spawning populations. Support in this area is critical. Tools such as food-web and relative reproduction models can be used in concert with Life Cycle models/ When combined with habitat, hatchery, hydropower, harvest and full lifestage recruitment information, this information can further refine the impacts various programs are having on overall population productivity at a sub-basin scale. Monitoring and evaluation in the sectors (all H's) is extensive, but to evaluate program effectiveness and progress toward recovery from a regional perspective, a more comprehensive analysis is needed. This analysis needs to be done in relation to well-defined biological objectives for each of the management sectors. Monitoring measurable biological objectives will clarify the role of artificial production.
- Habitat Restoration Monitoring, Recommendation: Council continues to develop and fund new approaches to determine effectiveness of salmon habitat restoration projects. Council should continue to articulate that the most central questions is: "What is the population response to salmon habitat restoration?" Action effectiveness monitoring is a cost effective way to deliver unbiased information about project effectiveness at the site scale, but does not provide information about population level response, and is therefore an incomplete answer to the question. Project effectiveness monitoring information should lead to project selection that benefits target species and lifestages, but the most critical gap in project prioritization is identifying which life stages limit recovery and this requires a new monitoring approach. Population response monitoring should occur year-round with PIT technology and smolt traps , and at spatial scales that are relevant for quantifying population dynamics (e.g. assessment units). These population-scale monitoring data provide also framework for populating life-cycle models that identify survival bottlenecks and evaluate population-level response to restoration actions. Additionally, initiating riverscape surveys of aquatic habitat and fish would provide critical information for identifying restoration areas, quantifying changes in fish distribution associated with restoration actions and climate change, and population-specific data to develop fish-habitat relationship for modeling. Council should support the leveraging of existing projects and funding to ensure coordination between life cycle models, habitat restoration, and fish monitoring data including fish in/fish out data.
- Measures: BPA should fund empirical studies for carrying capacity for watershed with hatchery supplementation per ISRP recommendation.
- (Biological objectives in the program – recovery plan abundance and targets section, .... Pages 11-14, biological objectives and page 63 program reporting): - The Council should report annually on progress towards achieving the Basin-Level Biological Objectives as presented in the Program. The reporting section of the Program (Section VII.E) should be expanded to include reporting high level indicators that represent the Program's basin-level biological objectives as reported in Section II.C of the current Program.

- Add explicit measurable biological objectives to support the more general Program goals consistent with ISAB recommendations (ISAB 2013-1). Also refer to Section 5 of this document, Species Focused Recommendations. These should integrate with the current Council high level indicators and would clarify how to report against current biological objectives:
  - Halt declining trends in salmon and steelhead populations
    - Graph trends in representative populations' abundance over time and determine whether populations are increasing, decreasing, or stable
  - Increase total runs that support tribal and non-tribal harvest
    - Report abundance of fish runs annually
    - Report tribal and non-tribal harvest in all fisheries annually
  - Achieve 5 million fish above Bonneville dam and 75 percent of recovery goals for LCR ESUs by 2025
    - Report annually total abundance by ESU for salmon and steelhead populations including harvest and other mortality
  - Achieve SARs of 2-6% with an average of 4% for Snake River and Upper Columbia River populations
    - Report annually appropriate dam to dam SARs for representative populations to determine if cumulative hydrosystem actions are achieving the targeted level of survival
  - Restore the widest set of salmon and steelhead populations in each province
    - Report population status by province including reintroduction goals
  - Restore lamprey, sturgeon and eulachon
    - Create a monitoring framework and report status of lamprey, sturgeon, and eulachon across the Columbia River Basin on a regular basis
  - Restore lamprey production, passage and habitat
    - Report passage counts at dams annually and map lamprey distribution every 5 years
- **14. Fully Incorporate Estuary, Plume and Nearshore Ocean in Program** Current Program: various sections
- Measure 1: Fund a collaborative forum of scientists and managers to: 1) identify key management questions related to the estuary, plume, and nearshore ocean environments; 2) identify what research and monitoring has already been done that addresses these management questions; 3) identify ongoing baseline monitoring and research priorities; 4) identify opportunities for information sharing between scientists and managers and 5) recommend to the Council ways to improve the utility and in-river freshwater resource management benefits of both ongoing and proposed ocean, estuary and plume research conducted under the Program.
- Measure 4: Explore and implement adaptive management experiments to improve survival of anadromous fish.
- Measure 5: Continue to research direct and indirect effects of anthropogenic freshwater management on marine ecological attributes affecting anadromous fish habitat, life histories and productivity.
- Measure 6: The Program should address the uncertainty regarding the effectiveness of estuarine restoration projects and different types of habitat and whether they contribute to increased juvenile survival and hence increased adult returns.
- Measure 7: Research is needed on forage fish in the lower estuary and nearshore area. The Fish and Wildlife Program should promote projects on forage fish in the lower estuary and nearshore area through the following measures:
  - Identify spawning and rearing life history attributes of forage fish in the estuary
  - Determine the role of forage fish as alternate prey for birds in the lower estuary
  - Elucidate the role eulachon may have as an alternative prey for sea lions
  - Determine how restoration projects in the estuary may contribute to reproductive success and rearing of forage fish
  - Identify the relation between Columbia River flow and forage fish abundance in the estuary
  - Identify role forage fish have in survival of juvenile Chinook salmon, coho, and steelhead
  - Determine how climate change, ocean acidification, salinity, estuary turbidity maximum (ETM), and localized hypoxia are likely to affect forage fish in the coming decades

**6. Lower Columbia Fish Recovery Board, LCFRB (6) (submitted by Jeff Breckel )**

- **Monitoring and Adaptive Management, *Recommendations:***
  - Provide for leadership and support of coordinated Basin-wide and local monitoring and adaptive management efforts.
  - Provide for the active participation in and support of Lower Columbia monitoring initiatives, particularly those dealing with action effectiveness and fish and habitat status and trends.
- **Artificial Production, *Recommendations:* .....**
  - Adopt and support funding for hatchery effectiveness monitoring providing the following basic indicators 1) the number of juveniles released by life stage and 2) the components of total adult hatchery production, including the number of hatchery adults returning to the hatchery, spawning in rivers, and caught in fisheries.
- **Estuary, Plume, and Near Ocean Environments, *Recommendations:***
  - The F&W program should call for and fund a collaborative effort involving resource managers and scientists to 1) the identify key management questions related to fish utilization of the estuary, plume, and near ocean environments, 2) assess what research and monitoring has been done that addresses these questions, 3) prioritize and conduct additional research and monitoring needed to fill key information gaps, and 4) formulate management recommendations.

**7. Upper Columbia Salmon Recovery Board, UCSRB (7) (submitted by Derek Van Marter )**

- **Adaptive Management - Monitoring and the Availability of Scientific Information to Guide Policy Decision Making Recommendations**
  - The Council should take the lead in articulating a minimum set of data for specific types of projects, and to have those data analyzed and reported in a consistent manner at the appropriate scale. The Council can work with local partners like the UCSRB to develop and evaluate High Level Indicators that will be routinely monitored, updated, and presented to stakeholders. These HLIs should directly relate to quantitative objectives to track progress across management regimes, and inform future actions and investments. They could also be used in outreach and reporting efforts for a variety of audiences.
  - Currently in the Upper Columbia, the most important regional information, analysis, and tools are: 1) status and trends of listed populations and their habitat; 2) modeling tools (e.g. Life Cycle Models) that can be used to inform “All-H” recovery scenarios; 3) abundance, survival, growth, and life history of freshwater life stages; and 4) tributary-scale productivity and carrying capacity.
  - We encourage the Council to work with partners to develop models that are informed by various monitoring results (e.g. Life Cycle Models) and are scalable. Partners could focus on identifying and filling data gaps in these models, and on testing the assumptions and outputs of the models. Several of these types of models are under development in the context of the AMIP process, but lack coordination at the regional level to ensure consistency and applicability.
  - The Council can also ensure fish monitoring programs are more integrated, transparent, and adaptive to regional needs with more emphasis on short-term, small-scale, applicable results that can be used to evaluate progress and success. Much of the RM&E in the Upper Columbia is focused on large-scale, long-term research-related questions, and results are difficult or impossible to interpret at other scales. Seven years ago, planning implementation efforts lacked a cohesive, focused direction. The UCSRB focused project implementation planning efforts on biological priority areas informed by available information and current investments. A similar regional effort in planning, collaboration, and coordination on RM&E needs could result in greater returns on those necessary investments.
- **Integrated Recovery (All-H) Recommendations**
  - Specific to hatchery programs, the Council should work with partners to assess carrying capacity that will influence recommendations for artificial production strategies. As noted in the 2013 ISAB review there are many critical uncertainties related to the cumulative impacts of artificial production on natural production and ecosystem processes at population, subbasin, and basin scales. Given the number of tributary hatchery programs in the region, and the limited ability to control hatchery fish on the spawning grounds, hatchery production may have a major impact on naturally spawning populations. Some tools such as Food Web models and relative reproductive

success studies are being used in the Upper Columbia to fill critical data and information gaps. Other tools such as Life Cycle Models can then be used to combine habitat, hatchery, hydropower, harvest, and full life-stage recruitment information to further refine the impacts various programs are having on overall population productivity at a subbasin scale.

- Monitoring and evaluation in each of the sectors (all H's) is extensive, but to evaluate program effectiveness and progress toward recovery from a regional perspective, a more comprehensive analysis is needed. This analysis needs to be done in relation to well-defined biological objectives for each of the management sectors. In relation to hatchery production, measurable biological objectives with monitoring to track progress toward those objectives would help clarify the role of artificial production in the overall Fish & Wildlife program. UCSRB (7)

**8. Lower Columbia Estuary Partnership, LCREP (11) (submitted by Debrah Marriott)**

- Nothing

## **Tribes/ Tribal Organizations**

**9. Burns Paiute Tribe, BPT (12) (submitted by Jason Kesling )**

- nothing

**10. Coeur d'Alene Tribe, CdA (13) (submitted by Cameron Heusser )**

- Anadromous fish passage – the CdA tribes recommends the following phased approach to being reintroduction of anadromous fish into their historic range Phase I – immediately fund studies in the period covered by this Program to investigate scientific-based feasibility of upstream and downstream passage options for salmon and steelhead, investigations to determine project timelines, appropriate potential donor stocks, evaluation of existing quantity, quality and capacity of salmon habitat in the upper basin, simulate hydro operations, and assess socio-economic implications of different hydrograph scenarios ..... Phase IV – Monitor ,evaluate, and adaptively manage the reintroduction efforts. ....
- Toxic Reduction, ..., II. The Council shall assess whether hydropower projects exacerbate any problems associated with the migration or effects of toxic substances; if any such correlation exists, the Council shall assess whether operational changes or other activities could help mitigate these impacts.
- Wildlife Mitigation .... V. Monitor habitat changes and management using UWMEP and other ISRP endorsed methods and protocols

**11. Columbia River Inter-Tribal Fish Commission, CRITFC (14) (submitted by Aja DeCoteau)**

- **2.4 Council's Comprehensive Review of the Program's Monitoring and Evaluation** The Program should:
  - Support implementation and maintenance of the PNAMP "Strategy For Coordinating Monitoring of Aquatic Environments In The Pacific Northwest."
  - Continue the CHaMP program for three more years to allow proper evaluation of its results, then incorporate its recommendations into an overall habitat monitoring program.
  - Integrate the monitoring recommendations of the ISAB Food Web report into the overall monitoring program. [ see reference section at end of document for excerpt of ISAB Food web recommendations (2011-1)]
  - Produce inventory of existing projects, what they are collecting, what results they expect to provide, and when.
- Environmental monitoring is expensive and has often been done in an uncoordinated project-by-project, agency-by-agency manner. Even in that piecemeal manner, it has been difficult to sustain monitoring programs for more than one or two salmon life cycles (3 – 10 years). The Council's current process relies heavily on ISRP reviews of projects, which virtually always recommend more monitoring and evaluation. Instead, the focus should be on assimilating existing efforts.
- The most feasible way to show this progress, given the very limited resources available for the task, is to coordinate monitoring efforts and data sharing among agencies and programs. The PNAMP report on "Strategy for Coordinating Monitoring of Aquatic Environments In The Pacific Northwest" is the most

realistic method available to achieve the necessary coordination of monitoring among resource managers. This plan calls for coordinating the statistical design of monitoring programs and can be modified as necessary to incorporate the measures listed above.

- **2.5 Fish Tagging Forum Recommendations on Coded Wire Tag (CWT) Funding** Current Program: Page 20, Harvest Strategies, Monitoring and Reporting, 4th bullet, and Page 31, Ocean Strategies, Distinguish Ocean Effects from Other Effects Recommendation: The Council should continue to support monitoring of all life cycle impacts, including harvest, through shared responsibility for funding the CWT program, particularly where no other technology is capable of providing the age and stock specific exploitation rates that are key to providing annual estimates of catch and survival and long term estimates of stock productivity, which are needed to separate the survival impacts of Council actions from the confounding impacts of harvest. Funding of the CWT program is not precluded by “in lieu” funding considerations.
- **2.7 Research Plan** The Council intends to update their 2006 research plan to identify critical uncertainties, which need further research. The following are critical uncertainties that we feel merit further study in order to increase effectiveness of fish and wildlife resource management. Recommendation 1: The Council should support research to address the critical uncertainties identified in the recommended measures in section 7.2 Reduce Toxic Contamination. The research effort should be collaborative in order to efficiently gain understanding the effects of toxic contamination in achieving the biological objectives of the program. Research proposals should be reviewed and coordinated by a group of regional experts.
- Recommendation 2: *The tribes do not support mass marking and mark selective fisheries as a general practice.* The Council should support, *only to the extent necessary*, collaborative efforts to address critical uncertainties and measure the impacts of mass marking and mark selective fisheries on obtaining the biological goals of the Fish and Wildlife Program. Efforts should emphasize the impacts of releasing unmarked fish on achieving spawning escapement objectives for naturally spawning populations. The release mortality rate is a key uncertainty and quantifying release mortality assumption through data collection will provide an understanding of the effects of mark selective fishing on reaching biological objectives. Studies to quantify release mortalities shall be reviewed and implemented by the state agencies and tribes.
- **3.0 Program Performance Objectives 3.1 Coordinated Assessments Monitoring and Reporting** Current Program: Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies : The Council should support the Coordinated Assessments project to **report** on the indicators of natural origin spawners (NOR), smolt to adult return (SAR), adult to adult recruitment (AAR), and juveniles per spawner (JpS) for Columbia River salmon and steelhead populations.
- Approximately 78 million dollars are spent annually on anadromous monitoring in the Columbia Basin. We need to find funding efficiencies through better coordinated efforts. This information is used to determine a population status and trend, effectiveness of habitat restoration, and for many other purposes. A variety of anadromous population data has been collected across various life stages and is reported by individual project sponsors in their annual reports. While this reporting is valuable at the project reporting scale, it is difficult to synthesize for reporting at the larger geographic scales such as the population, subbasin, province, major population, DPS/ESU, or Columbia Basin scales. In addition, there are many possible indicators that could be used for reporting. In 2010, fisheries agencies and tribes started the Coordinated Assessments (CA) project to standardize indicators for reporting across spatial scales and a data exchange standard to facilitate the associated data sharing. This was followed up with a pilot project that successfully demonstrated the proof of concept for this project. The CA project has now moved to the implementation phase, which includes modifying and developing new agency databases for storing raw and summarized data, analysis tools, and reporting databases. The agreed upon CA indicators track specific life stage survival and/or abundance of salmon and steelhead to provide the information needed for adaptive management process in the Columbia Basin and provide the necessary data for the FCRPS BiOp. These are the key indicators used for population status and trend analysis and for NOAA to determine population status under the ESA. The Program should continue to support this successful effort and expand the CA process to develop data sharing standards for resident fish and wildlife data.
- **3.2 Data Management** Current Program: Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies The Council, tribal, state and federal natural resource managers agree that an information feedback process is required to inform management decisions about the use of fish and wildlife resources. Often this feedback process is characterized as “Adaptive Management,” but this activity has not been funded or implemented.

- A clear set of measurable biological objectives at various scales within the Program (high level indicators) could provide a top-down monitoring framework with which to guide data management infrastructure. A plan and process for reporting against those objectives could serve as an adaptive management tool for evaluating success of strategies and actions within the Program at each level.
- A critical part of an adaptive management process is the collection, storage and analysis, and presentation of information about natural resources in a way that is useful to decision makers. Yet this critical activity has received little recognition and even less support in the Fish and Wildlife Program. The following actions are needed to rectify this oversight:
  - ☐☐ Use the StreamNet and Pacific Northwest Aquatic Monitoring Partnership (PNAMP) forums for development of the technical issues and tools necessary for coordinated data management. Extend this forum over time to include wildlife and terrestrial habitat data and other key sources of fish and wildlife related data sources (especially the Corps and LSRCP, but others such as the USFS, BLM, BOR, NRCPs, etc.);
  - ☐☐ Use the updated F&W Program as the starting point for developing a coordinated data management system based on explicit reporting requirements adopted by the Council.
  - ☐☐ Expand the Coordinated Assessment Project effort (under StreamNet and PNAMP) to develop data standards and sharing processes for derived data to support ESA and Fish and Wildlife Program reporting needs;
  - ☐☐ Incorporate concepts consistent with the Council staff Draft Guidance for Information Management, Evaluation and Reporting; and
  - ☐☐ Incorporate concepts consistent with the Council staff Draft Guidance for a Balanced and Coordinated Approach for Conducting Monitoring and Research Activities.
- As genetic knowledge and analytic power increases, potential applications become more `apparent. A coast-wide database for microsatellite data (GAPS) was developed with NOAA support. However, NOAA is discontinuing its support for the maintenance of this system. In recent years SNP genetic data have been developed and are being used for a wide array of analyses, including Parentage-Based Tagging of various steelhead and salmon populations. The IDFG is developing a framework for storing and sharing SNP data, but it needs to be integrated with regional data sharing efforts and systems and there is no funding for management of this database over time.
- PNAMP should convene a small work group of involved geneticists and policy representatives to design needed structures and processes to manage, share and apply fish and wildlife genetic data to programs under its Fish and Wildlife Program.
- A work group should be formed of data analysts (e.g. from the NOAA AMIP process and the *U.S. v Oregon* Technical Advisory Committee) and policy-level data users to review the existing and expanded data management efforts and recommend actions to coordinate and improve the efficiency of data sharing efforts to meet management needs. A system developed to meet the needs of these higher-level data users will be more likely to improve resource management than one designed by data managers who are often not part of decision processes. Implementation of a true adaptive management process will require the coordinated management, sharing and interpretation of more types of data than are presently available. Presently, the Coordinated Assessment project is working with StreamNet to provide access to some of the VSP indicators for natural and hatchery salmon and steelhead populations. However, development of data streams to support the Council's High Level Indicators will require additional data on habitat conditions, fish genetics, resident fish and wildlife populations. Additional resource management agencies (e.g. Corps of Engineers, Forest Service, Fish and Wildlife Service, Bureau of Reclamation, Bureau of Land Management, Natural Resource Conservation Service, and others) should also be engaged. A system to share this information will be more expensive to manage and less effective in sharing data if it is done piecemeal and without an overall unifying vision of how the pieces should fit together.
- **3.3 Hatchery Effectiveness Monitoring** Current Program: Pages 18-19, Artificial Production Strategies, and Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies Recommendation: Insert a new bullet under *Artificial Production Strategies* (page 19), or under *Reporting and Data Management* (page 25) as follows: ***“Hatchery Effectiveness Monitoring: The minimum reporting indicators for successful hatcheries to meet the Council’s Artificial Production Review are: 1) the number of juveniles released by life stage, and 2) the components of total adult hatchery production, which include the number of hatchery adults returning to the hatchery, spawning in rivers, and caught in fisheries. These***

*indicators can be used to assess whether facilities are meeting their mitigation requirements, as well as conservation and/or harvest benefits common of all hatchery programs.”*

- **5.0 Habitat 5.1 Address Toxic Contaminants** Current Program: Page 42-44, Water Quality ..... Measure 3: The Program should fund studies to determine which toxic contaminants most limit the restoration success of anadromous and resident fish and in particular determine how contaminants interfere with the reproduction and/or rearing success of key species such as white sturgeon and Pacific lamprey, as well as threatened and endangered salmonids, that are known to be vulnerable to bioaccumulation of toxins. The footprint of existing contamination and the location of known toxic discharges should be mapped in relationship to fish and wildlife populations and habitat restoration efforts and monitored as part of a basin-wide monitoring program. Assess foodweb transfer, sediment transport, and biological effects of emerging and legacy organic contaminants under current management regimes, and how those processes affect key Columbia River species and the success of restoration projects within the basin.
- Rationale: Various stressors threaten native fishes and other wildlife in the Columbia River basin. Urbanized large aquatic ecosystems are experiencing increasing contamination of water and sediment and ultimately foodwebs. Contaminants of concern include both legacy compounds such as DDT and PCBs that are still present in the system, as well as chemicals of emerging concern (CECs) such as pharmaceuticals and personal care products. Use and release into the environment of CECs is increasing, although little is known about their harmful levels and effects. Several interdisciplinary studies have been carried out in recent years to assess impacts of different classes of contaminants in several levels of the foodweb in the Columbia River. The USGS Columbia River Contaminants and Habitat Characterization (ConHab) project investigated transport pathways, chemical fate and effects of endocrine disrupting chemicals in the foodweb in the lower Columbia River and found that bio-magnification of multiple contaminants occurred in resident fish and osprey eggs, environmental quality benchmarks were exceeded in some cases, and reproductive parameters showed impairment at some sites and were significantly negatively correlated with various contaminant concentrations (Nilsen et al., in press; Nilsen and Morace, in press). In some species of vertebrates, these chemicals alter thyroid function, reduce sperm counts, and delay sperm maturation (Kuriyama et al., 2005) among other impacts. NOAA researchers have found multiple contaminants, including polycyclic aromatic hydrocarbons, PCBs, and DDTs in several stocks of Columbia River juvenile Chinook salmon (Yanagida et al. 2012; Johnson et al. 2013), often at concentrations associated with increased disease susceptibility (Arkoosh et al., 1998) and altered growth and metabolism (Meador et al. 2002, 2008). Juvenile salmon are also exposed to chemicals of emerging concern (CECs), such as environmental estrogens and the endocrine-disrupting flame retardants, polybrominated diphenyl ethers (PBDEs; LCREP 2007; Sloan et al. 2011). Better understanding of these effects on key first foods species is needed. In addition to understanding bioaccumulation and exposure pathways through food webs, there is a need to assess the indirect food-web mediated effects of contaminants on key species. Modern insecticides, metals, and other contaminants are highly toxic to the insects and crustaceans that constitute the prey base for salmon and other fish species. This raises the possibility that insecticides and other contaminants are compromising the biological integrity of critical foraging habitats for ESA-listed species, and putting these stocks at risk by reduced prey quality and quantity (Macneale et al. 2010). New research is needed to better understand how water quality improvements will enhance aquatic community diversity and abundance, as well as prey quality.
- Critical uncertainties in understanding impacts of contaminants on key species and foodwebs in the Columbia River basin include:
  - Chemicals of emerging concern (CECs) levels of concern to the health of key species including Pacific lamprey, white sturgeon, and salmonids.
  - Impacts of CECs on the carrying capacity of the Columbia River ecosystem for juvenile salmonids and other key species.
  - Impacts of contamination on habitat restoration success: Contaminants of concern should be assessed and monitored as part of current and future river restoration programs.
  - Role of contamination in reduced rearing success of white sturgeon in impounded pools: Impacts of contaminants on sturgeon reproduction and rearing success within areas of known high productivity. Comparison of potential contaminant impacts on impounded versus unimpounded populations.
  - Role of contamination on Pacific lamprey declines compared to threats from hydropower operations, such as dam passage. Assess levels of concern and effects of chemical mixtures.



- □□ Investigate impacts of different hydrologic scenarios and management actions on contaminant distributions and foodweb transfer.
- □□ Distributions, levels, and spatial patterns of contaminants of emerging concern (CECs) in the Columbia River basin including the estuary and coastal ocean.
- □□ Impacts of contamination from abandoned vessels: Abandoned vessels should be inventoried and mapped in relation to potential impacts to aquatic species.
- Measure 4: The Program should fund investigations of the cumulative and/or synergistic effects of multiple toxic contaminants particularly pesticides on riparian insects and other organisms that impact the carrying capacity of the Columbia River ecosystem, as well as interactions between these chemicals and non-chemical stressors.
- Rationale: Mixtures of organophosphate and carbamate pesticides are commonly detected in fresh water habitat that supports key species of interest to the Fish and Wildlife program. These pesticides interfere with behaviors that are essential for salmon survival. Some pesticides interact to produce synergistic toxicity in salmon (Laetz et al., 2009) and showed greater degree of synergism at higher exposure concentrations. Several combinations of organophosphates were lethal at concentrations that were sublethal in single-chemical trials. Single chemical risk assessments are likely to underestimate the impacts of insecticides in river systems where mixtures occur.

**12. Confederated Salish and Kootenai Tribes , CSKT (16) (submitted by Lynn DuCharme )**

- .Species Focused Recommendations, Implement Predator Control, ... The Program should support, and BPA should fund, additional research into the overall magnitude of the impacts of non-native predators including studies on abundance, movement and habitat use, and food web interactions in order to help guide improved management of non-natives
- Review Implementation of Program Measures Current Program: Page 63, Program Reporting Recommendation: The Council should work with fish and wildlife managers and partners to provide a periodic review of implementation of Fish and Wildlife Program measures and provide an annual report of the measures that were implemented and those which were not. In addition, because of the importance of Subbasin plans, progress towards implementation of these plans should be reported on periodically. This could be as simple as documenting which measures are currently funded and those which have not been funded.
- Rationale: We recommend ..... BPA has large discretion regarding funding levels, but the measures listed in the Program are presumed to be funded, at some level. Tracking of these measures needs to be transparent. In addition, it is critical that the cost of administering the Program be kept low. It is important that in an annual review of implementation, an accounting for Program administration costs be reviewed, as well

**13. Confederated Tribes and Bands of the Yakama Nation, YN (17) (submitted by steve parker )**

- Current Program, V.D.9.c., reporting and data management p.26: recommendations: in the subsection, Dissemination of data via the internet, include language acknowledging the need to establish data sharing agreements between the producers and consumers of data placed in the public domain to ensure that data are not misinterpreted or misused.

**14. Confederated Tribes of Grand Ronde, CTGR (18) (submitted by Lawrence Schwabe )**

- **Recommendation 18** — The High-Level Indicators paragraph on page 26 of the current Program should continue to expand to include reporting high level indicators in the Lower Columbia Province, as well as develop indicators for resident fish, pacific lamprey, and eulachon. The recently constructed Minto Adult Collection Facility in the Willamette Subbasin on the North Santiam River is a significant hydrosystem investment funded by the tax and rate payer. The data collected at this facility is an optimal metric for wild and hatchery steelhead and salmon species and should be incorporated as a High Level Indicator. Rationale: In accordance to the 2008 Upper Willamette Biological Opinion, significant tax and rate payer investments have been made and are expected to continue to recover listed fish directly affected by the hydrosystem. Utilizing data from at least one collection facility in the Willamette Subbasin would be an excellent metric to gauge mitigation success.

- **Recommendation 19** — High Level Indicators on page 26 need to be developed for quantitative biological objectives developed at the provincial scale. These include:
    - Restore the widest set of salmon and steelhead populations in each province; Report population status by province including reintroduction goals
    - Restore lamprey, sturgeon and eulachon; Create a monitoring framework and report status of lamprey, sturgeon, and eulachon across the Columbia River Basin on a regular basis
    - Restore lamprey production, passage and habitat; Report passage counts at dams annually and map lamprey distribution every 5 years
    - Rationale: The current Program, on page 11, calls for a process to assess the value of these goals. This should be implemented as called for. The Program should restate the call to assess the value of quantitative biological objectives and to develop an updated and scientifically rigorous set of such quantitative objectives. Reviewing and refining the adult fish return and SAR goals is appropriate to assure that these are correctly scaled to evaluate the Program. Measureable objectives provide:
      - Quantitative targets to support the Program vision, moving the program from the abstract to the concrete;
      - A method to track program progress (a report card); and
      - A measure of improvement needed in the program.
  - The above actions and metrics along with importance, feasibility, and cost components, help inform future funding priorities to achieve specific goals. This contributes to policy discussions to prioritize funding to achieve specific goals. It is currently possible to report progress against the basin-level biological objectives that are stated in the Program. Establishing a consistent, transparent, reliable report using metrics to demonstrate progress of Program implementation is required to support true adaptive management at the basin-wide scale. The data currently exists to report against the objectives; however, the data management capacity and practices are not in place to support efficient, cost effective reporting.
  - **Recommendation 46:** The NPCC should amend the Lower Columbia Subbasin Plan (1 paragraph on Page 2-18) to include more specific objectives and strategies for eulachon. BPA should fund protection, mitigation and enhancement of eulachon through the following measures:
    - Develop biological objectives for eulachon that are consistent with recovery.
    - Monitor and evaluate eulachon abundance in the Columbia River via annual spawning stock biomass surveys following protocols developed by the Washington Department of Fish and Wildlife and acoustic estimates by NOAA - NWFSC.
    - Monitor and evaluate the causal mechanisms and migration/behavior characteristics affecting survival of larval eulachon during their first weeks in the Columbia River estuary, plume, and ocean environments.
15. Monitor and evaluate the ecological importance of the tidal freshwater, estuary, plume, and nearshore ocean environments to the viability and recovery of eulachon in the Columbia River Basin.
- Develop an oceanographic indicators ecosystem conditions model to determine the significance of plume and nearshore ocean conditions that affect eulachon survival.

**16. Confederated Tribes of the Umatilla India Reservation, CTUIR (19) (submitted by Kat Brigham)**

- Recommendation 13: Revise final bullet under Water Quality on Page 44 as follows: Implementing actions to reduce toxic contaminants in the water to meet state, tribal and federal water quality standards. The federal action agencies should partner with and support federal, tribal, state, and regional agencies' efforts to monitor toxic contaminants in the mainstem Columbia and Snake rivers and evaluate whether these toxic contaminants adversely affect anadromous or resident fish important to this Program. If so, implement actions to reduce these toxic contaminants or their effects if doing so will provide survival benefits for fish in mitigation of adverse effects caused by the hydropower system. In particular, investigate whether exposure to toxics in the mainstem, combined with the stress associated with dam passage, leave juvenile salmon and adult and juvenile lamprey more susceptible to disease and result in increased mortality or reduced productivity.
- Recommendation : Revise the text of the first major bullet under *Lamprey* on Page 47 as follows:

- *Bonneville and the Corps, in coordination with federal, state, and tribal fish managers and the Council, should identify, develop, implement, and **monitor** measures to help restore Pacific lamprey including:*
- Delete the existing six sub-bullets and replace with the following 14 revised sub-bullets.  
... [omitted text]...
- • *Regional approaches to evaluate passage, abundance, distribution, and population structure, including the mainstem Columbia, Snake and Willamette rivers*
- • *Development of PIT and active tags suitable for adult and juvenile lamprey and establish an annual regional lamprey tagging forum*
- • *Development of a regional strategy for monitoring passage into tributaries to better understand differences in counts of adult lamprey between dams*
- • *Development and implementation of a regional tagging and monitoring strategy for evaluating the timing of larval and juvenile lamprey movement and active outmigration from tributaries into the mainstem and passing mainstem hydropower projects.*
- • *Increase knowledge regarding the use of the mainstem as spawning and rearing habitat with systematic occupancy sampling*
- • *Identify operations at mainstem hydropower dams such as ramping rates and water elevation changes that delay, obstruct, or kill migrating adult and juvenile lamprey*
- • *Monitor and address effects of hydrosystem operations on juvenile lamprey residing in reservoirs*
- • *Develop and implement passage aids for adult and juvenile lamprey at known passage obstacles*
- • *Monitor lamprey passage at mainstem hydropower dams to evaluate passage improvement actions and to identify additional passage problem areas,*
- • *Assess lamprey passage efficiency, direct mortality, and/or other metrics relating to migratory success of lamprey*
- • *Determine predation on adult and juvenile lamprey during migration*
- • *Determine the potential effects of climate change on lampreys, including the effects of increasing water temperatures and changing runoff regimes on lamprey energetics and performance*
- • *Support the Pacific Lamprey Conservation Agreement through collaborative development and management of a comprehensive GIS data clearing for all mainstem and tributary lamprey data that is accessible by co-managers and the public.*
- **Current Program. Freshwater Mussels. New Section: Recommendation: Include language in the Fish and Wildlife Program to recognize the importance of freshwater mussels regarding ecosystem diversity, function, and traditional cultural opportunities in the basin. The CTUIR pilot freshwater mussel project should continue and move from a research phase into a restoration and monitoring phase that will provide critical information regarding reintroduction and restoration that can be later applied to a larger scale. Rationale: Freshwater mussels are critically endangered world-wide. In western North America (genera Anodonta, Margaritifera, and Gonidea) are notoriously understudied, although they have historically been a major component of the biomass in western aquatic systems and likely have a disproportionately large impact on ecological stability and processes in these systems. Freshwater mussels were historically abundant in the Columbia Basin and can provide a myriad of ecosystem services that benefit other aquatic species, including salmonids. Recent studies suggest that freshwater mussels also benefit Pacific lamprey populations, in part by retaining organic matter in the system. Freshwater mussels have been harvested for food and shell material by Native Americans for over 10,000 years and are considered an important cultural resource. Recently BPA and CTUIR have funded pioneering work on the genetic composition, taxonomy, host fish, physiology and habitat associations of western freshwater mussels. Now that some of the basic questions (e.g., genetics, host fish) regarding western freshwater mussels have been answered, applied pilot actions and research can be appropriately designed and implemented to begin reintroduction and restoration efforts. Such studies and pilot efforts are critical for effective monitoring, conservation, and informing expanded restoration programs.**

**17. Cowlitz Indian Tribe (22), Cowlitz I.T. (submitted by William Iyall)**

(Reference Document of 2014 Fish and Wildlife Program Amendment Recommendations)

- Expand anadromous goals to the Subbasin and Province levels and add specific and measurable objectives for resident fish and wildlife to support high level indicators.

- The Council should report annually on progress towards achieving the Basin-Level Biological Objectives as presented in the Program. The reporting section of the Program (Section VII.E) should be expanded to include reporting high level indicators that represent the Program’s basin-level biological objectives as reported in Section II.C of the current Program.
- Add explicit measurable biological objectives to support the more general Program goals consistent with ISAB recommendations (ISAB 2013-1). Also refer to Section 5 of this document, Species Focused Recommendations. These should integrate with the current Council high level indicators and would clarify how to report against current biological objectives:
  - Halt declining trends in salmon and steelhead populations ; □□ Graph trends in representative populations’ abundance over time and determine whether populations are increasing, decreasing, or stable
  - Increase total runs that support tribal and non-tribal harvest ; □□ Report abundance of fish runs annually , □□ Report tribal and non-tribal harvest in all fisheries annually
  - Achieve 5 million fish above Bonneville dam and 75 percent of recovery goals for LCR ESUs by 2025 ; □□ Report annually total abundance by ESU for salmon and steelhead populations including harvest and other mortality
  - Achieve SARs of 2-6% with an average of 4% for Snake River and Upper Columbia River populations ; □□ Report annually appropriate dam to dam SARs for representative populations to determine if cumulative hydrosystem actions are achieving the targeted level of survival ;
  - Restore the widest set of salmon and steelhead populations in each province ; □ Report population status by province including reintroduction goals
    - o Restore lamprey, sturgeon and eulachon ; □ Create a monitoring framework and report status of lamprey, sturgeon, and eulachon across the Columbia River Basin on a regular basis
    - o Restore lamprey production, passage and habitat ; Report passage counts at dams annually and map lamprey distribution every 5 years
- Rationale: The current Program, on page 11, calls for a process to assess the value of these goals. This should be implemented as called for. The Program should restate the call to assess the value of quantitative biological objectives and to develop an updated and scientifically rigorous set of such quantitative objectives. Reviewing and refining the adult fish return and SAR goals is appropriate to assure that these are correctly scaled to evaluate the Program. Measureable objectives provide:
  - Quantitative targets to support the Program vision, moving the program from the abstract to the concrete;
  - A method to track program progress (a report card); and
  - A measure of improvement needed in the program.
- The above actions and metrics along with importance, feasibility, and cost components, help inform future funding priorities to achieve specific goals. This contributes to policy discussions to prioritize funding to achieve specific goals. It is currently possible to report progress against the basin-level biological objectives that are stated in the Program. Establishing a consistent, transparent, reliable report using metrics to demonstrate progress of Program implementation is required to support true adaptive management at the basin-wide scale. The data currently exists to report against the objectives; however, the data management capacity and practices are not in place to support efficient, cost effective reporting.
- **2.3 Coordinated Assessments Monitoring and Reporting** Current Program: Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
  - Measure 1: The Council should adopt and BPA should fund full implementation of the Coordinated Assessments project to **report** on the indicators of natural origin spawners (NOR), smolt to adult return (SAR), adult to adult recruitment (AAR), and juveniles per spawner (JpS) for Columbia River salmon and steelhead populations.
  - Measure 2: BPA should fund expansion of the Coordinated Assessments project to include indicators for resident fish and wildlife.

- Rationale: Approximately 78 million dollars are spent annually on anadromous monitoring in the Columbia Basin. This information is used to determine a population status and trend, effectiveness of habitat restoration, and for many other purposes. A variety of anadromous population data has been collected across various life stages and is reported by individual project sponsors in their annual reports. While this reporting is valuable at the project reporting scale, it is difficult to synthesize for reporting at the larger geographic scales such as the population, subbasin, province, major population, DPS/ESU, or Columbia Basin scales. In addition, there are many possible indicators that could be used for reporting. In 2010, fisheries agencies and tribes started the Coordinated Assessments (CA) project to standardize indicators for reporting across spatial scales and a data exchange standard to facilitate the associated data sharing. This was followed up with a pilot project that successfully demonstrated the proof of concept for this project. The CA project has now moved to the implementation phase, which includes modifying and developing new agency databases for storing raw and summarized data, analysis tools, and reporting databases. The agreed upon CA indicators track specific life stage survival and/or abundance of salmon and steelhead to provide the information needed for adaptive management process in the Columbia Basin and provide the necessary data for the FCRPS BiOP. These are the key indicators used for population status and trend analysis and for NOAA to determine population status under the ESA. The Program should continue to support this successful effort and expand the CA process to develop data sharing standards for resident fish and wildlife data.

- **2.4 Data Management** Current Program: Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies

- Measure 1: BPA should fund adequate data management projects with the agencies and tribes to support regional reporting requirements for evaluation of Program activities that are additional to the agencies' and tribes' routine data management activities. There are data specifically collected, managed, and analyzed due to the existence and operation of the FCRPS and its impact on fish and wildlife.

- Measure 2: BPA should fund adequate reporting at the Council level to provide annual, and periodic, reporting of Program actions and effectiveness which supports Program scale adaptive management.

- Rationale: The Council, tribal, state and federal natural resource managers agree that an information feedback process is required to inform management decisions about the use of fish and wildlife resources. Often this feedback process is characterized as "Adaptive Management," but this activity has not been funded or implemented.

- A clear set of measurable biological objectives at various scales within the Program (high level indicators) could provide a top-down monitoring framework with which to guide data management infrastructure. A plan and process for reporting against those objectives could serve as an adaptive management tool for evaluating success of strategies and actions within the Program at each level.

- A critical part of an adaptive management process is the collection, storage and analysis, and presentation of information about natural resources in a way that is useful to decision makers. Yet this critical activity has received little recognition and even less support in the Fish and Wildlife Program. The following actions are needed to rectify this oversight:

- Restructure and simplify the Program to provide Goals, Measurable Objectives, Strategies and Measures at the Basinwide, Province and Subbasin scale. All measures should be linked back to specific measurable objectives. The goals and objectives should then guide the development of a data management framework to support specific annual, bi-annual, and five year reporting requirements;

- Use a Regional Coordination forum including BPA, Council, tribal, state, and federal resource managers, and data management leaders to develop and review regional restoration progress reports, discuss options to improve reporting, and provide policy guidance for data management efforts;

- Use the StreamNet and Pacific Northwest Aquatic Monitoring Partnership (PNAMP) forums for development of the technical issues and tools necessary for coordinated data management. Extend this forum over time to include wildlife and terrestrial habitat data and other key sources of fish and wildlife related data sources (especially the Corps and LSRCP, but others such as the USFS, BLM, BOR, NRCs, etc.);

- Use the updated F&W Program as the starting point for developing a coordinated data management system based on explicit reporting requirements adopted by the Council.

- Expand the Coordinated Assessment Project effort (under StreamNet and PNAMP) to develop data standards and sharing processes for derived data to support ESA and Fish and Wildlife Program reporting needs;
  - Incorporate concepts consistent with the Council staff Draft Guidance for Information Management, Evaluation and Reporting; and
  - Incorporate concepts consistent with the Council staff Draft Guidance for a Balanced and Coordinated Approach for Conducting Monitoring and Research Activities.
- **2.5 Hatchery Effectiveness Monitoring** Current Program: Pages 18-19, Artificial Production Strategies, and Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
- Measure: The Council should adopt and BPA should fund hatchery effectiveness monitoring and reporting for Columbia Basin hatcheries.
- Recommendation: Insert a new bullet under *Artificial Production Strategies* (page 19), or under *Reporting and Data Management* (page 25) as follows: ***“Hatchery Effectiveness Monitoring: The minimum reporting indicators for successful hatcheries to meet the Council’s Artificial Production Review are: 1) the number of juveniles released by life stage, and 2) the components of total adult hatchery production, which include the number of hatchery adults returning to the hatchery, spawning in rivers, and caught in fisheries. These indicators can be used to assess the conservation and/or harvest benefits common of all hatchery programs. In addition to compiling this information for reporting, we also recommend a reporting database for these hatchery indicators be developed and funded to allow tracking of hatchery performance.”***
- Rationale: Currently, approximately 26 million dollars are spent annually on hatcheries in the Columbia Basin to mitigate for losses cause by the FCRPS and it is important for the Council to track the effectiveness of hatchery programs. Hatcheries and individual hatchery programs in the Columbia River have been reviewed by NOAA through the Columbia Basin Hatchery Environmental Impact Statement and Hatchery Genetic Management Plans, the Hatchery Science Review Group, and Independent Science Review Panel. In addition, the Council has developed an Artificial Production Review (ARP) Process (NPCC 1999). The NPCC (2004) judged a hatchery program to be successful if it met the following conditions: 1) it must produce a healthy and viable hatchery population; 2) it must make a sustainable contribution of adult returns to conservation and/or harvest; 2) its potential effects on wild and native populations and the environment must be understood, and 4) it must collect, record, evaluate, and disseminate information pertaining to the first three conditions so that decision-makers may be informed about the benefits and risks of the program relative to other means of achieving similar conservation and harvest goals. While it is the responsibility of hatchery operators and funders to develop specific hatchery goals, the purpose of this amendment is to develop interim indicators that provide measures hatchery performance for the Council’s role in hatchery oversight and to meet its reporting requirements. The minimum reporting indicators for successful hatcheries are 1) the number of juveniles released by life stage, and 2) the components of total adult hatchery production, which include the number of hatchery adults returning to the hatchery, spawning in rivers, and caught in fisheries as these can be used to assess the conservation and harvest benefits of all hatchery programs. In addition, to compiling this information in a report (see Roler 2012 for an example of total adult production report), we recommend a reporting database for these hatchery indicators be funded possibly through StreamNet.
- **3.3 Adequately Fund Wildlife M&E** , Current Program: Pages 20-22, Wildlife Strategies, and Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
- Measure: BPA shall fund adequate monitoring, data management, and reporting to answer the following questions in an annual report to Council and the region - How many habitat units have been mitigated for FCRPS construction and inundation caused losses of wildlife? How many of those habitat units are secured through long term funding? How are wildlife species and habitats responding to FCRPS mitigation actions? What is the FCRPS mitigation responsibility for wildlife operational impacts?
- Recommendation: The Council, through their Wildlife Advisory Committee, should identify and support specific reporting requirements for wildlife and wildlife projects for the Program. Rationale: It is appropriate for BPA to fund research, monitoring and evaluation of wildlife mitigation projects adequately to

assure tracking of crediting, to evaluate trends in ecological functions of managed ecosystems, and provide managers the ability to assess the effectiveness of their mitigation strategies by evaluating species and habitat responses that contributes to broader monitoring efforts. BPA should continue funding HEP surveys on acquired land in support of the Wildlife Advisory Committee to track mitigation implementation progress.

- Recommendation: A programmatic evaluation of the Wildlife Section of the Program should occur preceding Program amendments, to determine whether wildlife measures are moving the Program towards its biological objectives for performance. Rationale: Reporting high level indicators for wildlife, at the scale of the Columbia River Basin, is a daunting challenge. The impact of the BPA funded wildlife mitigation projects, while significant, may not be detectable within the environmental noise of such a large landscape. Individual wildlife populations are generally highly migratory, and trends in population size is not an appropriate indicator of Program success as species ranges are far greater than the individual project areas, and in many cases far greater the Columbia River Basin. Habitat quantity and quality is the currency for implementation of the BPA funded wildlife mitigation program and should be taken into account when developing HLIs for areas within the Program influence...[omitted text].... Following the Wildlife Crediting Forum, the co-managers developed a working draft for a reporting framework called the Wildlife Monitoring Implementation Strategy based on three categories of HLIs as determined by the Council. Further work is required to fully develop a reporting mechanism for the Council's needs. The Council identified the following three categories of HLIs:

- 1) Habitat and Vegetation Types – several metrics would be reported for each cover type that represents status and trend in quality and quantity of the cover type, which can infer benefits to focal species or guilds. While this data is collected by individual wildlife projects within the Program, compilation and reporting will be required at a scale larger than any individual project. Reporting this information would require a designated project to perform the summary, analysis and reporting necessary to provide useful and timely indicators for Council reports.
- 2) Focal Species – several national/state level data sets could be used to represent relative status of wildlife species in this area. This level of data would be retrieved from national or state databases, and not from the individual projects; however, most of the data is initiated at the project level. Reporting this information would require a designated project to perform the summary, analysis and reporting necessary to provide useful and timely indicators for Council reports.
- 3) Habitat Units – the BPA HU ledger would continue to be reported as a measure of mitigation actions implemented specific to the Fish and Wildlife Program.

- The recent completion of the Wildlife Crediting Forum has provided a clean slate for reporting HUs at the project scale, a project may be needed to provide the high level summary of this information similar to the CBFWA Status of the Resource Report and website. In developing the Wildlife Monitoring Implementation Strategy (WMIS), wildlife managers considered the following concepts:

- Scale integration: data collected can be used at multiple scales of interest for decisions
- Integration across separate monitoring programs: information gathered serves multiple functions and thus reduces costs
- Integration of policy and technical domains: precision of data fits time frames and acceptable risks for decisions
- Species integration: collection of data for multiple species in an efficient manner
- Adequate sample size: sample sizes are statistically adequate to discern differences among populations, across spatial distributions, and across temporal scales relative to varying human-induced and natural environmental stressors

- Based on this effort, the wildlife managers are prepared to engage with the Council and BPA to develop biological and environmental performance objectives for the wildlife portion of the Program and establish an annual and five-year reporting process for evaluating implementation success.

- Resident fish substitution for anadromous fish losses, Current Program: Page 23-24, Resident Fish Substitution Strategies , Rationale: A wide cross section of resident fish substitution projects, particularly in the basins where passage of anadromous adults and juveniles is currently blocked by Federal Columbia River Power System (FCRPS) projects, have been implemented over time without a standard definition of program goals or a methodology for converting anadromous fish losses to resident fish substitution goals where in-kind mitigation projects are not currently possible to implement. Giving clearer Council guidance for these types of efforts seems timely, as these mitigation requirements of BPA have not yet been uniformly and systematically addressed. ...[ omitted text] .. While these various types of mitigation programs have merit and may be suitable

for a wide variety of geographic areas and environmental conditions, without a common currency for evaluating the extent of a program and establishing program goals and objectives that adequately address the value of anadromous fish that were lost due to the effects of construction and operation of the FCRPS that created the passage blockages initially, full and equitable mitigation for these losses will remain difficult to define

- White sturgeon .. [ omitted text ] ... *Monitor and evaluate mitigative white sturgeon restoration actions, and population responses to environmental condition consistent with the Columbia Basin White Sturgeon Planning Framework.*”
- Eulachon ..[omitted text]... Monitor and evaluate eulachon abundance in the Columbia River via annual spawning stock biomass surveys following protocols developed by the Washington Department of Fish and Wildlife and acoustic estimates by NOAA - NWFSC. Monitor and evaluate the causal mechanisms and migration/behavior characteristics affecting survival of larval eulachon during their first weeks in the Columbia River estuary, plume, and ocean environments. Monitor and evaluate the ecological importance of the tidal freshwater, estuary, plume, and nearshore ocean environments to the viability and recovery of eulachon in the Columbia River Basin. Develop an oceanographic indicators ecosystem conditions model to determine the significance of plume and nearshore ocean conditions that affect eulachon survival.

- **7.1 Fully Incorporate Estuary, Plume and Nearshore Ocean in Program** Current Program: various sections, Measure 4: Explore and implement adaptive management experiments to improve survival of anadromous fish. Rationale: The Council has been interested for some time in ways in which managers can use the results of the ocean research to change/alter freshwater habitat and production management to improve overall survival. It has been suggested that there may be applications such as changing the timing of hatchery releases or changing migration methods (transport and in-river) to take advantage of optimal plume or ocean conditions and subsequently, to improve survival for these fish. Presently hatchery fish release timing is set by hatchery managers that are considering water temperature, readiness of the fish to migrate and to take advantage of in river flow. It is unclear, however, if potential management strategies are realistic or practical and if the potential survival benefits would outweigh other risks. Further discussions are warranted between researchers and freshwater fisheries and hatchery managers to explore the practical potential of these concepts. There are specific experiments that can be conducted using individual hatcheries that are already investigating variable release timing. Stock-specific information about growth and survival in the ocean should be better linked to stock management in the freshwater.

- **7.1 Fully Incorporate Estuary, Plume and Nearshore Ocean in Program** Current Program: various sections Measure 5: Continue to research direct and indirect effects of anthropogenic freshwater management on marine ecological attributes affecting anadromous fish habitat, life histories and productivity.

Rationale: Management of the Columbia River Basin hydropower system directly affects the ocean environment by changes in the natural hydrograph and ecological processes caused by development and operation of the hydro-system, and through changes to the estuary and plume habitats due to the timing, quantity and quality of river flows. There is much more to be learned about how to improve conditions and thus survival for anadromous fish in the estuary and plume.

Measure 6: The Program should address the uncertainty regarding the effectiveness of estuarine restoration projects and different types of habitat and whether they contribute to increased juvenile survival and hence increased adult returns.

Rationale: The primary critical uncertainty regarding estuarine restoration projects and different types of habitat is whether they contribute to increased juvenile survival and hence increased adult returns. Good estimates of residence time in rearing habitat, and the quantity and quality of the habitat that will likely influence survival, are generally lacking. Also, how fish move between rearing habitats and the importance of habitat connectivity and spatial distribution are poorly understood. Along these lines, a general understanding of the quantity of available habitat, quality of fish habitat, how fish use them, and how they are distributed throughout the migration and rearing reaches of the Lower Columbia River and estuary are not well known. Another critical uncertainty is to identify status and trends of the ecosystem processes in the lower Columbia River and estuary to better understand the ecosystems processes and the effects on restoration and mitigation efforts.

Measure 7: Research is needed on forage fish in the lower estuary and nearshore area. The Fish and Wildlife Program should promote projects on forage fish in the lower estuary and nearshore area through the following measures:

Identify spawning and rearing life history attributes of forage fish in the estuary



Determine the role of forage fish as alternate prey for birds in the lower estuary  
 Elucidate the role eulachon may have as an alternative prey for sea lions  
 Determine how restoration projects in the estuary may contribute to reproductive success and rearing of forage fish  
 Identify the relation between Columbia River flow and forage fish abundance in the estuary  
 Identify role forage fish have in survival of juvenile Chinook salmon, coho, and steelhead  
 Determine how climate change, ocean acidification, salinity, estuary turbidity maximum (ETM), and localized hypoxia are likely to affect forage fish in the coming decades

- Rationale: The proposed amendment will update the Program to reflect a move toward ecosystem management approach to provide salmon with their total life cycle needs including an adequate food web to support growth and improve survival. Forage fish in the lower estuary include a broad group of species including surf smelt, Pacific sand lance, Pacific herring, eulachon, and juvenile American shad. These species have diverse reproductive strategies but all species can occur in the lower estuary during their life histories. For example, surf smelt and Pacific sand lance may use beaches for spawning while Pacific herring may spawn on nearshore macro-algae. Eulachon and American shad are anadromous and can produce large numbers of juveniles that disperse downstream and enter the estuary. The Fish and Wildlife Program places an emphasis on salmon restoration and forage fish are a major link between habitat and environmental conditions and the survival of salmon.

- **7.2 Reduce Toxic Contaminants** Current Program: Page 42-44, Water Quality , Measure 1: BPA should fund a programmatic review and assessment of how hydropower projects exacerbate any problems associated with the effects of toxic substances and if any such correlation exists, the Council shall identify opportunities for operational changes or other activities to help mitigate these impacts and reduce toxic contamination. Determine how seasonal anoxia in dam reservoirs controls the release of toxics and other pollutants from the sediments to the water column and how the uptake and transfer of these toxics and pollutants transfer up the food web and negatively impact fish. Evaluate how environmental toxicants impact the reproductive fitness of fish that are impounded behind dams. Rationale: ...[omitted text]...a research focus that addresses the following items will better inform resource managers and facilitate future amelioration opportunities:

- Levels of mercury and variation in bio-indicator taxa across reservoirs in the Columbia River Basin.
- Influence of seasonal drawdown and flood-up patterns on methylmercury cycling and bioaccumulation in Columbia River Basin reservoirs.
- Influence of lake stratification, dissolved oxygen, and primary production on mercury cycling and bioaccumulation in Columbia River Basin reservoirs.
- The influence of fish growth, condition, and energetics on mercury bioaccumulation rates and fish mercury concentrations in Columbia River Basin reservoirs.
- The influence of food quality and energy content on mercury bioaccumulation rates and fish mercury concentrations in Columbia River Basin reservoirs.
- The role that variation in littoral versus pelagic foraging reliance plays in driving mercury bioaccumulation pathways in Columbia River Basin reservoirs.
- The influence of prey/forage fish community structure and species assemblages on mercury exposure in top predator fishes in Columbia River Basin reservoirs.
- Biochemical, behavioral, and reproductive effects of mercury in fishes and aquatic dependent wildlife in Columbia River Basin reservoirs.

**7.2 Reduce Toxic Contaminants** Current Program: Page 42-44, Water Quality , Measure 3: Fund studies to determine which toxic contaminants most limit the restoration success of anadromous and resident fish and in particular determine how contaminants interfere with the reproduction and/or rearing success of key species such as white sturgeon and Pacific lamprey that are known to be vulnerable to bioaccumulation of toxins. The footprint of existing contamination and the location of known toxic discharges should be mapped in relationship to fish and wildlife populations and habitat restoration efforts and monitored as part of a basin-wide monitoring program. Assess foodweb transfer, sediment transport, and biological effects of emerging and legacy organic contaminants under current management regimes, and how those processes affect key Columbia River species and the success of restoration projects within the basin.

Rationale: Various stressors threaten native fishes and other wildlife in the Columbia River basin. Urbanized large aquatic ecosystems are experiencing increasing contamination of water and sediment and ultimately foodwebs. Contaminants of concern include both legacy compounds such as DDT and PCBs that are still present in the system, as well as chemicals of emerging concern (CECs) such as pharmaceuticals and personal care products. Use and release into the environment of CECs is increasing, although little is known about their harmful levels and effects. Several interdisciplinary studies have been carried out in recent years to assess impacts of different classes of contaminants in several levels of the foodweb in the Columbia River.

The USGS Columbia River Contaminants and Habitat Characterization (ConHab) project investigated transport pathways, chemical fate and effects of endocrine disrupting chemicals in the foodweb in the lower Columbia River and found that bio-magnification of multiple contaminants occurred in resident fish and osprey eggs, environmental quality benchmarks were exceeded in some cases, and reproductive parameters showed impairment at some sites and were significantly negatively correlated with various contaminant concentrations (Nilsen et al., in press; Nilsen and Morace, in press). In some species of vertebrates, these chemicals alter thyroid function, reduce sperm counts, and delay sperm maturation (Kuriyama et al., 2005) among other impacts. NOAA researchers found from studies on juvenile chinook salmon that exposure to urban contaminants was linked to an increase in disease susceptibility (Arkoosh et al., 1998). Better understanding of these effects on key first foods species is needed.

Critical uncertainties in understanding impacts of contaminants on key species and foodwebs in the Columbia River basin include:

- Chemicals of emerging concern (CECs) levels of concern to the health of key species including Pacific lamprey, white sturgeon, and salmonids.
- Impacts of CECs on the carrying capacity of the Columbia River ecosystem for juvenile salmonids and other key species.
- Impacts of contamination on habitat restoration success: Contaminants of concern should be assessed and monitored as part of current and future river restoration programs.
- Role of contamination in reduced rearing success of white sturgeon in impounded pools: Impacts of contaminants on sturgeon reproduction and rearing success within areas of known high productivity. Comparison of potential contaminant impacts on impounded versus unimpounded populations.
- Role of contamination on Pacific lamprey declines compared to threats from hydropower operations, such as dam passage. Assess levels of concern and effects of chemical mixtures.
- Investigate impacts of different hydrologic scenarios and management actions on contaminant distributions and foodweb transfer.
- Distributions, levels, and spatial patterns of contaminants of emerging concern (CECs) in the Columbia River basin including the estuary and coastal ocean.
- Impacts of contamination from abandoned vessels: Abandoned vessels should be inventoried and mapped in relation to potential impacts to aquatic species.

**7.2 Reduce Toxic Contaminants** Current Program: Page 42-44, Water Quality , Measure 4: Investigate the cumulative and/or synergistic effects of multiple toxic contaminants particularly pesticides on riparian insects and other organisms that impact the carrying capacity of the Columbia River ecosystem. Rationale: Mixtures of organophosphate and carbamate pesticides are commonly detected in fresh water habitat that supports key species of interest to the Fish and Wildlife program. These pesticides interfere with behaviors that are essential for salmon survival. Some pesticides interact to produce synergistic toxicity in salmon (Laetz et al., 2009) and showed greater degree of synergism at higher exposure concentrations. Several combinations of organophosphates were lethal at concentrations that were sublethal in single-chemical trials. Single chemical risk assessments are likely to underestimate the impacts of insecticides in river systems where mixtures occur.

**7.4 Implement Predator Control** Current Program: Page 52, Piscivorous predator control

The Program should strive to measure the effects of predation and express them in common terms such as salmon adult equivalents to facilitate comparison and evaluation against other limiting factors. Predator evaluations should include salmon adult equivalent metrics in their reports.

Measure 1: BPA should continue to implement annually the base piscivorous predator-control program and expand northern pikeminnow (*Ptychocheilus oregonensis*) removals to other mainstem dams in the lower Columbia River ie, expand program to include northern pikeminnow removals at McNary and Bonneville dams. The action agencies

should evaluate the effectiveness of focused pikeminnow removals for these expanded efforts and implement as warranted.

**7.4 Implement Predator Control** Current Program: Page 52, Measure 2: [omitted text]..Rationale [ omitted text] ... The Program should support, and BPA should fund, additional research into the overall magnitude of the impacts of non-native predators including abundance, diel and temporal distributions, and food web interactions in order to help guide improved management of non-natives.

**7.4 Implement Predator Control** Current Program: Page 52-53, Pinniped predator control , Measure: Identify opportunities to reduce fish losses through pinniped predator management. Recommendation: Program language should be added to establish funding responsibility: ***“The Corps [or Bonneville] should fund federal, tribal and state agencies to evaluate the extent of pinniped predation on salmonids, sturgeon, and Pacific lamprey in the lower Columbia River from Bonneville Dam to the mouth of the river. The Corps should take action to improve the exclusion of sea lions at all main adult fish ladder entrances and locks at Bonneville Dam.”***

**18. Kootenai Tribe of Idaho, Kootenai T.I. (24) (submitted by Sue Ireland )**

- Support UCUT recommendations in addition to the below

**2.1.4.1 Integrated Fish and Wildlife Program**, Measure 3: BPA shall provide sufficient monitoring and evaluation funding to support full implementation of the Tribe’s integrated fish and wildlife program. Specifically, BPA shall provide sufficient monitoring and evaluation funding to support science-based analysis of the effectiveness of the Tribe’s integrated fish and wildlife program (i.e., project numbers 1988-064-00, 1994-049-00, 2002-002-00, 2002-008-00, 2002-011-00, and 1992-061-05), support monitoring and evaluation of protected mitigation sites, and to support science-based adaptive management of the integrated fish and wildlife program and its constituent projects. This shall include sufficient funding to support Kootenai Tribe contracted restoration, monitoring and evaluation activities, and should embrace habitat and species responses to mitigation actions. In addition, recognizing the efficiencies that are gained through collaborative data and information sharing, and in the spirit of avoiding duplicative efforts and associated costs, BPA shall include sufficient funding to support IDFG and MFWP restoration, monitoring and evaluation at levels that are necessary to support the goals, objectives and adaptive management information needs of the Tribe’s integrated fish and wildlife program (e.g., IDFG provides monitoring and evaluation information critical to implementation of projects 1988-064-00, 1994-049-00, and 2002-002-00; and MFWP cooperation is integral in application of project 2002-001-00). Rationale for Measure 3: Sufficient monitoring and evaluation funding is critical to determining the effectiveness the individual projects within the Tribe’s integrated fish and wildlife program in meeting stated goals and objectives, and to supporting science-based adaptive management. Sufficient monitoring and evaluation funding is also essential to determining the effectiveness of actions designed to meet specific ESA objectives, conservation planning objectives, and/or other legal obligations as identified in section 1.2.2. Targeted monitoring and evaluation is necessary to understanding the impacts of climate change within the ecosystem, as well as developing a better understanding of limiting factors, and how to effectively address them. Moreover, monitoring and evaluation is critical to determining the effectiveness the restoration actions, and understanding species responses to those actions. Specifically, targeted monitoring and evaluation is necessary to determine the effectiveness of efforts to increase and manage native habitats to support increased quantities of fish and wildlife species and wild foods, and to guide adaptive management of future restoration and management activities. Sufficient funding of monitoring and evaluation efforts that generate information and data necessary to multiple projects is also critical. For example, monitoring and evaluation conducted by the Kootenai Tribe and IDFG is absolutely critical to informing project production goals, genetics objectives, and release strategies for the Kootenai sturgeon and burbot conservation aquaculture programs. The same is true of the need for funding to support biological monitoring of the effectiveness of the habitat restoration projects being implemented through the Tribe’s Kootenai River Habitat Restoration Program (2002-002-00), Reconnect Project (2002-008-00), and Kootenai River Floodplain Ecosystem Operational Loss Assessment, Protection, Mitigation and Rehabilitation Project (2002-011-00).

**2.1.4.1 Integrated Fish and Wildlife Program**, Measure 4: BPA shall provide adequate funding to support critical ongoing and new research necessary to the effective implementation of the Tribe’s integrated fish and wildlife program and its constituent projects (i.e., project numbers 1988-064-00, 1994-049-00, 2002-002-00, 2002-008-00, 2002-011-00, and 1992-061-05). The Council and BPA shall in good faith implement the recommendations of the Tribe regarding critical research priorities. Understanding that limited funding must be directed strategically, the Tribe in turn, will work collaboratively with regional managers in the Kootenai River subbasin (i.e., IDFG, MFWP,

BCMFLNRO, USFWS) to identify and prioritize research. Rationale for Measure 4: Sufficient research funding is necessary to support specific targeted research needs under the Tribe's integrated fish and wildlife program and its constituent projects (i.e., project numbers 1988-064-00, 1994-049-00, 2002-002-00, 2002-008-00, 2002-011-00, and 1992-061-05). In particular, targeted research is needed to enhance our understanding of critical uncertainties including: 1) sturgeon genetics, 2) burbot genetics, 3) burbot culture, and 4) recruitment failure, and 5) ecosystem process uncertainties (i.e., floodplain food web and nutrient cycling). The value of well-designed and well-implemented targeted research is multiplied many times as that information is shared throughout the Columbia River Basin and enhances species recovery and ecosystem restoration efforts. Examples include the Tribe's cutting edge research into burbot culture techniques, and years of research involving white sturgeon culture and genetics. Additionally, the Tribe has developed a framework in which to assess and understand the impacts of dam operations on the ecosystem.

**2.4.3 Monitoring, Evaluation, Reporting, Research and Data Management** The Tribe recommends the following improvements to monitoring, evaluation, reporting, research and data management:

- The Council's efforts to standardize research, monitoring, evaluation, and data sharing should recognize that needs differ throughout the Columbia Basin. Forums often already exist to coordinate among management agencies. The Tribe suggests that the Council should not apply "one size fits all" strategies and instead focus on specific problem areas where coordination is currently lacking or has room for improvement.
- We recommend that monitoringmethods.org be discontinued. This process has not proven useful or cost-effective.

**19. Nez Perce Tribe, NPT (25) (submitted by David Johnson )**

- Section II D. Basinwide Provisions - Basinwide Strategies Monitoring, Evaluation, Research, and Reporting Strategies Page 24.
- Recommendation: The Council should report annually on progress towards achieving the Basin-Level Biological Objectives as presented in the Program. The reporting section of the Program (Section VII.E) should be expanded to include reporting high level indicators that represent the Program's basin-level biological objectives as reported in Section II.0 of the current Program. Add explicit measurable biological objectives to support the more general Program goals consistent with ISAB recommendations (ISAB 2013-1).
- Recommendation: BPA to fund full implementation of the Coordinated Assessments project to report on the indicators of natural origin spawners (NOR), smolt to adult return (SAR), adult to adult recruitment (AAR), and juveniles per spawner (JpS) for Columbia River salmon and steelhead populations.
- Recommendation: BPA shall fund expansion of the Coordinated Assessments project to include indicators for non-salmonid anadromous fish, resident fish and wildlife.
- Page 25.
- Recommendation: BPA to fund adequate data management projects with the agencies and tribes to support regional reporting requirements for evaluation of Program activities that are additional to the agencies' and tribes' routine data management activities. There are data specifically collected, managed, and analyzed due to the existence and operation of the FCRPS and its impact on fish and wildlife.
- Recommendation: BPA to fund adequate reporting at the Council level to provide annual, and periodic, reporting of Program actions and effectiveness which supports Program scale adaptive management
- Section V A. - Columbia River Estuary - Estuary Strategies, Page 32, Bullet 3. Revise wording to: "Evaluate salmon, steelhead and Pacific lamprey migration and survival rates in the lower Columbia River, the estuary, and the marine environment."

**20. Spokane Tribe of Indians, STI (26) (submitted by B.J. Kieffer )**

- **ANADROMOUS FISH PASSAGE** Spokane Tribe of Indians, *Council will include the following guidance language in the Program: ...[omitted text]... to the area above Grand Coulee Dams as the "blocked area."* The Spokane Tribe of Indians recommends reference to this area be changed to "Habitats above Grand Coulee Dams." Fish passage into their historic range will involve a phased approach and the Spokane Tribe of Indians recommends the following: ...[omitted text]... Phase V- Bonneville Power Administration will fund the monitor, evaluate, and adaptive management of the reintroduction efforts and will implement additional habitat and hydro-related infrastructure improvements as necessary.

- **MONITORING AND EVALUATION:** The Spokane Tribe of Indians recommends retention of measures in the Program that support annual wildlife monitoring and evaluation activities on lands that are acquired as partial mitigation for the construction and inundation losses for Grand Coulee Dam.
- BPA will continue to fund the Upper Columbia United Tribes Wildlife Monitoring and Evaluation Program (UWMEP). UWMEP assess the effectiveness of management activities on Tribal mitigation properties by comparing the habitat cover type on permanent sample sites to that on reference sites. The monitoring and evaluation requirements of approximately 70,000 acres of Tribal mitigation lands are completed under UWMEP. The UWMEP has garnered ISRP support for its existing scope as well as support for an expanded reach into the region.
- ***The Council will include in the Program the following Upper Columbia Ecoregional Monitoring and Evaluation language:***--The Upper Columbia Ecoregion requires a robust, well-funded monitoring and evaluation and data management programs to ensure that long-term anadromous, resident fish and wildlife projects are achieving the established biological benchmarks over time. The strategy relies on 1) adequate funding for long-term monitoring and evaluation elements; 2) proper linkages to data sharing and data management; and 3) investments in appropriate infrastructure.
  1. BPA will provide adequate funding for long-term based monitoring and evaluation elements- Funding should be available to provide the core programs and projects with the resources necessary to adaptively manage resources toward the achievement of biological outcomes. Consistent with funding allocation priorities and principles, project level monitoring and evaluation funding should be reasonably funded and not capped. It should be based on the needs of long-term biologically-based outcomes.
  2. BPA will fund data assimilation efforts within the Upper Columbia Ecoregion. Proper linkages to data sharing and data management must be established- Data sharing and data management has been elevated as an important topic to improve decision making relative to fish and wildlife within the Columbia River Basin. Several efforts have been initiated over the years focusing on consolidating data from the tribal, federal and state agencies.
  3. BPA will fund appropriate tribal infrastructure-  
The Upper Columbia managers do not have robust fish and wildlife information and technology (IT) support and most biologists are not well trained in database administration, function, or operations. Require BPA to bridge this gap by adequately funding improvements to the tribal technological infrastructure. This infrastructure will enable communication within both the ecoregional and regional (Columbia River Basin) data management infrastructure. --
- From table - Assess current status in the Spokane Arm and Columbia River adjacent to the Spokane Indian Reservation [about freshwater mussels]

**21. Upper Columbia United Tribes (27), UCUT (submitted by DR Michael ) \*\* Kootenai T.I. (24 supports these)**

Data Management -...[omitted text]... UCUT recommends maintaining quantitative benchmarks within the Fish and Wildlife Program and expanding them to include sustainable and useable abundance, distribution, and genetic viability objectives as interim quantitative performance objectives for Upper Columbia Basin populations and interim use of a UCUT report card to report on population performance relative to these objectives. In addition, the UCUT and the Upper Columbia Salmon Recovery Board are currently developing draft report cards that will reflect the progress toward protecting, mitigating, enhancing, and recovering focal species of fish and wildlife, including their habitats, within the provinces. The report cards will utilize established metrics in the project and recovery plans to reflect what has been accomplished historically and will describe future actions necessary to achieve the desirable biological outcomes consistent with subbasin plans. The UCUT propose the following approach to establish, maintain and operate an Upper Columbia Data Management Program:

Phase I- Provide adequate funding to UCUT toward continuing on-going data management initiatives (e.g., UWMEP) and the development of a data management Program for the Upper Columbia River Basin consistent with ISRP/ISAB and Council monitoring and evaluation recommendations as needed for some fisheries resources and for other wildlife resources and tools (e.g., Longterm Settlement Agreement/s for Wildlife Resources).

Phase II- The Upper Columbia Data Management Program will work with the UCUT, co-managers, and applicable stakeholders towards the collection, management, and dissemination of information and the production of the Upper Columbia Fish and Wildlife Report Card and publicly accessible database that connects with the Council's High Level Indicators.

Phase III- Utilizing the Upper Columbia Fish and Wildlife Report Card, UCUT will work with the member tribes, co-managers and applicable stakeholders in identifying and addressing limiting factors, environmental, and adaptive management changes necessary for accomplishing ongoing biological goals and objectives of the fish and wildlife managers.

Non-Native Species - The UCUT propose the following to be included in the new Program: „,[omitted text]... III. The UCUT recommends that the Council coordinate with organizations and programs that track and monitor data on existing non-native invasive species distribution throughout the Columbia Basin.

Emphasis should be on rapid response, prevention, containment, control, eradication, enforcement, education, and outreach, and may include participation in local, state, tribal, regional, national, and international efforts regarding invasive species. Public awareness of the threats that non-native invasive species pose to aquatic ecosystems and the native species therein is critical for curtailing the introduction and spread of new non-native species. Planning for future actions to prevent, control, and minimize non-native species' impacts to native species and their ecosystems should be a priority

Anadromous Fish Passage – ...[omitted text]... the UCUT continue to pursue the goal of re-establishing salmon and steelhead to habitats above Chief Joseph and Grand Coulee Dams. The Northwest Power and Conservation Council's Fish and Wildlife Program has referred to the areas above Chief Joseph and Grand Coulee Dams as "blocked areas." The UCUT recommend reference to these areas as "Habitats Above Chief Joseph and Grand Coulee Dams." Fish passage into their historic range will involve a phased approach and UCUT recommends the following ...[omitted text]... Phase IV-Monitor, evaluate, and adaptively manage the reintroduction efforts. Implement additional habitat and hydro-related infrastructure improvements as necessary

Toxics Reduction ...[omitted text]... The Council shall assess whether hydropower projects exacerbate any problems associated with the migration or effects of toxic substances; if any such correlation exists, the Council shall assess whether operational changes or other activities could help mitigate these impacts

Wildlife Mitigation..[omitted text]... Monitor habitat changes and management using UWMEP methods and protocols as described under the UCUT Data Management recommendations, and other ISRP endorsed methods and protocols as an inherent part of these recommendations

## **22. Upper Snake River Tribes Foundation, USRTF (28) (submitted by Heather Ray)**

- USRT supports the fish and wildlife recommendations as developed and compiled by the Columbia River Fish and Wildlife Manager's and contained in the attached Reference Document of 2014 Fish and Wildlife Program Amendment Recommendations:
  - Relevant Extracts from the Reference Document of 2014 Fish and Wildlife Program Amendment Recommendations)
    - Expand anadromous goals to the Subbasin and Province levels and add specific and measurable objectives for resident fish and wildlife to support high level indicators.
    - The Council should report annually on progress towards achieving the Basin-Level Biological Objectives as presented in the Program. The reporting section of the Program (Section VII.E) should be expanded to include reporting high level indicators that represent the Program's basin-level biological objectives as reported in Section II.C of the current Program.
    - Add explicit measurable biological objectives to support the more general Program goals consistent with ISAB recommendations (ISAB 2013-1). Also refer to Section 5 of this document,

Species Focused Recommendations. These should integrate with the current Council high level indicators and would clarify how to report against current biological objectives:

- Halt declining trends in salmon and steelhead populations ; □□ Graph trends in representative populations' abundance over time and determine whether populations are increasing, decreasing, or stable
- Increase total runs that support tribal and non-tribal harvest ; □□ Report abundance of fish runs annually , □□ Report tribal and non-tribal harvest in all fisheries annually
- Achieve 5 million fish above Bonneville dam and 75 percent of recovery goals for LCR ESUs by 2025 ; □□ Report annually total abundance by ESU for salmon and steelhead populations including harvest and other mortality
- Achieve SARs of 2-6% with an average of 4% for Snake River and Upper Columbia River populations ; □□ Report annually appropriate dam to dam SARs for representative populations to determine if cumulative hydrosystem actions are achieving the targeted level of survival ;
- Restore the widest set of salmon and steelhead populations in each province ; □ Report population status by province including reintroduction goals
  - o Restore lamprey, sturgeon and eulachon ; □ Create a monitoring framework and report status of lamprey, sturgeon, and eulachon across the Columbia River Basin on a regular basis
  - o Restore lamprey production, passage and habitat ; Report passage counts at dams annually and map lamprey distribution every 5 years

- Rationale: The current Program, on page 11, calls for a process to assess the value of these goals. This should be implemented as called for. The Program should restate the call to assess the value of quantitative biological objectives and to develop an updated and scientifically rigorous set of such quantitative objectives. Reviewing and refining the adult fish return and SAR goals is appropriate to assure that these are correctly scaled to evaluate the Program. Measureable objectives provide:

- Quantitative targets to support the Program vision, moving the program from the abstract to the concrete;
- A method to track program progress (a report card); and
- A measure of improvement needed in the program.

- The above actions and metrics along with importance, feasibility, and cost components, help inform future funding priorities to achieve specific goals. This contributes to policy discussions to prioritize funding to achieve specific goals. It is currently possible to report progress against the basin-level biological objectives that are stated in the Program. Establishing a consistent, transparent, reliable report using metrics to demonstrate progress of Program implementation is required to support true adaptive management at the basin-wide scale. The data currently exists to report against the objectives; however, the data management capacity and practices are not in place to support efficient, cost effective reporting.

- **2.3 Coordinated Assessments Monitoring and Reporting** Current Program: Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies

- Measure 1: The Council should adopt and BPA should fund full implementation of the Coordinated Assessments project to **report** on the indicators of natural origin spawners (NOR), smolt to adult return (SAR), adult to adult recruitment (AAR), and juveniles per spawner (JpS) for Columbia River salmon and steelhead populations.

- Measure 2: BPA should fund expansion of the Coordinated Assessments project to include indicators for resident fish and wildlife.

- Rationale: Approximately 78 million dollars are spent annually on anadromous monitoring in the Columbia Basin. This information is used to determine a population status and trend, effectiveness of habitat restoration, and for many other purposes. A variety of anadromous population data has been collected across various life stages and is reported by individual project sponsors in their annual reports. While this reporting is valuable at the project reporting scale, it is difficult to synthesize for reporting at the larger geographic scales such as the population, subbasin, province, major population, DPS/ESU, or Columbia Basin scales. In addition, there are many possible indicators that could be used for reporting. In 2010, fisheries agencies and tribes started

the Coordinated Assessments (CA) project to standardize indicators for reporting across spatial scales and a data exchange standard to facilitate the associated data sharing. This was followed up with a pilot project that successfully demonstrated the proof of concept for this project. The CA project has now moved to the implementation phase, which includes modifying and developing new agency databases for storing raw and summarized data, analysis tools, and reporting databases. The agreed upon CA indicators track specific life stage survival and/or abundance of salmon and steelhead to provide the information needed for adaptive management process in the Columbia Basin and provide the necessary data for the FCRPS BiOP. These are the key indicators used for population status and trend analysis and for NOAA to determine population status under the ESA. The Program should continue to support this successful effort and expand the CA process to develop data sharing standards for resident fish and wildlife data.

- **2.4 Data Management** Current Program: Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies

- Measure 1: BPA should fund adequate data management projects with the agencies and tribes to support regional reporting requirements for evaluation of Program activities that are additional to the agencies' and tribes' routine data management activities. There are data specifically collected, managed, and analyzed due to the existence and operation of the FCRPS and its impact on fish and wildlife.

- Measure 2: BPA should fund adequate reporting at the Council level to provide annual, and periodic, reporting of Program actions and effectiveness which supports Program scale adaptive management.

- Rationale: The Council, tribal, state and federal natural resource managers agree that an information feedback process is required to inform management decisions about the use of fish and wildlife resources. Often this feedback process is characterized as "Adaptive Management," but this activity has not been funded or implemented.

- A clear set of measurable biological objectives at various scales within the Program (high level indicators) could provide a top-down monitoring framework with which to guide data management infrastructure. A plan and process for reporting against those objectives could serve as an adaptive management tool for evaluating success of strategies and actions within the Program at each level.

- A critical part of an adaptive management process is the collection, storage and analysis, and presentation of information about natural resources in a way that is useful to decision makers. Yet this critical activity has received little recognition and even less support in the Fish and Wildlife Program. The following actions are needed to rectify this oversight:

- Restructure and simplify the Program to provide Goals, Measurable Objectives, Strategies and Measures at the Basinwide, Province and Subbasin scale. All measures should be linked back to specific measurable objectives. The goals and objectives should then guide the development of a data management framework to support specific annual, bi-annual, and five year reporting requirements;
- Use a Regional Coordination forum including BPA, Council, tribal, state, and federal resource managers, and data management leaders to develop and review regional restoration progress reports, discuss options to improve reporting, and provide policy guidance for data management efforts;
- Use the StreamNet and Pacific Northwest Aquatic Monitoring Partnership (PNAMP) forums for development of the technical issues and tools necessary for coordinated data management. Extend this forum over time to include wildlife and terrestrial habitat data and other key sources of fish and wildlife related data sources (especially the Corps and LSRCP, but others such as the USFS, BLM, BOR, NRCs, etc.);
- Use the updated F&W Program as the starting point for developing a coordinated data management system based on explicit reporting requirements adopted by the Council.
- Expand the Coordinated Assessment Project effort (under StreamNet and PNAMP) to develop data standards and sharing processes for derived data to support ESA and Fish and Wildlife Program reporting needs;
- Incorporate concepts consistent with the Council staff Draft Guidance for Information Management, Evaluation and Reporting; and
- Incorporate concepts consistent with the Council staff Draft Guidance for a Balanced and Coordinated Approach for Conducting Monitoring and Research Activities.



- **2.5 Hatchery Effectiveness Monitoring** Current Program: Pages 18-19, Artificial Production Strategies, and Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
- Measure: The Council should adopt and BPA should fund hatchery effectiveness monitoring and reporting for Columbia Basin hatcheries.
- Recommendation: Insert a new bullet under *Artificial Production Strategies* (page 19), or under *Reporting and Data Management* (page 25) as follows: ***“Hatchery Effectiveness Monitoring: The minimum reporting indicators for successful hatcheries to meet the Council’s Artificial Production Review are: 1) the number of juveniles released by life stage, and 2) the components of total adult hatchery production, which include the number of hatchery adults returning to the hatchery, spawning in rivers, and caught in fisheries. These indicators can be used to assess the conservation and/or harvest benefits common of all hatchery programs. In addition to compiling this information for reporting, we also recommend a reporting database for these hatchery indicators be developed and funded to allow tracking of hatchery performance.”***
- Rationale: Currently, approximately 26 million dollars are spent annually on hatcheries in the Columbia Basin to mitigate for losses cause by the FCRPS and it is important for the Council to track the effectiveness of hatchery programs. Hatcheries and individual hatchery programs in the Columbia River have been reviewed by NOAA through the Columbia Basin Hatchery Environmental Impact Statement and Hatchery Genetic Management Plans, the Hatchery Science Review Group, and Independent Science Review Panel. In addition, the Council has developed an Artificial Production Review (ARP) Process (NPCC 1999). The NPCC (2004) judged a hatchery program to be successful if it met the following conditions: 1) it must produce a healthy and viable hatchery population; 2) it must make a sustainable contribution of adult returns to conservation and/or harvest; 2) its potential effects on wild and native populations and the environment must be understood, and 4) it must collect, record, evaluate, and disseminate information pertaining to the first three conditions so that decision-makers may be informed about the benefits and risks of the program relative to other means of achieving similar conservation and harvest goals. While it is the responsibility of hatchery operators and funders to develop specific hatchery goals, the purpose of this amendment is to develop interim indicators that provide measures hatchery performance for the Council’s role in hatchery oversight and to meet its reporting requirements. The minimum reporting indicators for successful hatcheries are 1) the number of juveniles released by life stage, and 2) the components of total adult hatchery production, which include the number of hatchery adults returning to the hatchery, spawning in rivers, and caught in fisheries as these can be used to assess the conservation and harvest benefits of all hatchery programs. In addition, to compiling this information in a report (see Roler 2012 for an example of total adult production report), we recommend a reporting database for these hatchery indicators be funded possibly through StreamNet.
- **3.3 Adequately Fund Wildlife M&E** , Current Program: Pages 20-22, Wildlife Strategies, and Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
- Measure: BPA shall fund adequate monitoring, data management, and reporting to answer the following questions in an annual report to Council and the region - How many habitat units have been mitigated for FCRPS construction and inundation caused losses of wildlife? How many of those habitat units are secured through long term funding? How are wildlife species and habitats responding to FCRPS mitigation actions? What is the FCRPS mitigation responsibility for wildlife operational impacts?
- Recommendation: The Council, through their Wildlife Advisory Committee, should identify and support specific reporting requirements for wildlife and wildlife projects for the Program. Rationale: It is appropriate for BPA to fund research, monitoring and evaluation of wildlife mitigation projects adequately to assure tracking of crediting, to evaluate trends in ecological functions of managed ecosystems, and provide managers the ability to assess the effectiveness of their mitigation strategies by evaluating species and habitat responses that contributes to broader monitoring efforts. BPA should continue funding HEP surveys on acquired land in support of the Wildlife Advisory Committee to track mitigation implementation progress.
- Recommendation: A programmatic evaluation of the Wildlife Section of the Program should occur preceding Program amendments, to determine whether wildlife measures are moving the Program towards its biological objectives for performance. Rationale: Reporting high level indicators for wildlife, at the scale of the Columbia River Basin, is a daunting challenge. The impact of the BPA funded wildlife mitigation projects,

while significant, may not be detectable within the environmental noise of such a large landscape. Individual wildlife populations are generally highly migratory, and trends in population size is not an appropriate indicator of Program success as species ranges are far greater than the individual project areas, and in many cases far greater the Columbia River Basin. Habitat quantity and quality is the currency for implementation of the BPA funded wildlife mitigation program and should be taken into account when developing HLIs for areas within the Program influence...[omitted text].... Following the Wildlife Crediting Forum, the co-managers developed a working draft for a reporting framework called the Wildlife Monitoring Implementation Strategy based on three categories of HLIs as determined by the Council. Further work is required to fully develop a reporting mechanism for the Council's needs. The Council identified the following three categories of HLIs:

- 1) Habitat and Vegetation Types – several metrics would be reported for each cover type that represents status and trend in quality and quantity of the cover type, which can infer benefits to focal species or guilds. While this data is collected by individual wildlife projects within the Program, compilation and reporting will be required at a scale larger than any individual project. Reporting this information would require a designated project to perform the summary, analysis and reporting necessary to provide useful and timely indicators for Council reports.
- 2) Focal Species – several national/state level data sets could be used to represent relative status of wildlife species in this area. This level of data would be retrieved from national or state databases, and not from the individual projects; however, most of the data is initiated at the project level. Reporting this information would require a designated project to perform the summary, analysis and reporting necessary to provide useful and timely indicators for Council reports.
- 3) Habitat Units – the BPA HU ledger would continue to be reported as a measure of mitigation actions implemented specific to the Fish and Wildlife Program.

- The recent completion of the Wildlife Crediting Forum has provided a clean slate for reporting HUs at the project scale, a project may be needed to provide the high level summary of this information similar to the CBFWA Status of the Resource Report and website. In developing the Wildlife Monitoring Implementation Strategy (WMIS), wildlife managers considered the following concepts:

- Scale integration: data collected can be used at multiple scales of interest for decisions
- Integration across separate monitoring programs: information gathered serves multiple functions and thus reduces costs
- Integration of policy and technical domains: precision of data fits time frames and acceptable risks for decisions
- Species integration: collection of data for multiple species in an efficient manner
- Adequate sample size: sample sizes are statistically adequate to discern differences among populations, across spatial distributions, and across temporal scales relative to varying human-induced and natural environmental stressors

- Based on this effort, the wildlife managers are prepared to engage with the Council and BPA to develop biological and environmental performance objectives for the wildlife portion of the Program and establish an annual and five-year reporting process for evaluating implementation success.
- Resident fish substitution for anadromous fish losses, Current Program: Page 23-24, Resident Fish Substitution Strategies , Rationale: A wide cross section of resident fish substitution projects, particularly in the basins where passage of anadromous adults and juveniles is currently blocked by Federal Columbia River Power System (FCRPS) projects, have been implemented over time without a standard definition of program goals or a methodology for converting anadromous fish losses to resident fish substitution goals where in-kind mitigation projects are not currently possible to implement. Giving clearer Council guidance for these types of efforts seems timely, as these mitigation requirements of BPA have not yet been uniformly and systematically addressed. ...[ omitted text] .. While these various types of mitigation programs have merit and may be suitable for a wide variety of geographic areas and environmental conditions, without a common currency for evaluating the extent of a program and establishing program goals and objectives that adequately address the value of anadromous fish that were lost due to the effects of construction and operation of the FCRPS that created the passage blockages initially, full and equitable mitigation for these losses will remain difficult to define
  - White sturgeon .. [ omitted text ] ... *Monitor and evaluate mitigative white sturgeon restoration actions, and population responses to environmental condition consistent with the Columbia Basin White Sturgeon Planning Framework.*”

- Eulachon ..[omitted text]... Monitor and evaluate eulachon abundance in the Columbia River via annual spawning stock biomass surveys following protocols developed by the Washington Department of Fish and Wildlife and acoustic estimates by NOAA - NWFSC. Monitor and evaluate the causal mechanisms and migration/behavior characteristics affecting survival of larval eulachon during their first weeks in the Columbia River estuary, plume, and ocean environments. Monitor and evaluate the ecological importance of the tidal freshwater, estuary, plume, and nearshore ocean environments to the viability and recovery of eulachon in the Columbia River Basin. Develop an oceanographic indicators ecosystem conditions model to determine the significance of plume and nearshore ocean conditions that affect eulachon survival.

- **7.1 Fully Incorporate Estuary, Plume and Nearshore Ocean in Program** Current Program: various sections, Measure 4: Explore and implement adaptive management experiments to improve survival of anadromous fish. Rationale: The Council has been interested for some time in ways in which managers can use the results of the ocean research to change/alter freshwater habitat and production management to improve overall survival. It has been suggested that there may be applications such as changing the timing of hatchery releases or changing migration methods (transport and in-river) to take advantage of optimal plume or ocean conditions and subsequently, to improve survival for these fish. Presently hatchery fish release timing is set by hatchery managers that are considering water temperature, readiness of the fish to migrate and to take advantage of in river flow. It is unclear, however, if potential management strategies are realistic or practical and if the potential survival benefits would outweigh other risks. Further discussions are warranted between researchers and freshwater fisheries and hatchery managers to explore the practical potential of these concepts. There are specific experiments that can be conducted using individual hatcheries that are already investigating variable release timing. Stock-specific information about growth and survival in the ocean should be better linked to stock management in the freshwater.

- **7.1 Fully Incorporate Estuary, Plume and Nearshore Ocean in Program** Current Program: various sections Measure 5: Continue to research direct and indirect effects of anthropogenic freshwater management on marine ecological attributes affecting anadromous fish habitat, life histories and productivity.

Rationale: Management of the Columbia River Basin hydropower system directly affects the ocean environment by changes in the natural hydrograph and ecological processes caused by development and operation of the hydro-system, and through changes to the estuary and plume habitats due to the timing, quantity and quality of river flows. There is much more to be learned about how to improve conditions and thus survival for anadromous fish in the estuary and plume.

Measure 6: The Program should address the uncertainty regarding the effectiveness of estuarine restoration projects and different types of habitat and whether they contribute to increased juvenile survival and hence increased adult returns.

Rationale: The primary critical uncertainty regarding estuarine restoration projects and different types of habitat is whether they contribute to increased juvenile survival and hence increased adult returns. Good estimates of residence time in rearing habitat, and the quantity and quality of the habitat that will likely influence survival, are generally lacking. Also, how fish move between rearing habitats and the importance of habitat connectivity and spatial distribution are poorly understood. Along these lines, a general understanding of the quantity of available habitat, quality of fish habitat, how fish use them, and how they are distributed throughout the migration and rearing reaches of the Lower Columbia River and estuary are not well known. Another critical uncertainty is to identify status and trends of the ecosystem processes in the lower Columbia River and estuary to better understand the ecosystems processes and the effects on restoration and mitigation efforts.

Measure 7: Research is needed on forage fish in the lower estuary and nearshore area. The Fish and Wildlife Program should promote projects on forage fish in the lower estuary and nearshore area through the following measures:

Identify spawning and rearing life history attributes of forage fish in the estuary

Determine the role of forage fish as alternate prey for birds in the lower estuary

Elucidate the role eulachon may have as an alternative prey for sea lions

Determine how restoration projects in the estuary may contribute to reproductive success and rearing of forage fish

Identify the relation between Columbia River flow and forage fish abundance in the estuary

Identify role forage fish have in survival of juvenile Chinook salmon, coho, and steelhead

Determine how climate change, ocean acidification, salinity, estuary turbidity maximum (ETM), and localized hypoxia are likely to affect forage fish in the coming decades

- Rationale: The proposed amendment will update the Program to reflect a move toward ecosystem management approach to provide salmon with their total life cycle needs including an adequate food web to support growth and improve survival. Forage fish in the lower estuary include a broad group of species including surf smelt, Pacific sand lance, Pacific herring, eulachon, and juvenile American shad. These species have diverse reproductive strategies but all species can occur in the lower estuary during their life histories. For example, surf smelt and Pacific sand lance may use beaches for spawning while Pacific herring may spawn on nearshore macro-algae. Eulachon and American shad are anadromous and can produce large numbers of juveniles that disperse downstream and enter the estuary. The Fish and Wildlife Program places an emphasis on salmon restoration and forage fish are a major link between habitat and environmental conditions and the survival of salmon.
- **7.2 Reduce Toxic Contaminants** Current Program: Page 42-44, Water Quality , Measure 1: BPA should fund a programmatic review and assessment of how hydropower projects exacerbate any problems associated with the effects of toxic substances and if any such correlation exists, the Council shall identify opportunities for operational changes or other activities to help mitigate these impacts and reduce toxic contamination. Determine how seasonal anoxia in dam reservoirs controls the release of toxics and other pollutants from the sediments to the water column and how the uptake and transfer of these toxics and pollutants transfer up the food web and negatively impact fish. Evaluate how environmental toxicants impact the reproductive fitness of fish that are impounded behind dams.

Rationale: ...[omitted text]...a research focus that addresses the following items will better inform resource managers and facilitate future amelioration opportunities:

- Levels of mercury and variation in bio-indicator taxa across reservoirs in the Columbia River Basin.
- Influence of seasonal drawdown and flood-up patterns on methylmercury cycling and bioaccumulation in Columbia River Basin reservoirs.
- Influence of lake stratification, dissolved oxygen, and primary production on mercury cycling and bioaccumulation in Columbia River Basin reservoirs.
- The influence of fish growth, condition, and energetics on mercury bioaccumulation rates and fish mercury concentrations in Columbia River Basin reservoirs.
- The influence of food quality and energy content on mercury bioaccumulation rates and fish mercury concentrations in Columbia River Basin reservoirs.
- The role that variation in littoral versus pelagic foraging reliance plays in driving mercury bioaccumulation pathways in Columbia River Basin reservoirs.
- The influence of prey/forage fish community structure and species assemblages on mercury exposure in top predator fishes in Columbia River Basin reservoirs.
- Biochemical, behavioral, and reproductive effects of mercury in fishes and aquatic dependent wildlife in Columbia River Basin reservoirs.

**7.2 Reduce Toxic Contaminants** Current Program: Page 42-44, Water Quality , Measure 3: Fund studies to determine which toxic contaminants most limit the restoration success of anadromous and resident fish and in particular determine how contaminants interfere with the reproduction and/or rearing success of key species such as white sturgeon and Pacific lamprey that are known to be vulnerable to bioaccumulation of toxins. The footprint of existing contamination and the location of known toxic discharges should be mapped in relationship to fish and wildlife populations and habitat restoration efforts and monitored as part of a basin-wide monitoring program. Assess foodweb transfer, sediment transport, and biological effects of emerging and legacy organic contaminants under current management regimes, and how those processes affect key Columbia River species and the success of restoration projects within the basin.

Rationale: Various stressors threaten native fishes and other wildlife in the Columbia River basin. Urbanized large aquatic ecosystems are experiencing increasing contamination of water and sediment and ultimately foodwebs. Contaminants of concern include both legacy compounds such as DDT and PCBs that are still present in the system, as well as chemicals of emerging concern (CECs) such as pharmaceuticals and personal care products. Use and release into the environment of CECs is increasing, although little is known about their harmful levels and effects. Several interdisciplinary studies have been carried out in recent years to assess impacts of different classes of contaminants in several levels of the foodweb in the Columbia River.

The USGS Columbia River Contaminants and Habitat Characterization (ConHab) project investigated transport pathways, chemical fate and effects of endocrine disrupting chemicals in the foodweb in the lower Columbia River and found that bio-magnification of multiple contaminants occurred in resident fish and osprey eggs, environmental

quality benchmarks were exceeded in some cases, and reproductive parameters showed impairment at some sites and were significantly negatively correlated with various contaminant concentrations (Nilsen et al., in press; Nilsen and Morace, in press). In some species of vertebrates, these chemicals alter thyroid function, reduce sperm counts, and delay sperm maturation (Kuriyama et al., 2005) among other impacts. NOAA researchers found from studies on juvenile chinook salmon that exposure to urban contaminants was linked to an increase in disease susceptibility (Arkoosh et al., 1998). Better understanding of these effects on key first foods species is needed.

Critical uncertainties in understanding impacts of contaminants on key species and foodwebs in the Columbia River basin include:

- Chemicals of emerging concern (CECs) levels of concern to the health of key species including Pacific lamprey, white sturgeon, and salmonids.
- Impacts of CECs on the carrying capacity of the Columbia River ecosystem for juvenile salmonids and other key species.
- Impacts of contamination on habitat restoration success: Contaminants of concern should be assessed and monitored as part of current and future river restoration programs.
- Role of contamination in reduced rearing success of white sturgeon in impounded pools: Impacts of contaminants on sturgeon reproduction and rearing success within areas of known high productivity. Comparison of potential contaminant impacts on impounded versus unimpounded populations.
- Role of contamination on Pacific lamprey declines compared to threats from hydropower operations, such as dam passage. Assess levels of concern and effects of chemical mixtures.
- Investigate impacts of different hydrologic scenarios and management actions on contaminant distributions and foodweb transfer.
- Distributions, levels, and spatial patterns of contaminants of emerging concern (CECs) in the Columbia River basin including the estuary and coastal ocean.
- Impacts of contamination from abandoned vessels: Abandoned vessels should be inventoried and mapped in relation to potential impacts to aquatic species.

**7.2 Reduce Toxic Contaminants** Current Program: Page 42-44, Water Quality , Measure 4: Investigate the cumulative and/or synergistic effects of multiple toxic contaminants particularly pesticides on riparian insects and other organisms that impact the carrying capacity of the Columbia River ecosystem. Rationale: Mixtures of organophosphate and carbamate pesticides are commonly detected in fresh water habitat that supports key species of interest to the Fish and Wildlife program. These pesticides interfere with behaviors that are essential for salmon survival. Some pesticides interact to produce synergistic toxicity in salmon (Laetz et al., 2009) and showed greater degree of synergism at higher exposure concentrations. Several combinations of organophosphates were lethal at concentrations that were sublethal in single-chemical trials. Single chemical risk assessments are likely to underestimate the impacts of insecticides in river systems where mixtures occur.

**7.4 Implement Predator Control** Current Program: Page 52, Piscivorous predator control

The Program should strive to measure the effects of predation and express them in common terms such as salmon adult equivalents to facilitate comparison and evaluation against other limiting factors. Predator evaluations should include salmon adult equivalent metrics in their reports.

Measure 1: BPA should continue to implement annually the base piscivorous predator-control program and expand northern pikeminnow (*Ptychocheilus oregonensis*) removals to other mainstem dams in the lower Columbia River ie, expand program to include northern pikeminnow removals at McNary and Bonneville dams. The action agencies should evaluate the effectiveness of focused pikeminnow removals for these expanded efforts and implement as warranted.

**7.4 Implement Predator Control** Current Program: Page 52, Measure 2: [omitted text]..Rationale [ omitted text] ... The Program should support, and BPA should fund, additional research into the overall magnitude of the impacts of non-native predators including abundance, diel and temporal distributions, and food web interactions in order to help guide improved management of non-natives.

**7.4 Implement Predator Control** Current Program: Page 52-53, Pinniped predator control , Measure: Identify opportunities to reduce fish losses through pinniped predator management. Recommendation: Program language should be added to establish funding responsibility:

*“The Corps [or Bonneville] should fund federal, tribal and state agencies to evaluate the extent of pinniped predation on salmonids, sturgeon, and Pacific lamprey in the lower Columbia River from Bonneville Dam to the mouth of the river. The Corps should take action to improve the exclusion of sea lions at all main adult fish ladder entrances and locks at Bonneville Dam.”*

## **Federal F&W Agencies/Other Federal agencies**

### **23. National Oceanic and Atmospheric Administration, NOAA-F (30) (submitted by Elizabeth Gaar )**

Monitoring, Evaluation, Research, and Reporting Strategies:

- Update the Anadromous Salmonid Monitoring Strategies (ASMS): In 2010 the Council collaborated with the management agencies and tribes to develop monitoring strategies for each of the basin's listed salmon and steelhead populations. Since then, the Program and co-managers have been implementing the ASMS. An updated inventory of monitoring activities should be conducted to assess remaining gaps in implementing the ASMS. Additionally, the ASMS may need to be updated based on lessons learned, logistical constraints, impacts to the species, and fiscal realities.
- NOAA supports the ISAB's Program Review recommendations for monitoring strategies (see reference section at end of document)
- Life Cycle Context: The Council should support continued research and life cycle modeling to inform decision makers of the biological benefits they could expect from implementing or synchronizing different suites of actions across the life cycle. • Lifecycle modeling will help decision-makers understand potential survival outcomes under different sets of assumptions regarding future ocean and climate conditions.
- Artificial Production: The Council should identify and prioritize research, monitoring and evaluation to address knowledge gaps that contribute to policy disagreements about the effect of artificial propagation on the viability of listed species. • The Council should support the testing of different goals, strategies and practices for artificial propagation across the basin.
- Harvest: Additional research is needed on catch-and-release mortality to supplement the information we have and to address questions from tribes and other stakeholders.
- Harvest , page 19: Revises Monitoring and Reporting strategy (fourth bullet) to add the need to define objectives for the monitoring program. Also, delete language that calls for automatic expansion of monitoring to reduce critical uncertainties. Replace it with language that compels us to first determine the objectives for addressing the key information need, then determine how much and where monitoring is needed.
- Monitoring, Evaluation, Research and Reporting Strategies , page 24 Recommendation 1: Implement Research, Monitoring, and Evaluation at a Regional Scale and coordinate it with other programs
- Monitoring, Evaluation, Research and Reporting Strategies , page 24 Recommendation 2: Follow through on the intent in the 2009 Program to update the research plan. This should begin with a process that identifies key management questions and objectives. Address ISAB recommendations in its 2009 Program review on threats to sustainability and knowledge gaps. Rationale: The research plan is seriously outdated. Our key management questions have evolved as the threats to sustainability have emerged. We need to ensure that research is targeted to respond to priority management questions. The rationale is well overviewed in the ISAB's Program review, particularly in Section II, where they describe threats to sustainability and knowledge gaps.
- Monitoring, Evaluation, Research and Reporting Strategies , page 24 Recommendation 3: Add a strategy for coordinated assessments monitoring and reporting Measure 1: The Council should adopt the Coordinated Assessments project to report on the indicators of natural origin spawners (NOR), smolt to adult return (SAR), adult to adult recruitment (AAR), and juveniles per spawner (JpS) for Columbia River salmon and steelhead populations. Rationale:
- Data Management , pages 24-26 Current Program: Pages 24-26, Monitoring, Evaluation, Research, and Reporting Strategies
  - Measure 1: Implement adequate data management projects with the agencies and tribes to support regional reporting requirements for evaluation of Program activities that are additional to the agencies' and tribes' routine data management activities. There are data specifically collected, managed, and analyzed due to the existence and operation of the FCRPS and its impact on fish and wildlife.

- Measure 2: Implement adequate reporting at the Council level to provide annual, and periodic, reporting of Program actions and effectiveness which supports Program scale adaptive management.
- Rationale: The Council, tribal, state and federal natural resource managers agree that an information feedback process is required to inform management decisions about the use of fish and wildlife resources. Often this feedback process is characterized as “Adaptive Management,” but this activity has not been funded or implemented. A clear set of measurable biological objectives at various scales within the Program (high level indicators) could provide a top-down monitoring framework with which to guide data management infrastructure. A plan and process for reporting against those objectives could serve as an adaptive management tool for evaluating success of strategies and actions within the Program at each level. A critical part of an adaptive management process is the collection, storage and analysis, and presentation of information about natural resources in a way that is useful to decision makers. Yet this critical activity has received little recognition and even less support in the Fish and Wildlife Program. The following actions are needed to rectify this oversight:
  - Restructure and simplify the Program to provide Goals, Measurable Objectives, Strategies and Measures at the Basinwide, Province and Subbasin scale. All measures should be linked back to specific measurable objectives. The goals and objectives should then guide the development of a data management framework to support specific annual, bi-annual, and five year reporting requirements;
  - Use a Regional Coordination forum including BPA, Council, tribal, state, and federal resource managers, and data management leaders to develop and review regional restoration progress reports, discuss options to improve reporting, and provide policy guidance for data management efforts;
  - Use the StreamNet and Pacific Northwest Aquatic Monitoring Partnership (PNAMP) forums for development of the technical issues and tools necessary for coordinated data management. Extend this forum over time to include wildlife and terrestrial habitat data and other key sources of fish and wildlife related data sources (especially the Corps and LSRCP, but others such as the USFS, BLM, BOR, NRCPS, etc.);
  - Use the updated Program as the starting point for developing a coordinated data management system based on explicit reporting requirements adopted by the Council.
  - Expand the Coordinated Assessment Project effort (under StreamNet and PNAMP) to develop data standards and sharing processes for derived data to support ESA and Fish and Wildlife Program reporting needs;
  - Incorporate concepts consistent with the Council staff Draft Guidance for Information Management, Evaluation and Reporting; and
  - Incorporate concepts consistent with the Council staff Draft Guidance for a Balanced and Coordinated Approach for Conducting Monitoring and Research Activities
- Toxics , pages 42-44 Current Program: Page 42-44, Water Quality
  - Both the Independent Scientific Advisory Board (2013) and the Independent Scientific Review Panel (2013) recommend that the Program take a more active role in ensuring that toxic contamination associated with FCRPS be addressed
  - Recommendation: Insert the following language into the Fish and Wildlife Program that recognizes fishery resources are clearly affected by toxics that have accumulated due to the development and operation of the federal hydropower system: “Fishery resources are clearly affected by the development and operation of the federal hydropower system. Dam presence can be associated with the accumulation of contaminated sediment (Colas et al., 2013) and the presence of reservoirs and their operations can be a controlling factor on the chemical conditions such as anoxia which impact the distribution and bioavailability of toxics in the system. An example of a specific impact caused by the dams is to sturgeon; once anadromous, sturgeon are now blocked in reservoirs and subjected to contaminants year-around at contaminant levels exacerbated by the reservoirs.”
  - Measure 1: Coordinate with other federal agencies and co managers on a programmatic review and assessment of how hydropower projects exacerbate any problems associated with the effects of toxic substances and if any such correlation exists, the Council should identify opportunities for operational changes or other activities to help mitigate these impacts and reduce toxic contamination. Determine how seasonal anoxia in dam reservoirs controls the release of toxics and other pollutants from the sediments to the water column and how the uptake and transfer of these toxics and pollutants transfer up the food web and negatively impact fish. Evaluate how environmental toxicants impact the reproductive fitness of fish that are impounded behind dams
- Rationale ... [omitted text] ... The ecological risk of mercury toxicity is directly related to the production of the bio-accumulative and toxic organic form, methyl mercury, which is driven by specific biogeochemical parameters. Importantly, many of those parameters are directly linked to factors associated with water management activities such as water inundation and wetting and drying cycles, organic carbon and nutrient cycling and inputs from upland terrestrial habitats. Reservoirs are among the most common managed hydrological features on the western landscape with a high likelihood for enhancing methyl mercury

production, transport, bioaccumulation, and risk to fish, wildlife, and human health. Thus, a better understanding of linkages between reservoir management and mercury risk is needed in order to develop approaches to minimize the environmental risks due to mercury while still meeting critical water needs in the Columbia River Basin. Although it is generally well documented that mercury concentrations in some organisms in aquatic ecosystems and reservoirs of the Columbia River Basin exceed those considered safe for ecosystem and human health, little is still known about which factors are most important in driving variation in mercury concentrations among reservoirs, and what management options present the most effective opportunities for controlling mercury risk. Therefore, a research focus that addresses the following items will better inform resource managers and facilitate future amelioration opportunities (i) Levels of mercury and variation in bio-indicator taxa across reservoirs in the Columbia River Basin. (ii) Influence of seasonal drawdown and flood-up patterns on methyl mercury cycling and bioaccumulation in Columbia River Basin reservoirs. (iii) •Influence of lake stratification, dissolved oxygen, and primary production on mercury cycling and bioaccumulation in Columbia River Basin reservoirs. (iv) •The influence of fish growth, condition, and energetics on mercury bioaccumulation rates and fish mercury concentrations in Columbia River Basin reservoirs. (v) •The influence of food quality and energy content on mercury bioaccumulation rates and fish mercury concentrations in Columbia River Basin reservoirs. (vi) • The role that variation in littoral versus pelagic foraging reliance plays in driving mercury bioaccumulation pathways in Columbia River Basin reservoirs. (vii) • The influence of prey/forage fish community structure and species assemblages on mercury exposure in top predator fishes in Columbia River Basin reservoirs. (viii) • Biochemical, behavioral, and reproductive effects of mercury in fishes and aquatic dependent wildlife in Columbia River Basin reservoirs.

- New research is needed to better understand how water quality improvements will enhance aquatic community diversity and abundance, as well as prey quality. Critical uncertainties in understanding impacts of contaminants on key species and foodwebs in the Columbia River basin include:
  - Chemicals of emerging concern (CECs) levels of concern to the health of key species including Pacific lamprey, white sturgeon, and salmonids.
  - Impacts of CECs on the carrying capacity of the Columbia River ecosystem for juvenile salmonids and other key species.
  - Impacts of contamination on habitat restoration success: Contaminants of concern should be assessed and monitored as part of current and future river restoration programs.
  - Role of contamination in reduced rearing success of white sturgeon in impounded pools: Impacts of contaminants on sturgeon reproduction and rearing success within areas of known high productivity. Comparison of potential contaminant impacts on impounded versus unimpounded populations.
  - Role of contamination on Pacific lamprey declines compared to threats from hydropower operations, such as dam passage. Assess levels of concern and effects of chemical mixtures.
  - Investigate impacts of different hydrologic scenarios and management actions on contaminant distributions and foodweb transfer.
  - Distributions, levels, and spatial patterns of contaminants of emerging concern (CECs) in the Columbia River basin including the estuary and coastal ocean.
  - Impacts of contamination from abandoned vessels: Abandoned vessels should be inventoried and mapped in relation to potential impacts to aquatic species
- Ocean page 31
  - Measure 5: Continue to research direct and indirect effects of anthropogenic freshwater management on marine ecological attributes affecting anadromous fish habitat, life histories and productivity.
  - Rationale: Management of the Columbia River Basin hydropower system directly affects the ocean environment by changes in the natural hydrograph and ecological processes caused by development and operation of the hydro-system, and through changes to the estuary and plume habitats due to the timing, quantity and quality of river flows. There is much more to be learned about how to improve conditions and thus survival for anadromous fish in the estuary and plume.
  - Measure 6: The Program should address the uncertainty regarding the effectiveness of estuarine restoration projects and different types of habitat and whether they contribute to increased juvenile survival and hence increased adult returns
  - Rationale: The primary critical uncertainty regarding estuarine restoration projects and different types of habitat is whether they contribute to increased juvenile survival and hence increased adult returns. Good estimates of residence time in rearing habitat, and the quantity and quality of the habitat that will likely influence survival, are generally lacking. Also, how fish move between rearing habitats and the importance of habitat connectivity and spatial distribution are poorly understood. Along these lines, a general understanding of the quantity of available habitat, quality of fish habitat, how fish use them, and how they are distributed throughout the migration and rearing reaches of the Lower Columbia River and estuary are not well known. Another critical uncertainty is to identify status and trends of the



- ecosystem processes in the lower Columbia River and estuary to better understand the ecosystems processes and the effects on restoration and mitigation efforts.
- Measure 7: Research is needed on forage fish in the lower estuary and nearshore area. The Program should promote projects on forage fish in the lower estuary and nearshore area through the following measures:
    - Identify spawning and rearing life history attributes of forage fish in the estuary
    - Determine the role of forage fish as alternate prey for birds in the lower estuary
    - Elucidate the role eulachon may have as an alternative prey for sea lions
    - Determine how restoration projects in the estuary may contribute to reproductive success and rearing of forage fish
    - Identify the relation between Columbia River flow and forage fish abundance in the estuary
    - Identify role forage fish have in survival of juvenile Chinook salmon, coho, and steelhead
    - Determine how climate change, ocean acidification, salinity, estuary turbidity maximum (ETM), and localized hypoxia are likely to affect forage fish in the coming decades
  - Rationale: The proposed amendment will update the Program to reflect a move toward ecosystem management approach to provide salmon with their total life cycle needs including an adequate food web to support growth and improve survival. Forage fish in the lower estuary include a broad group of species including surf smelt, Pacific sand lance, Pacific herring, eulachon, and juvenile American shad. These species have diverse reproductive strategies but all species can occur in the lower estuary during their life histories. For example, surf smelt and Pacific sand lance may use beaches for spawning while Pacific herring may spawn on nearshore macro-algae. Eulachon and American shad are anadromous and can produce large numbers of juveniles that disperse downstream and enter the estuary. The Fish and Wildlife Program places an emphasis on salmon restoration and forage fish are a major link between habitat and environmental conditions and the survival of salmon.
  - The Columbia River Estuary , page 32
    - Recommendation: Address ISAB recommendations on developing an Estuary Plan that meshes to the Mainstem Plan and Ocean Strategies, evaluating the success of restoration in the estuary in terms of benefits to salmon; monitoring diversity metrics; long-term effectiveness monitoring for habitat improvement projects; and redefining the estuary subbasin to include the tidal regions at the mouths of tributaries draining to the estuary. NMFS is likely to update its estuary recovery plan module by 2018, per the ISAB's 5<sup>th</sup> recommendation '5. Reassess factors limiting production in the estuary, including contaminants, in light of new research. As suggested earlier by the ISAB, it may be appropriate to update and peer review the Estuary Module.'
  - Eulachon Recommendation: Include measurable eulachon objectives and strategies in the Program. The Program should incorporate and BPA should fund protection, mitigation and enhancement of eulachon through the following measures ..[omitted text]... (i) Monitor and evaluate eulachon abundance in the Columbia River via annual spawning stock biomass surveys following protocols developed by the Washington Department of Fish and Wildlife and acoustic estimates by NOAA - NWFSC. (ii) • Monitor and evaluate the causal mechanisms and migration/behavior characteristics affecting survival of larval eulachon during their first weeks in the Columbia River estuary, plume, and ocean environments. (iii) • Monitor and evaluate the ecological importance of the tidal freshwater, estuary, plume, and nearshore ocean environments to the viability and recovery of eulachon in the Columbia River Basin (iv) Develop an oceanographic indicators ecosystem conditions model to determine the significance of plume and nearshore ocean conditions that affect eulachon survival.

NOAA F supports the ISAB RECOMMENDATIONS for Monitoring, Evaluation and Research , see REFERENCE DOCUMENT SECTION at the end of this document for details.

#### **24. NOAA Fisheries Northwest Fisheries Science Center , NOAA-NW (31) (submitted by Walton Dickhoff)**

- **2. Improve our understanding of contaminant exposure and accumulation among Columbia Basin fishes, including ESA-listed stocks**
  - *Conduct targeted monitoring for vulnerable fish species to address data gaps specific to contaminant exposure and accumulation.* Field assessments conducted to date by NOAA and the Lower Columbia Estuary Partnership have profiled persistent bioaccumulative toxicants in juvenile fall Chinook salmon from Lower Columbia River population segments (LCREP 2007; Sloan et al. 2010; Yanagida et al. 2012; Johnson et al. 2013). However, as highlighted recently in a needs assessment by the Columbia River Toxics Workgroup (EPA 2010), much less is known about exposure risks to interior Columbia Basin spring and fall Chinook or any stocks of coho,

chum, and steelhead. Similarly, toxic threats to eulachon, lamprey, and sturgeon are very poorly understood.

- **2.2. Conduct synoptic monitoring to profile toxics in surface waters in relation to distinct land uses and associated pollution sources.** The U.S. Geological Survey and others have conducted extensive, albeit now somewhat dated, monitoring of pesticides related to agricultural practices. This monitoring has been extended more recently to pharmaceuticals and other contaminants of emerging concern in the Lower Columbia River Estuary, in relation to municipal wastewater discharges (Morace 2012; Nilsen and Morace in press). However, a lack of environmental fate and persistence data for many contaminants makes it difficult to estimate water quality conditions based on land use activities over large spatial scales.
- **Assess the direct effects of contaminants on fish health**
- **3.1. Develop sensitive and diagnostic indicators of chemical exposure and salmon health for use in regional monitoring efforts.** Ongoing advances in molecular biology are rapidly expanding the toolbox of biological indicators to assess chemical exposure and toxicity in field-collected salmon from different habitats throughout the Columbia River Basin. In tandem with parallel advances in analytical chemistry, these new tools will greatly expand our understanding of how water quality degradation affects salmon health and survival. This includes non-lethal sampling from threatened and endangered species. More work is needed to develop and implement these next-generation biomarkers, particularly those that are specific to distinct classes of chemical contaminants (e.g., pharmaceuticals, petroleum hydrocarbons, modern pesticides, legacy PCBs, etc.).
- **3.2 Evaluate the health of underrepresented species, including lamprey, eulachon, and sturgeon.** The effects of toxics on several culturally and recreationally important fish species in the Columbia River Basin are practically unknown. Certain species may be particularly vulnerable to bioaccumulative and persistent organic pollutants (POPs; e.g., PCBs and DDTs) because they are long-lived (sturgeon) or lipid-rich (eulachon). Field and laboratory studies are needed to assess the impacts of these and other contaminants on individual survival and population abundance.
- **4.1 Investigate the combinatorial impacts of chemical mixtures on salmon and other fish.** As the discipline of ecotoxicology evolves, it is becoming increasingly clear that chemicals can interact in mixtures to produce much greater toxicity to fish than expected based on the potency of individual chemicals in isolation. Of particular relevance for the interior Columbia River Basin, mixtures of certain common agricultural insecticides have recently been shown to produce synergistic neurobehavioral toxicity in juvenile salmon. Chemicals at trace concentrations can therefore have unexpectedly severe impacts on fish when they co-occur in aquatic habitats with synergists. Mixture interactions are not well understood, and more work is needed to guide future pollution reduction strategies.
- **4.2 Investigate interactions between chemical and non-chemical habitat stressors.** For fish throughout the Columbia River Basin, exposures to contaminants usually take place against a backdrop of many other habitat stressors. Environmental factors such as elevated water temperature and low dissolved oxygen are known to increase the relative impacts of many toxics. Conversely, contaminants can exacerbate the adverse effects of non-chemical factors that determine fish survival. In salmon, for example, the dietary accumulation of POPs can compromise the immune system, thereby increasing mortality rates in subsequent encounters of environmental pathogens. Due to these types of interactions, actual losses from wild fish populations in the Basin are likely higher than would be predicted from the results of chemical toxicity testing under ideal (i.e., non-stressful) laboratory conditions. The future role of climate change deserves particular attention, in the context of reduced flows (less dilution for pollution) and summer thermal extremes enhancing chemical toxicity. Warming water temperatures and changing precipitation patterns resulting from climate change are expected to have a deleterious impact on Pacific salmonid populations throughout the Columbia Basin, including approximately 40% salmon habitat loss in Oregon and Idaho and 22% loss in Washington by 2090 (ISAB 2007).
- **Assess the indirect, food web-mediated effects of contaminants on salmon**
- **5.1. Determine the extent to which toxics limit prey quality and abundance in degraded habitats.**
- Healthy riverine and estuarine food webs are essential for salmon growth and survival. Salmonids rely extensively on a prey base of insects and crustaceans, many of which are considerably more sensitive to pesticides, metals, and other contaminants. Modern insecticides, for example, are (by design) toxic to riparian and aquatic insects, and are also commonly detected in agricultural watersheds in the interior Columbia River Basin. This raises the possibility that insecticides and other contaminants are compromising the biological integrity of critical foraging habitats for ESA-listed species. (Macneale et al.

2010). Macroinvertebrates also accumulate POPs and are therefore an exposure conduit for salmon, including otherwise healthy stocks from the interior Basin that must outmigrate through a gauntlet of toxic “hot spots” in the Lower Columbia River Estuary. New research is needed to better understand

- how water quality improvements will enhance aquatic community diversity and abundance, as well as prey quality, thereby accelerating salmon recovery.
- **Develop models to extrapolate sub-organismal toxicity to the population-scale**
- *6.1 Improve forecasting capabilities, to more accurately understand how toxic control and cleanup efforts will improve individual salmon health and increase population abundance.* Whereas toxicity takes place at or below the scale of an individual fish, vulnerable stocks in the Columbia River Basin are managed at the scale of wild populations. An enduring challenge in ecotoxicology is to link the health of individual animals to these higher scales. Some preliminary work has been done in this area, including models of population effects of current use pesticides and bioaccumulative contaminants in Pacific salmon stocks. Additional refinement is needed to adapt these models to address specific stock of concern, and to incorporate threats from multiple contaminants. These population models can then be used to forecast future extinction risks associated with pollution, to estimate the relative importance of pollution as a limiting factor for the recovery and delisting of threatened or endangered salmonids, and to estimate the degree to which successful toxics reduction actions will contribute to stock productivity.
- **Anticipate and minimize future pollution threats**
- *8.1 Develop new tools to predict the cumulative and interrelated impacts of regional human population growth, land use change, toxic terrestrial runoff, and climate change on salmon population viability.* As noted recently by both the U.S. Commission on Ocean Policy and the Pew Oceans Commission, nonpoint source pollution is one of the most significant emerging threats to aquatic species worldwide. This is particularly true of the Pacific Northwest, where large increases in population growth and development are expected to dramatically increase the loading of toxic chemicals to salmon habitats in the years ahead. Non-point source pollution is driven largely by weather patterns, and thus future changes in climate will have important implications for the chemical quality of salmon habitats.
- *8.2 Implement new research to assess chemicals of emerging concern.* Since salmon recovery efforts in the Pacific Northwest will continue to evolve over the next several decades, it is critical that new research anticipates (to the extent possible) emerging threats to species that are either listed or likely to be listed under the ESA in the foreseeable future. This includes chemicals associated with current and future human activities throughout the region, such as brominated flame retardants, pyrethroid insecticides, and endocrine-disrupting pharmaceuticals. Preliminary studies by USGS and NOAA have highlighted the presence pharmaceuticals and personal care products in Columbia River waters, and exposure of juvenile salmon to environmental estrogens. Additional work is needed to better understand the extent and effects of such exposure in salmon

## **25. US Fish and Wildlife Service, USFWS (33) (submitted by Richard Hannon )**

- However, we also believe the collective recommendations from all the Federal and State fish and wildlife managers and Native American Tribes in the Columbia Basin provide a comprehensive foundation on which the Council should develop the draft Program
- **Juvenile Lamprey Passage :** The Corps sponsored a series of regional workshops for juvenile (macrophthalmia) and larval (ammocoetes) lamprey passage and survival in 2011 and 2012. Regional partners (State, Federal and Tribal) prioritized the research needs for juvenile and larval lamprey passage and survival. The top three research needs were identified.
- Recommendation : We recommend the Council **support these research needs** and add the following text as a bullet under C. Biological Objectives, 2. Specific Objectives and Performance Standards for Habitat Characteristics and for Population Performance, b. Migration and passage conditions for anadromous fish, page 39. {see reference section at end of document for content of this report}
  - *The Council recognizes the need to improve passage and survival of juvenile and larval Pacific lamprey migrating through the mainstem and advises the Corps and Bonneville, in coordination with Federal, State, and Tribal fish managers to ensure the rigorous collection of data needed to answer the following uncertainties of juvenile and larval lamprey passage.*
  - *Determine spatial distribution (vertical and horizontal) of juvenile Pacific lamprey in forebays of mainstem Columbia and Snake River dams*

- Complete a systematic investigation of juvenile bypass systems (JBS) impacts on juvenile Pacific lamprey at the lower Columbia and Snake River dams.
- Determine timing and magnitude of Pacific lamprey macrophthalmia outmigration at mainstem Columbia and Snake River dams.
- **Adult Lamprey Passage** , The Pacific Lamprey Conservation Agreement and the Tribal Pacific Lamprey Restoration Plan for the Columbia River Basin identifies achieving substantive successful improvements in dam passage efficiencies and survival of primary importance. The Columbia River Basin Lamprey Technical Workgroup identified lamprey passage improvement at hydropower dams as the highest priority. The need to develop better aids to passage and a more complete understanding of passage problems through the FCRPS has become critical. A systematic ladder and entranceway evaluation survey, integrated with biological information and a stage-based model to evaluate lamprey passage at each FCRPS project is needed. Recommendation : We recommend the Council support this work by adding the following text after the bullets under Lamprey and Sturgeon Passage, a. Lamprey on page 47. ... [omitted text]... *Develop a **database** with lamprey biological information and physical characteristics of ladders and entranceways by specific hydroelectric project that is easily accessible to all regional managers*
- **Distribution Monitoring and Evaluation** , Many needs have been identified by regional co-managers for Pacific lamprey, and among the most critical is the need to fill in data gaps in Pacific lamprey occupancy and distribution and the creation of a shared data clearinghouse. Partners in most regions have started contributing to the collection of distribution and occupancy data but many areas with no data still exist. Some co-managers are currently working with the Columbia River Basin Lamprey Technical Workgroup and all partners to develop standardized sampling techniques for collection of this data. Regional workshops would facilitate development and training of standardized sampling techniques to ensure consistent and transferable information across the range of Pacific lamprey. The co-managers have identified the development of a comprehensive GIS data clearing house as a critical tool for meeting conservation goals. It should include all mainstem and tributary lamprey data and would be accessible by the co-managers and the public. The data clearinghouse will be built on a GIS framework including demographics, threats, and conservation actions at both watershed and landscape scales. Recommendation : We recommend the Council support this by adding the following text at the end of the section *Lamprey and Sturgeon Passage, a. Lamprey* on page 47.
  - *Many needs have been identified by regional co-managers for Pacific lamprey, and among the most critical are the need to fill in data gaps in Pacific lamprey occupancy and distribution and the creation of a shared data clearinghouse.*
  - *The Council asks the Corps and BPA to fully support the following:*
    - *Conduct occupancy and distribution surveys in basins identified through the Pacific lamprey Conservation Initiative (i.e., basins where distribution is unknown). Surveys should use a statistically rigorous probabilistic design.*
    - *Conduct workshops for regional partners to provide guidance on the sampling methodology and study design for occupancy and distribution surveys. A series of workshops should be held to blanket the geographical range of Pacific lamprey in the Pacific Northwest.*
    - *Develop a data clearinghouse for Pacific lamprey based on a GIS framework containing occupancy and distribution, threat information, demographics and needed actions. This geographic framework should be WEB based and available to partners.*
- Recommendation : Revise the text of the first major bullet under *Lamprey* on Page 47 as follows:
  - *Bonneville and the Corps, in coordination with federal, state, and tribal fish managers and the Council, should identify, develop, implement, and **monitor** measures to help restore Pacific lamprey including:*
  - Delete the existing six sub-bullets and replace with the following 14 revised sub-bullets. ... [omitted text]...
  - *• Regional approaches to evaluate passage, abundance, distribution, and population structure, including the mainstem Columbia, Snake and Willamette rivers*
  - *• Development of PIT and active tags suitable for adult and juvenile lamprey and establish an annual regional lamprey tagging forum*
  - *• Development of a regional strategy for monitoring passage into tributaries to better understand differences in counts of adult lamprey between dams*

- • *Development and implementation of a regional tagging and monitoring strategy for evaluating the timing of larval and juvenile lamprey movement and active outmigration from tributaries into the mainstem and passing mainstem hydropower projects.*
- • *Increase knowledge regarding the use of the mainstem as spawning and rearing habitat with systematic occupancy sampling*
- • *Identify operations at mainstem hydropower dams such as ramping rates and water elevation changes that delay, obstruct, or kill migrating adult and juvenile lamprey*
- • *Monitor and address effects of hydrosystem operations on juvenile lamprey residing in reservoirs*
- • *Develop and implement passage aids for adult and juvenile lamprey at known passage obstacles*
- • *Monitor lamprey passage at mainstem hydropower dams to evaluate passage improvement actions and to identify additional passage problem areas,*
- • *Assess lamprey passage efficiency, direct mortality, and/or other metrics relating to migratory success of lamprey*
- • *Determine predation on adult and juvenile lamprey during migration*
- • *Determine the potential effects of climate change on lampreys, including the effects of increasing water temperatures and changing runoff regimes on lamprey energetics and performance*
- • *Support the Pacific Lamprey Conservation Agreement through collaborative development and management of a comprehensive GIS data clearing for all mainstem and tributary lamprey data that is accessible by co-managers and the public.*
- **Revise text under Reintroduction of Anadromous Fish in Blocked Areas on Page 56 as follows:**
  - *....evaluate the feasibility of salmon, steelhead, and Pacific lamprey reintroduction, consistent with the objectives in the appropriate subbasin plans.*

#### **References**

- CRBLTWG (Columbia River Basin Lamprey Technical Workgroup). 2005. Critical uncertainties for lamprey in the Columbia River Basin: results from a strategic planning retreat of the Columbia River Basin Lamprey Technical Workgroup {relevant text extracted in the reference section at the end of this document}
- [omitted ref]
- USFWS (U. S. Fish and Wildlife Service). 2010. Best Management Practices to Minimize Adverse Effects to Pacific Lamprey (*Entosphenus tridentatus*). U.S. Fish and Wildlife Service, Portland, Oregon. 25 pages.
- [omitted ref]
- The Council should consider incorporating the priorities of understanding food webs outlined by the Independent Scientific Advisory Board (ISAB 2011). The ISAB Report makes a strong case for investigating how the Columbia River basin food web supports the growth and survival of Pacific salmon and other native fishes. [omitted text] The proposed research will move the Program toward an ecosystem management approach to provide salmon with their total life cycle needs including an adequate food web to support growth and improve survival. The Council should also build on and expand existing Fish and Wildlife projects that have collected food web data to incorporate concepts and research needs identified as ISAB priorities. Continue to support work under species-specific project whose results would be applicable to other related species. Although the ISAB report was comprehensive, the Council should remain flexible to support projects that address new and emerging challenges regarding changes to Columbia Basin food webs such as invasive species. Fall Chinook salmon in Lower Granite Reservoir are an ideal species/habitat coupling for evaluating the food web relationships, as some historical invertebrate work has been conducted (Dorband 1980; Curet 1993; Haskell et al. 2006; Tiffan et al. 2013), growth and body size of listed juvenile fall Chinook salmon has declined over the past decade (Connor et al. in press), and an understanding of the food web has been identified as a key information need in recovery plans.
- Recommendation : We support genetic-based fish marking as a management tool through continued development and maintenance of a multi-agency database and through analysis of genetic samples to answer specific management questions related to straying and population status.
- Recommendation : In the 2014 version of the Fish and Wildlife Program, the Council should develop a vision for reintroduction of anadromous fish into blocked areas and, over the next five years, define the path forward on this issue. During this time, the Council should conduct a comprehensive evaluation of the

reintroduction of anadromous fish into blocked areas of the Columbia Basin. A comprehensive evaluation should:

- Identify specific Federal and non-Federal hydropower projects that currently block anadromous fish from historic spawning grounds in the Columbia Basin;
- Evaluate the success of the current efforts at re-introducing anadromous fish into blocked areas throughout the Pacific Northwest;
- Assess the feasibility of reintroducing anadromous fish at each Federal and non-Federal project that currently blocks anadromous fish from historic habitat, and evaluate the potential for eventual development of fish passage facilities.
- The details of a feasibility assessment should be developed in collaboration with the Federal and State fish and wildlife agencies, Native American Tribes, the appropriate Federal agencies, and the owners of non-Federal hydropower projects, if applicable. These assessments would evaluate the feasibility of anadromous fish reintroductions, at the reconnaissance level, to include costs, potential benefits, partnership opportunities, and timelines for initiation of these projects. We believe anadromous fish reintroduction should proceed sequentially, such that feasibility at each stage would be determined before the next phase is initiated.

**26. Pacific Fishery Management Council, PFMC (34) (submitted by Jennifer Gilden)**

- Test the Efficacy of Higher Spill Levels to Increase Smolt-to-Adult Return Rates: ... [omitted text] recommendation: [ omitted text] ... The NPCC should also recommend a study of higher spill levels to test the efficacy of spill in increasing adult returns to the Columbia Basin. Quantitative Performance Goals set by NPCC for smolt-to-adult return rates should also be emphasized, and performance assessed annually
- Artificial Production of Salmon - Since the inception of hydropower facilities in the Northwest, hatchery programs have been justified as mitigation for the impacts of dams on lost salmon spawning and rearing habitat, and the operational impacts of dams on migrating or rearing salmon. As long as dams affecting salmon remain in place, these mitigation commitments remain. The challenge is to adaptively manage hatchery programs based on the best available information in order to fully address recovery plan implementation and ESA compliance issues while also meeting ongoing mitigation obligations that are critically important to West Coast sport, commercial, and tribal fisheries. The current Fish and Wildlife Program recognizes that these artificial production strategies "must be implemented within an experimental, adaptive-management design that includes an aggressive program to evaluate the risks and benefits and addresses scientific uncertainties." The Program should also recognize the need for monitoring to assess progress in achieving mitigation goals and hatchery performance. Because biological uncertainties remain and salmon production benefits are high, adequate funding to support adaptive management should remain a priority. Recommendation: We recommend the Program supports hatchery program reviews to ensure compliance with regional mitigation, conservation and recovery goals, using performance indicators and adaptive management measures, and a **structured monitoring, evaluation, and research program**

**27. Bonneville Power Administration, BPA (35) (submitted by Lorri Bodi )**

- **Process Improvements—Streamlining Reporting:** The Program should continue to support on-going efforts to take a standardized, programmatic approach to habitat monitoring, analysis and reporting, while providing for collection of information that individual co-managers may need to make adaptive management decisions regarding their projects. Coordinating these efforts can provide the most effective means for incorporating information into management decisions for on-the-ground implementation and adaptive management of habitat improvement projects.
- **High Level Indicators:** For consistency in reporting, the Program's High Level Indicators (HLIs) should employ the data (metrics) rolled up to report on the Action Agencies' progress under the FCRPS BiOp, as well as streamlined indicators for the Columbia River Basin alignment with other federal and state performance metrics. Examples of performance metrics used in the biological opinions and Accords include the following:
  - acre-feet of water protected
  - miles stream with improved complexity
  - acres of riparian habitat treated or improved
  - fish screens installed or addressed for fish protection
  - miles of improved access to fish habitat

Adopting performance metrics from the BiOps and Accords for use as the HLIs to measure Program performance could facilitate a more collaborative regional approach to implementing our data management strategy and standardizing input to any regional data exchange as it comes on line across the region. Standardized data management will ultimately be reflected in the data rolled into the HLIs and provide useful information and tracking for decision makers.

- **Wildlife:** The Accords do not address wildlife mitigation crediting in any detail. Nonetheless, we recommend that the Program should adopt the conclusions and recommendations from the Wildlife Crediting Forum closeout report, including encouragement for subregional efforts to resolve the few remaining areas where resource managers and BPA disagree on remaining mitigation. With respect to wildlife habitat mitigation tracking, the Program should continue to support flexible negotiated resolutions that can rely on any agreed upon metric or base. For tracking Program accomplishments after construction and inundation mitigation is completed, the Council should consider retiring habitat units, because they are not adopted or accepted in all parts of the basin and rely instead simply on acres. The Program should also support our efforts to explore innovative approaches, such as endowing stewardship funds to ensure long-term funding for operations and maintenance.

**Accord Agreements to Amend into the Program (check for performance standards etc):**

<http://www.salmonrecovery.gov/Partners/FishAccords.aspx>

- Three Treaty Tribes and CRITFC
- Colville Tribes
- Shoshone Bannock Tribes
- Kalispel Tribe of Indians
- Idaho
- Montana
- Washington/Estuary

**Biological Opinions to Amend into the Program**

- USFWS Bull Trout:

<https://www.salmonrecovery.gov/Files/BiologicalOpinions/2000/FCRPS%20USFWS%20BiOp%2020dec2000.final.pdf>

e Sturgeon:

<http://www.salmonrecovery.gov/Files/BiologicalOpinions/2008/Final%20Libby%20Dam%20BiOp%202-18-06lr3.pdf>

- NOAA FCRPS:

[http://www.salmonrecovery.gov/Files/BiologicalOpinions/2010/FCRPS\\_Supplemental\\_2010\\_05-20\[1\].pdf](http://www.salmonrecovery.gov/Files/BiologicalOpinions/2010/FCRPS_Supplemental_2010_05-20[1].pdf)

- NOAA Willamette:

[http://www.nwr.noaa.gov/hydropower/willamette\\_opinion/index.html](http://www.nwr.noaa.gov/hydropower/willamette_opinion/index.html)

- USFWS Willamette:

[http://nwpapps.usace.army.mil/environment/wbiop\\_docs%5CUSFWS\\_WillametteBOFinal\\_071108.pdf](http://nwpapps.usace.army.mil/environment/wbiop_docs%5CUSFWS_WillametteBOFinal_071108.pdf)

- NOAA US v. Oregon:

[http://www.nwr.noaa.gov/fisheries/salmon\\_and\\_steelhead\\_fisheries/united\\_states\\_v\\_oregon.html](http://www.nwr.noaa.gov/fisheries/salmon_and_steelhead_fisheries/united_states_v_oregon.html)

**28. US Environmental Protection Agency, USEPA (37) (submitted by Mary Lou Soscia)**

- A second recommendation is for the Council to provide support for a Basin wide monitoring and characterization of toxic contamination, including the mapping of existing contamination and known toxic discharges in relation to fish and wildlife populations and habitat restoration. The EPA recommends to the Council that an increased understanding of existing toxic contamination will bring financial accountability to the Council program to ensure that the benefits of resources allocated to fish recovery will not be diminished by potential effects of toxic contamination.
- A third recommendation is for the Council to provide a review and assessment of how hydroelectric projects affect toxic contaminants in the Columbia River Basin and how toxic contaminants can impact the fish that are impounded behind dams. Fish species have been affected in various ways by the development and operation of the hydropower system. Dam presence can be associated with the accumulation of toxic sediments and the presence of reservoirs and their operations can be a controlling factor on the chemical conditions, such as anoxia and mercury as previously discussed,

which can impact the distribution and bioavailability of toxics in a reservoir system and in turn may impact recovery efforts.

**29. US Geological Survey NW Regional Office, USGS-NW (38) (submitted by Lief Horwitz)**

- Predictive Capacity — From a management perspective, an effective way to ameliorate such impacts is to grow our predictive capacity. This can be achieved by complementing the restoration activities under the Fish and Wildlife Program with a dedicated component for research, monitoring, and evaluation. By establishing a baseline of current conditions against which to measure trends, the Fish and Wildlife Program could develop the capacity to quantify benefits and more importantly associate them with causal factors. By understanding the relationships between physical and biological factors, predictive capacity could inform how new restoration projects can be deployed in the most effective way, such as by considering the type, timing, and distribution of projects in relation to the changes that are predicted from the landscape scale stressors. For example, salmon predation modeling that was completed in the 1980s generated predictive capacity that led to many changes in predator control, juvenile bypass facilities, spill patterns, and increased interest in food webs. All of these changes have improved juvenile salmon survival. For this reason we recommend that the Council, over the next five years, develop the capabilities necessary to estimate the carrying capacity of the system. The ISAB and ISRP have been calling for food web studies, which need to be conducted at a landscape scale to provide managers guidance for fish stocking and restoration. Scientific papers have already cautioned that too many juvenile salmon are being released, and now efforts to add sturgeon, lamprey and burbot are underway. Managers need guidelines for salmon stocking and fish restoration based on the capacity of the altered environments to support additional demands.
- Role for Science in the Fish and Wildlife Program — For almost three decades the NPCC has supported the implementation of hundreds of excellent restoration projects. While the Fish and Wildlife Program has sought to address science-based management questions through these projects, it has done so without benefit of a dedicated science component within the Fish and Wildlife Program. This explains why long standing, critical scientific data gaps still, persist, as the current funding model of project scale work in three year increments, is not designed to support the type of long term research and monitoring necessary to improve the effectiveness of the Fish and Wildlife Program, and thereby minimize costs. The idea that fundamental science should be sponsored by the NPCC to support Fish and Wildlife Program objectives has long been recognized by many entities within the region, including the Independent Scientific Advisory Board (ISAB). In their report on Columbia River Basin Food Webs the ISAB identified the need to "to fill a very large number of perplexing information gaps and critical uncertainties impeding progress" (ISAB 2011-1). Previously, the Scientific Review Group (precursor to the ISAB), released a report titled the Critical Uncertainties in the Fish and Wildlife Program. The first and last sentences of the summary of the report follow: " We present and discuss critical ecological uncertainties that identify important gaps in our knowledge of the resources and functional relationships that determine fish and wildlife productivity in the Columbia River ecosystem....Finally, we again call for immediate development and implementation of a system-wide monitoring and evaluation Fish and Wildlife Program that also is responsive to critical uncertainties (SRG 93-3)." We concur and recommend that the Fish and Wildlife Program could benefit from the inclusion of a dedicated research, monitoring, and evaluation component designed to reduce uncertainty and provide information for changing Fish and Wildlife Program focus and direction when warranted. By shrinking the uncertainty surrounding restoration options and supporting the quantification of their likely benefits, fundamental science and monitoring can help decision makers define and focus those options.
- Fulfilling the Promise of Adaptive Management — The Fish and Wildlife Program could become more effective and efficient by implementing a dedicated research, monitoring, and evaluation component that can provide the basis for learning and support adaptive management. Although often ignored, monitoring comprises the missing ingredient for a practical approach to adaptive management in the Columbia River Basin. Evaluation provides the basis for re-directing Fish and Wildlife Program emphases or charting a new course; ensuring Fish and Wildlife Program accountability; and, detecting unanticipated events that could impact the Fish and Wildlife Program. For these reasons, the USGS recommends that the Fish and Wildlife Program include an ecological monitoring component as the basis for measuring changes in physical, chemical, and biological attributes of the Columbia River Basin in a way that can detect trends. This would support the evaluation of the effects of landscape scale stressors such as climate change, invasive species, and contaminants on the ecosystem that the Fish and Wildlife Program strives to restore. These landscape



scale stressors already contribute to the limiting factors that prevent the Fish and Wildlife Program from meeting its biological objectives, a situation that will become exacerbated in the future. Consequently, we recommend developing a monitoring and reporting framework for limiting factors that would complement the current monitoring and reporting of species and populations. Science can inform the development of this framework, help identify reasonable objectives and limiting factors, and identify critical uncertainties to guide further research. The implementation of the Biological Opinion and the salmonid Recovery Plans seek to (1) determine causal linkages between restoration projects and the benefits they confer and (2) quantify those benefits in support of delisting decisions. In light of the significant investment of public resources and the passage of several decades, a dedicated research, monitoring, and evaluation component would modernize the Fish and Wildlife Program and aid in protecting the investment in restoration and recovery already made by the Fish and Wildlife Program.

- Lamprey , Current Fish and Wildlife Program: various sections Recommendation: Research is needed on lampreys and the Fish and Wildlife Program should expand its two primary strategies to address these additional topics:
  - Implementing a PIT-tagging Fish and Wildlife Program for lampreys throughout the Columbia River Basin, which would not only provide new insight into juvenile fish passage issues, but would also provide unprecedented information on lamprey biology and life history (e.g. growth rates, time spent in the ocean, and homing efficiency—or a lack thereof).
  - Determine the potential effects of climate change on lampreys, including the effects of increasing water temperatures and changing runoff regimes on lamprey energetics and performance.
  - Embark on studies of juvenile lamprey passage, including research using PIT-tags and active acoustic transmitters.
  - Determine the effects of contaminants on lamprey biology, physiology, and performance.
  - Explore the feasibility of lamprey aquaculture for supplementing and restoring depressed populations.
- Sturgeon , Current Fish and Wildlife Program: Page 12, 39, 41, 43, 47-49, 53, and 55, Recommendation ..[omitted text]... The Fish and Wildlife Program should require the development of a method to store and quickly analyze information on sturgeon populations and restoration actions throughout the basin. ..[omitted text].
- Estuary , Current Fish and Wildlife Program: Page 32, Recommendation: Research is needed to address the uncertainty regarding the types of habitat needed for juvenile salmon survival, the effectiveness of estuarine projects to restore juvenile habitat, and whether these restoration actions contribute to juvenile survival and increased adult returns. Rationale: It is understood that the estuary provides food and shelter to salmonids undergoing smoltification, the period of greatest physiological stress in their life history. However, whether estuarine restoration projects can contribute to increased juvenile survival and hence increased adult returns remains uncertain. Good estimates of residence time in rearing habitat that will likely influence survival are generally lacking. How fish move between rearing habitats and the importance of habitat connectivity and spatial distribution is poorly understood. The quantity of available habitat, and how that habitat is distributed throughout the migration and rearing reaches of the Lower Columbia River and estuary is not well known. The quality of that habitat, and the extent to which fish utilize these habitat, are also uncertain. Therefore, research to address these uncertainties can help inform decision making on what types of projects will be most effective, where the restoration projects should be sited, and how many projects will be necessary to restore sufficient habitat to support increases in adult returns.
- Sediment Budget for Lower Columbia River Recommendation: The Council should consider updating the Fish and Wildlife Plan to request that the appropriate agencies assess key components of a sediment budget for the lower Columbia River including:
  - •Inputs and outputs for a defined reach should be determined. A logical study reach would extend from Bonneville Dam to the mouth. This would be most complete if it included main-stem measurements of flux at or near (1) Warrendale (just downstream of Bonneville), (2) Beaver Army terminal (downstream of major tributary inputs but upstream of the bay-head depositional zone), and (3) a location near the mouth so as to understand net transport out of the lower Columbia River. Ideally, these locations should be supplemented by measurements allowing independent estimates of sediment brought in by major tributaries, particularly the Cowlitz and Willamette Rivers. • Both bedload and suspended load measurements should be determined, and sufficient observations made so as to allow estimating total flux at each measurement location. As noted above, the management issues involving these components of the overall sediment flux are distinct. Rationale: The volume of sediment entering and passing through the lower Columbia River downstream of Bonneville is highly uncertain. Recent studies have estimated the sediment

budget for the lower Columbia River, based on very limited data—primarily measurements made between 1963 and 1969 on the Columbia River, measurements made between 1911-1912 and 1962-1964 on the Willamette River, and 1980-1984 measurements on the Cowlitz River. None of these measurements include bed-load transport, which may contribute a significant portion of the sand flux. Even despite high uncertainties, analysis shows that the volume of sediment moving through the lower Columbia River has probably been reduced by 60 percent since the late 19<sup>th</sup> century owing to sediment retention behind dams, changes in flow patterns, and changes in climate. Sand transport has likely been reduced by 85 percent over this time [omitted text]...

- **Process Habitat Protection and Restoration Recommendation:** The Council should consider updating the Fish and Wildlife Plan to include assessments of how streamflow, sediment, and large woody debris interact under current management regimes. It would be valuable to understand whether and how those geomorphic processes sustain the success of aquatic and floodplain restoration projects for biological benefits. The lower alluvial segments along the Willamette River and its major salmon bearing tributaries provide one example of a suitable location for a pilot of these assessments because of the many floodplain and aquatic habitat restoration projects in this area. Rationale ..[omitted text]... USGS suggests the Council consider research, monitoring, and evaluation to better understand the hydrologic and geomorphic context of potential restoration sites by: identifying geomorphically functional floodplains; mapping floodplain landforms and their vegetation; and, determining the likely future trajectories of these landforms and vegetation communities
- **Process Monitoring Habitat-Generating Processes in Response to Restoration Recommendation:** The Council should develop a monitoring plan using unmanned aircraft systems (UAS) technology to assess inundation and water temperature conditions across a range of stream morphology and land-use patterns. These data would ideally be utilized in concert with more traditional data describing sediment transport and occurrence of large wood to provide insight into the habitat-generating processes associated with restoration projects, especially focused in low gradient and unconfined valley segments. In these segments, UAS technology could capture critical habitat forming processes, such as patterns of floodplain and side-channel inundation and channel migration, as well as locate thermal refugia or areas of significant groundwater discharge to streams. Key streams to target for this monitoring would include salmon bearing tributaries to the Willamette River that are the focus of environmental flow releases, as well as low gradient and unconfined valley reaches in more remote eastern Oregon basins. Rationale: A range of habitat restoration and conservation activities are underway in the Columbia Basin to mitigate the detrimental effects of human impacts. Many of these efforts are focused on restoring elements of the natural flow regime (low flows and peak flows) that support access to floodplain and side-channel habitat, minimizing summer stream temperatures, and increasing channel complexity to promote thermal refugia. Typical monitoring data to evaluate these responses are labor-intensive to collect, and generally focus on relatively small stream reaches making it difficult to generalize about restoration effectiveness at a larger scale. Incorporation of remote-sensing data into the research, monitoring, and evaluation of restoration activities will provide an important technological boost to the capacity to assess the response of key fish habitat-forming processes at the basin scale, which is becoming increasingly important as the size of restoration projects expands
- **Impacts of Contaminants on Key Species and Foodwebs, Recommendation:** The Council should consider updating the Fish and Wildlife Plan to request that the appropriate agencies assess foodweb transfer, sediment transport, and biological effects of emerging and legacy organic contaminants under current management regimes, and how those processes affect key Columbia River species and the potential success of restoration projects within the basin. Critical uncertainties in understanding impacts of contaminants on key species and foodwebs include:
  - Distributions, levels, and spatial patterns of contaminants of emerging concern (CECs) in the Columbia River basin, including the estuary and coastal ocean.
  - Transfer, accumulation, and persistence of CECs in estuarine, coastal ocean, and riverine foodwebs. Additive and/or synergistic effects of chemical mixtures on species of interest.
  - Levels of chemicals of emerging concern (CECs) that adversely affect the health of keystone species, such as Pacific lamprey, white sturgeon, and salmonids.
  - Impacts of CECs on the carrying capacity of the Columbia River ecosystem for
    - juvenile salmonids and other key species.
    - Impacts of contaminants on habitat restoration success (contaminants of concern should be assessed and monitored as part of current and future river restoration programs.)
    - Role of contamination in reduced rearing success of white sturgeon in impounded pools of reservoirs versus unimpounded areas.
    - Impacts of contaminants on sturgeon reproduction and rearing success within areas of known high productivity.
    - Role of contaminants (levels of concern and

effects of chemical mixtures) on Pacific lamprey declines compared to threats by dam passage. • Investigate impacts of different hydrologic scenarios and management actions on contaminant distributions and foodweb transfer. • Investigate the potential impacts of trace element contamination of UCR sediments on the quality of critical white sturgeon habitat throughout the UCR from Lake Roosevelt upstream to the International Border. Rationale: Various stressors threaten native fishes and other wildlife in the Columbia River basin ..[omitted text]....

- Process Climate Change Recommendation: The Council should update the Fish and Wildlife Plan to assess the potential effects of climate change on river hydraulics, temperature, and sediment movement in tributaries and mainstem reaches of the Columbia River Basin and the collateral effects on aquatic biota. Critical uncertainties in understanding future impacts of climate change on target aquatic species include: • Changes in the magnitude, timing, and persistence of stream flows throughout the year. • Changes in stream temperatures. • Changes in sediment transport and habitat formation. • Effects of flow changes on salmonids, sturgeon, and lamprey. • Impacts of climate change on habitat restoration success. • Shifts in the food web and resultant impacts on bioenergetics. Rationale: Changes in the timing and magnitude of stream flows impact aquatic species in the Columbia River Basin. Up to 15 percent of the Columbia River's annual flow has been lost in the last century due to climate change and anthropogenic consumptive use ..[omitted text]....
- Fish Tagging, Current Program: Fish Tagging Forum, Recommendations: In addition to the review of the Decision Memorandum of the Council's Fish Tagging Forum (Forum): • Consider less expensive deployments of JSATS or other active telemetry systems to measure compliance with BiOp performance standards.; and, • Future studies of passage and survival in the hydro system should focus on further efficiencies in water use.
- Food Web Research , Recommendation: Incorporate ISAB priorities for understanding food webs to support the ability of the Fish and Wildlife Program to help sustain an abundant, productive, and diverse community of fish and wildlife in the Columbia River Basin. Build on and expand existing Fish and Wildlife projects that have collected food web data to incorporate concepts and research needs identified as ISAB priorities. Continue to support work under species-specific projects whose results would be applicable to other related species. Support new food web research approaches and technologies beyond those identified by the ISAB as they are developed. Although the ISAB report was comprehensive, flexibility should be maintained to support projects that address new and emerging challenges regarding food webs such as invasive species. Establish a long-term monitoring program to track trends in food web dynamics in the mainstem Columbia and Snake Rivers and tributary systems through time. Rationale: The ISAB food web report calls for investigating how the Columbia River basin food web supports the growth and survival of listed salmonids and other native fishes. By conducting research that builds upon existing data and expertise the region could move towards a more holistic understanding of food, web function., the effects of existing invasive species, the potential for food web alterations from new biological invasions, and habitat alterations. The amendment process therefore provides an important opportunity to update the Program to reflect an ecosystem management approach that could provide salmon with their total life cycle needs including an adequate food web to support growth and improve survival
- USGS Recommendations to NPCC Fish & Wildlife Program Amendment Process ..[omitted text]... Establish long-term integrated monitoring programs in the mainstem Columbia and Snake Rivers and tributary systems that incorporate the taxonomic expertise to identify new and existing invasive species so that factors affecting their distribution (e.g., climate change, habitat alterations) can be tracked through time. • Establish long-term integrated monitoring programs in the mainstem Columbia and Snake Rivers and tributary systems that incorporate the taxonomic expertise to establish the distribution of existing invasive species so that the potential for these species to affect habitat restoration activities can be determined. • Support research that seeks new and innovative ways to control or eradicate new and existing infestations of invasive species. • Support research that seeks to determine the effects of existing invasive species on efforts to restore anadromous fish and healthy ecosystems in the Columbia River Basin (CRB).

### **30. Columbia Basin Water Transactions Program, CBWTP (40) (submitted by Scott McCaulou )**

- Provide technical and financial support for the establishment of a framework for prioritizing flow restoration activities with respect to the anticipated effects of climate change on tributary streamflows. Based on the existing body of climate change science, it is generally understood that future flow conditions will deviate from historical flow patterns. Flow restoration transactions can help mitigate the impacts of climate change on target species, but more work is needed to prioritize where these investments should be made relative to the Council's priorities. The CBWTP would like to explore partnering with Bonneville to

develop an assessment of climate change impacts specifically on streamflows and coordinate the development of a strategy for prioritizing actions to mitigate those impacts through flow restoration transactions.

**31. StreamNet (41) (submitted by Bruce Schmidt )**

- Last year through the Council's Project Review and Evaluation Committee (PERC) you reviewed regional scale database projects, and in the final report mentioned the need for a means to establish regional data priorities. I wish to support that recommendation and recommend that the recommendation should be included in the amended program.
- Data management at a regional scale has largely developed in response to individual or independent needs. What has been missing is a means to clearly establish and articulate regional scale monitoring questions and their related data priorities, along with a mechanism to assure coordination among regional-scale database projects to avoid duplication of effort and/or to encourage supportive interactions among projects (for example, for one project to acquire and manage the data and another to use existing capabilities to disseminate the data).
- It may also be possible for the Council to utilize existing programs or projects to carry out some of the work on behalf of the Council. For example, PNAMP already includes participation from many of these same agencies. The Council could make formal requests that PNAMP take on specific tasks related to recommending monitoring and/or data priorities and to make formal recommendations back to the Council. The Council's PERC-like committee or program would then publicly consider those recommendations and make final decisions. This would help to encourage greater participation in PNAMP. If some agencies chose not to join PNAMP, they would still be able to comment on the recommendations prior to Council action on them.

**32. Northwest Habitat Institute, NHI (42) (submitted by Thomas O'Neil )**

- As stated by in the Independent Scientific Review Panel (ISRP) Review of 2009 Fish and Wildlife Program, "establishing quantitative performance goals both for the biological objectives and restoration strategies is an essential feature and provides measurable thresholds for determining success.... The amended Program should include quantitative biological objectives that can be regularly monitored and evaluated as a means to determine whether the Program is on target or in need of change".
- Given the above and the ISRP and ISAB comments regarding the Council's Fish and Wildlife Program, NHI recommends: 1) compliance monitoring that is conducted by independent evaluators, 2) employing the Combined Habitat Assessment Protocols or CHAP approach to establish baseline conditions and habitat enhancements to give consistency to compliance monitoring, and 3) continue mapping riparian habitat condition and land cover/use throughout the Columbia River Basin (CRB). Our rationale for these recommendations follows:
- *Independent Compliance Monitoring* - the purpose of having independent evaluations is to avoid any possible conflict-of-interest. Additionally, using a third party provides a credible outside analysis and objectivity; if enforcement is needed. A widely used definition is, "a conflict of interest is a set of circumstances that creates a risk that professional judgment or actions regarding a primary interest will be unduly influenced by a secondary interest." This can stem from having an interest in a property or having/seeking to obtain a value from a property. In the Fish and Wildlife Program obtaining habitat value is a *primary interest* of most all participants. *Primary interest* refers to the principal goals of the profession or activity, such as the creating or enhancing habitat quantity/quality, the integrity of research, and meeting the requirements of a legal document (i.e. biological opinion). For the Fish and Wildlife Program, it is in regard to the integrity and reliability of the working being completed and reported accurately. Given that nearly every federal, state and tribal organization is involved in receiving funding, doing the work, as well as setting goals and objectives for within the Program some objectivity is required as a *best practice*. This required objectivity can be found in various federal codes and state statues. For instance, the call for independent or third party evaluations are well established when looking at other government regulations [please see, Federal Register / Vol. 73, No. 70 / April 10, 2008 / Rules and Regulations / Dept. of the Army, Corps of Engineers ~ 33 CFR Parts 325 and 332; Environmental Protection Agency ~ 40 CFR 230]. Finally, accountability cannot exist without proper accounting practices; in other words, an absence of accounting means an absence of accountability. Another example of establishing an independent

evaluation as a best practices can be found in the Section 170(h)(4)(A)(ii) of the Internal Revenue Code and Oregon Revised Statute § 271.715 regarding obtaining a conservation easement. These code and statues both require an independent group to do the appraisal. Given that the main focus of the mitigation program is fish and wildlife habitat, conducting the baseline inventory should be done by a group that has the capacity and appraisal experience to conduct habitat evaluations that also have the ability to measure biological diversity and other ecosystem characteristics. This group should have no stake in the property or receives program habitat enhancement funds. This independence is also a requirement under compliance monitoring (for wetlands) especially if enforcement is needed. Finally, the scientific method also supports an independent assessment by calling for an objective framework to obtain some reliability about the information being reported. *Best Practice* is defined as a method or technique that has consistently shown results superior to those achieved with other means; it can evolve to become better as improvements are discovered. Best practices are often incorporated into good operating procedures. Classic example of this in action is when the Council established within the Fish and Wildlife Program the Independent Scientific Review Panel and Independent Scientific Advisory Board as best practices that are now part of the Council's operating procedures. Thus, there is a need for establishing independent field evaluators to assess habitat baselines and improvements as a best practice and as a good operating procedure.

- 2) *Employing the Combined Habitat Assessment Protocols or CHAP* – the purpose is to provide consistent assessments for baseline habitat conditions and their enhancements across the Columbia River Basin (CRB). Emphasize the need for rigorous monitoring and evaluation of these measures and for public reporting and accountability, and (p. 35 2009 report Council doc 2009-09) strategic goal calls for accountability, which in ethics and governance is defined as being answerable and having some liability. Accountability cannot exist without proper accounting practices; in other words, an absence of accounting means an absence of accountability. Therefore, we ask that as part of the Fish and Wildlife Program role that new rules and guidelines for independent evaluation of a site ecological baseline condition be addressed by incorporating biological accounting as a best management practice. Specifically CHAP should be recommended as a preferred method for compliance monitoring and impact/mitigation evaluations. Currently, there are more than 60 habitat classification is use within the CRB [see Pacific Northwest Habitat Classification Systems database at: <http://www.nwhi.org/index/publications>] and all of these classifications have been crosswalked to the Integrated Habitat and Biodiversity Information System (IBIS). IBIS is listed as “Best Available Science” in the state of Washington [Washington State Department of Community, Trade and Economic Development and listed for counties like Thurston and Spokane in their Critical Areas Ordinance Updates; most recent for Thurston County as of July 24, 2012] and was the principal data system for the Fish and Wildlife Program in developing the terrestrial portion of the subbasin plans. The IBIS data system is also incorporated into the CHAP protocols. Additionally, in the ISRP response to the Willamette Wildlife Mitigation Program (ISRP Report 2012-21; p. 6), they call for baseline condition evaluations that are able to address the components and/or characteristics describing resilience and habitat condition. Additionally, the ISAB wants to see a more comprehensive measure of biodiversity in the monitoring program (ISAB Report 2013-1; p.52). CHAP is a tool that can meet these requests for providing a consistent monitoring method of fish and wildlife habitat while providing a more comprehensive biodiversity measure. CHAP is also spatially explicit and provides outcomes in a Geographic Information System or GIS. Finally, CHAP provides a functional assessment with outcome values expressed as per-acre and/or put in terms of habitat units. CHAP has been reviewed and approved by the ISRP in the 2009 project review process. In 2010, CHAP was used as the sole procuring method for Willamette Wildlife Mitigation whereby the State of Oregon obtained \$150 million dollar settlement with Bonneville Power Administration. Additionally, CHAP has undergone further peer review and evaluation by the Army Corps of Engineers, Planning Center for Expertise. The CHAP results for the Los Angeles River ecosystem restoration/flood- risk management project was recommended for approval in May 2013 by the Corps' Center for Expertise. The CHAP approach has already been used in Idaho, Oregon, and Washington, and most recently (summer 2013) used to determine baseline conditions for a hydroelectric site in western Washington. CHAP uses data sets that were developed in the Wildlife-Habitat Relationships in Oregon and Washington effort that also produced a book in 2001 (with the same name). The Wildlife-Habitat Relationships book was accepted into the Fish and Wildlife Program during the 2009 review of the program.
- 3) *Continue Mapping Riparian Habitat and Land Cover/Use* - the purpose is to meet an essential need, which is to have an ongoing census of environmental conditions throughout the Basin for key parameters. The ISAB has identified this need as well as several components including riparian cover/condition and

land cover/use and establishing quantitative objectives for focal habitats and species [ISAB 2013-1; p. 52-53]. The reason for doing an ongoing census is so progress can be documented and evaluated. That is, it is hard to say that progress in restoring riparian habitat is being made when you really don't know the extent or condition of this habitat within the watershed or subbasin. As an example, quantitative objectives for protection of key habitat might include "no loss of key habitats" or "protection of a specific amount of habitat (miles of stream, or acres of habitat)" such that the key habitats must be identified, quantified, and monitored [ISAB 2013-1; p. 53]. NHI has mapped riparian habitat in detail within the Willamette Valley subbasin and this data has been used by the Willamette Biological Opinion and forms the controlling data set for the Willamette Synthesis map used by agencies and other organizations to evaluate potential mitigation sites. In most all areas that the Salmon Biological Opinion covers there is a call for enhancing and expanding riparian habitat.

## **Bonneville Customers/other utilities and user groups**

### **33. PPC/NW RiverPartners/PNGC Power/NRU, Bonneville Customers (44) (submitted by Bo Downen )**

#### **The Next 5-Year Period Should be Used to Refine and Improve the Focus of the Program:**

**a) Research, Monitoring and Evaluation** - The Council should ensure a robust and efficient RM&E Program but needs to reduce the overall costs which now represent half the entire cost of the Program:

- Clearly define and estimate the costs of current RM&E efforts.
- Delineate research from ongoing monitoring.
- Establish a policy framework to prioritize and recommend RM&E projects based on an evaluation of cost, risk, and certainty as developed by your staff.

**b) Habitat Project Evaluation-** The Council should conduct an evaluation of the habitat monitoring efforts to date and determine how much is necessary:

- Define the fish habitat improvement efforts conducted under the Program.
- Evaluate extent of habitat monitoring work to date.
- Assess the usefulness and necessity of continued monitoring for habitat improvements.

## **Environmental /NGOs**

### **34. Native Fish Society ( 60) (submitted by Bill Bakke)**

- we are submitting the ISAB recommendations to the Council for adoption by reference see Reference Document Section at the end of this document for program objective details from the **ISAB 2013-1 Review of 2009 Program**
- Uncertainty and Levels of Evidence; ISAB recommendations for addressing uncertainty and levels of evidence:
  - Require all project proposals to acknowledge uncertainty. Proposals should describe areas of uncertainty and what will be done to deal with the uncertainties. Consideration of uncertainty is essential for effective adaptive management and structured decision making.
  - Recognize that uncertainty is inevitable and encourage efforts to enhance resilience. The importance of resilience and enhancement strategies are included elsewhere in this review.
- ISAB recommendations for monitoring strategies, information sharing, addressing non-natives and predation , addressing carrying capacity for juvenile salmonids, **Loss of Productivity in Natural Populations, and** for freshwater habitat requirements (see REFERENCE DOCUMENT SECTION at the end of this document for details)

### **35. NSIA and ANWS (62) (submitted by Liz Hamilton )**

- The Council should adopt an adaptive management project to test increased levels of spill in the spring to achieve better, more reliable survival of smolts passing through the hydro system. Scientists have used

sixteen years of data from spill and the Comparative Survival Study (CSS) to analyze the probable effects of increased spill. Their modeling and extensive analysis suggests that increasing spill levels to a gas cap of 125% demonstrates the potential to increase survival rates to the level needed to achieve recovery of the listed species. The current levels of survival only maintain the status quo with expectations of recovery in over one hundred years. Given the looming prospects of climate change and the demands of growing human development within the basin, this is not acceptable. Any new plan must call for significant improvement in salmon recovery efforts. Best available science dictates that the amended Program should call for this approach toward more certainty.

- The Council should include an initiative to collect and develop information concerning the economic benefits of fishing activities within the basin. There are currently sources of some economic information but the Council should support and advocate the collection of timely and specific information that applies to the entire Columbia Basin. This information would be very useful in evaluations of future policy alternatives and would be a source of economic information that would be continually up to date and specific to the Columbia. A database of this economic activity will be very useful within the region and the Council is the appropriate entity for this important project.
- Also support the recommendation from **Pacific Fishery Management Council, PFMC (34) (submitted by Jennifer Gilden)**

**36. Regional Fisheries Enhancement Group, RFEG (63) (submitted by Margaret Newuman )**

- nothing

**37. Snake River Salmon Solutions (65) (submitted by Bert Bowler)**

- An accurate accounting and reporting system to enumerate by species and ESU wild/natural and hatchery origin salmon and steelhead returning to the Columbia River for public consumption.
- The Council and federal government like to spin return data in the aggregate with little regard for listed ESUs. Graphics need to include earlier (1960s) returns rather than using NOAA's 1990s baseline.

**38. Trout Unlimited (67) (submitted by Kate Miller )**

- **Promote Scientific Principles, Objectives and Strategies** , TU believes that fish and wildlife management should be based on the best available science. Accordingly, we place much stock in the work the of the Council's Independent Scientific Advisory Board (ISAB). Our recommendation is that the Council should adopt the ISAB's recommendations set forth in the ISAB's *Review of 2009 Fish and Wildlife Program*, a report issued in March 2013.
- **ISAB's recommendation related to the RME Strategy**, (see REFERENCE DOCUMENT SECTION at the end of this document for details)

## **Reference Material - Specific Content of Documents Referred to within the Recommendations**

### **A. ISAB 2013 Program Review**

<http://www.nwcouncil.org/media/5950466/isab2013-1.pdf>

WDFW (4) NOAA-F (30) Native Fish Society (60) Trout Unlimited (67) , per ISAB 2013-1,

1. Monitoring, Evaluation and Research

#### **A. Uncertainty and Levels of Evidence**, ISAB recommendations for addressing uncertainty and levels of evidence

1. Require all project proposals to acknowledge uncertainty. Proposals should describe areas of uncertainty and what will be done to deal with the uncertainties. Consideration of uncertainty is essential for effective adaptive management and structured decision making.
2. Recognize that uncertainty is inevitable and encourage efforts to enhance resilience. The importance of resilience and enhancement strategies are included elsewhere in this review.

#### **B. Monitoring Strategies to Measure Success**, ISAB recommendations for monitoring strategies

1. Support development and evaluation of HLIs.
2. Implement monitoring to evaluate progress against new quantitative objectives as recommended elsewhere in this review, for example diversity performance, artificial production programs, and habitat restoration benefits.
3. Implement social monitoring to better evaluate and improve acceptance of the Program at local scales in the region, for example, by regular surveying of public opinion about progress and strategies for achieving the vision.
4. Design monitoring to support adaptive management and structured decision making by providing data to test current knowledge and revise management program

#### **C. Information Sharing**, ISAB recommendations for information sharing

1. Accelerate efforts to improve data availability and sharing through emerging monitoring programs to ensure that these tasks are completed in next two to three years and that data access and sharing become functional. Further, the ISAB or another group should be directed to identify additional basic data that should be acquired and shared, for example, measures of genetic diversity.
2. Initiate and support a comprehensive citizen science program. Identify citizen science programs that already exist in the Basin. Promote a comprehensive citizen science program by starting in a few selected subbasins with existing programs with a view to expand these programs to all parts of the Basin within a few years and linking them to the appropriate agencies and Tribes. Partnerships and mechanisms to guide new efforts can be encouraged through funding or broad recognition.
3. Organize and support “communities of practice” and support technology transfer and education (e.g., workshops) on issues of importance to the ecological province. Collaboration at the ecological province scale is essential for effective restoration.
4. Use HLIs and information from other monitoring programs to engage the public and develop a common Program vision. Conduct regular press and other briefings; use fact sheets and message boxes to define the issues. Use of “mobile apps” is one example of effective information sharing.  
[.omitted text]

### **2. Threats to Sustainability,**

#### **A. Loss of Biological Diversity**, ISAB recommendations for diversity

1. Develop and refine HLI. The Council should consider revising the Program objectives for biological performance to include quantitative measures of diversity. Council staff and others who are working to develop and refine HLI should explore simple measures of population viability that depend on life history diversity and spatial structure (and are provided in periodic



status reviews) as potential HLI to represent population diversity across recovery units.

2. Develop new capacity and knowledge. For nearly two decades the Program has recognized the need to understand biological diversity as the critical foundation for resilience and sustainability. It is now possible to develop new measures to monitor biological diversity at the scale of the entire basin. An active program of research implemented through focused RFPs should be initiated

**B. Climate Change, ISAB recommendations for addressing climate change**

[..omitted text]

3. Examine management options under climate change scenarios by using monitoring data and modeling tools where possible

4. Assess and appropriately revise ongoing monitoring to optimize collection of data regarding species responses, interactions and production under climate change

[..omitted text]

**C. Proliferation of Chemicals and Contaminant, ISAB recommendations for addressing chemicals and contaminants**

1. Actively investigate the impact of chemicals on restoration activities by fully implementing a water quality program. This initiative will require working partnerships with the Federal Action Agencies (e.g., EPA, Bureau of Land Management, U.S. Forest Service and others) as well as initiating modeling of climate-temperature effects for all parts of the Basin.

[..omitted text]

**D. Novel Hybrid Communities: Non-native Species and Predation, ISAB recommendations for addressing non-natives and predation**

[..omitted text]

2. Develop a system for regularly monitoring the status of non-native species across the entire Basin.

3. Support research to understand or mitigate past ecological changes created by the hydrosystem that have lead to current conditions fostering the proliferation of predators and their impacts on salmonids, sturgeon, lamprey, and other species.

4. Support research to understand trophic interactions involving non-native species in hybrid and novel ecosystems with reference to improved diversity, abundance, and productivity.

[..omitted text]

**E. Uncertainty about Carrying Capacity, ISAB recommendations for addressing carrying capacity for juvenile salmonids**

{omitted text}

2. Conduct empirical investigations and develop bioenergetic models to estimate trophic demands on food supplies by native and non-native competitors of juvenile salmonids.

**F. Artificial Propagation: Loss of Productivity in Natural Populations, ISAB recommendations for artificial production strategies**

[..omitted text]

2. Recognize and address the need to quantify the cumulative impacts of artificial production on natural production and ecosystem processes at population, subbasin, and basin scales.

7. Adopt guidelines, benchmarks, and a basin-level experimental framework specifically for reintroduction of salmon and steelhead into watersheds from which they have been extirpated.

8. Develop quantitative goals and basin-scale monitoring for artificial production.

**G. Harvest Strategies, ISAB recommendations for harvest strategies**

1. Assess the extent to which harvest slows recovery of naturally-reproducing populations that are below the replacement level ( $R/S < 1$ ) and delays the objective of establishing healthy

naturally-reproducing populations.

2. Recognize and address ecosystem-scale effects of harvest and potential fisheries-induced evolution. Address whether harvest management plans have been scientifically reviewed and analyzed to assess compatibility with the Program.

[..omitted text]

4. Evaluate the impacts that limitations in the extent of hatchery fish harvest have on natural spawning populations through factors such as overexploitation and straying. Address whether hatcheries are being terminated as recommended in the 2009 Program.

5. Develop the capability to monitor hatchery and natural-origin fish separately so that the productivity and abundance of the naturally reproducing stock can be tracked and used to develop escapement goals and harvest rates. Recognize that this monitoring has been an important “term and condition” in some NMFS hatchery Biological Opinions.

### **3. Knowledge Gaps**

A. Hydrosystem Impacts, ISAB recommendations for addressing hydrosystem impacts

1. Continue to foster and support more formal adaptive management experiments designed to provide information on hydrosystem operations and their effects on salmon and other species.

2. Foster and support efforts to monitor and improve white sturgeon passage through lower mainstem dams and conduct research on factors in the mainstem hydrosystem (including aspects of reservoirs) that affect natural spawning, reproduction, and recruitment success (Consistent with Council direction to the 2012 Columbia River Basin White Sturgeon Planning and Passage Workshop).

[..omitted text]

4. Evaluate the feasibility and cost-effectiveness of steelhead kelt reconditioning, particularly in relation to mainstem hydrosystem operation and passage issues.

5. Investigate the potential impacts of short-term fluctuations in water releases and of reservoir habitat and water levels on access to habitat, growth and survival of larval and juvenile fishes and other species.

B. Freshwater Habitat Restoration Requirements, ISAB recommendations for freshwater habitat requirements

1. Uncertainties concerning the success of habitat restoration efforts should be addressed. There is a need to view habitat restoration as an experimental process that will require much better sampling designs at multiple scales. The ISRP has commented that the effectiveness of habitat restoration will depend not only the success of a specific action (e.g. planting riparian zones, fencing, flood plain reconnection) but also on how those actions are arranged within a watershed. For example, in many subbasins, actions are implemented through willing landowners, not through a prioritized strategy – and the success of such an opportunistic approach is questionable (ISAB 2011-4).

[..omitted text]

3. Establish quantitative objectives and timelines and require detailed evaluations, or formal reviews to evaluate whether habitat restoration efforts are really providing the anticipated benefits. Quantifiable objectives are required to provide clear direction and context. An audit/review process involving experts (such as was done for hatcheries by the HSRG), but with a focus on habitat and landscape restoration, could be used to explore the current state of restoration actions in the Basin. A formal review of the results from ISEMP and CHaMP should be highlighted and shared broadly with all engaged in Program projects.

[..omitted text]

5. Encourage the sharing of experience and information among programs engaged in similar actions. Innovation and diffusion of ideas, successes, and failures across the Program can strengthen the capacity to adapt and refine restoration actions. By supporting “communities of practice” (Rogers 2006), the integration of information across projects becomes a basic principle of effective habitat protection and restoration activities.

C. Terrestrial Wildlife Restoration Strategies, ISAB recommendations for terrestrial wildlife restoration strategies

1. Validate the relationship between the HEP habitat units and some real measure of value of the habitat, consistent with an ecosystem approach, such as abundance, productivity, diversity, and spatial extent for key species.

[..omitted text]

D. Estuary Strategies, ISAB recommendations for estuary strategies

[..omitted text]

2. Develop methods to measure the potential increase in survival of Chinook and steelhead that benefit from estuary restoration.
3. Develop methods to monitor diversity in the estuary to track diversity in time.
4. Develop a comprehensive plan for monitoring estuary restoration. Long-term effectiveness monitoring of representative habitat restoration projects will be essential for evaluating outcomes as part of adaptive management. [..omitted text]

## **B. ISAB Food web recommendations (2011-1)**

<http://www.nwcouncil.org/media/5759993/isab2011-1.pdf>

recommended by CRTFIC (14) and USFWS (33)

*The below recommendation excerpt is based on a search for the term 'recommendation' so the extraction may be incomplete*

### C.3. Food Web Consequences of Fish Predation

[omitted text]... the Basin's altered physicochemical template necessitates facing the reality that hybrid food webs will be part of the future; we must learn when and where they should be accepted and managed as persistent ecological components. An inventory of hybrid food webs would be a good first step to scope out future challenges and restoration activities. Additional research is needed to define strategies and actions for effectively managing hybrid ecosystems and food webs, and for deciding when non-natives should be accepted as parts of desirable food webs. The difficulty of the topic and its immediate-term importance suggest that a Basin-wide symposium or workshop would be advisable to gather input to develop better understanding of and strategies for managing the hybrid environments and food webs of the future and to communicate the finding to the general public.

### C.6 Conclusions and Recommendations for Restoration

[omitted text]... Ideally, concurrent simulations should be conducted on the major planktivores and piscivores inhabiting specific habitats or combination of habitats used during rearing and migration by various life stages of fish. Collective monthly consumption rates, when compared to the temporal biomass or production dynamics of key prey, could inform managers if consumption demand exceeds carrying capacity, or if predation regulates prey population dynamics [omitted text]... some of the critical data needed for these analyses are currently lacking or inaccessible. However, food web studies that are designed at the outset to sample growth, thermal experience, and diet of all major species concurrently benefit tremendously from economies of scale.

### D.2. Large tributaries

Frame Future Studies involving Tributary Food Webs in Relation to Broader Conceptual Frameworks. Future investigations of food webs in the Basin's large tributaries will benefit by planning investigations in at least one of these major conceptual frameworks. To simplify the issue, and for the purpose of illustration, many investigations can be framed by one of three frameworks: the Flood Pulse Concept, the River Continuum/stream zonation Concept, and the Serial Discontinuity Concept (Table D.2.2).

### D.5 Water Storage Impoundments. Conclusions and Recommendations

Water-storage reservoir food webs support important sport fisheries for kokanee and other species and, in some cases, are important for sustaining for ESA-listed adfluvial bull trout. Dam operations and land use affect thermal regime, water retention time, and reservoir levels, which in turn affect seasonal production cycles of algae and zooplankton, accessibility of prey to planktivorous and piscivorous fishes, and connectivity between stream- and lake-rearing phases of adfluvial life cycles. These food-web interactions have important implications for restoration efforts and water management

### E.4. A Total System Perspective: Phenology Attributes of Productivity and Resilience: Connectivity and Timing

There are three key research challenges in establishing a better understanding of how food web connections and timing can be functionally incorporated into restoration activities:

1. In the short term, use existing literature or data to better identify extant food web patterns (e.g., aquatic insect emergence) and their related ecological responses. Much can be learned from the information already in hand, if it is examined in a thoughtful and comprehensive manner

2. In the medium term, discover and quantify connections among patterns and processes. For instance, connections between the place-based production of foods and the timing of movements by juvenile salmon during their seaward journey. Basic investigations will advance a mechanistic understanding of phenology within the Columbia River Basin. Similarly, multidisciplinary, large-scale catchment projects can foster collaborative efforts among various scientific disciplines and resource managers. Expertise is currently fragmented across the main contributory disciplines (ecology, hydrology, geomorphology, flood risk management, civil engineering), restricting the effectiveness and potential of restoration activities. This is counter-productive, given the shared vision of effective river management and restoration that is based on good science producing positive social impacts. We need a diverse expertise because a range of approaches is necessary to build a sufficient, integrated capacity that delivers science of real management value.

3. Management and restoration of food webs on river floodplains – for the sustainable productivity and diversity of fish – demands a sound understanding of connections between water regimes and ecological responses. Basically, we have to restore the floodplain component of the food web to restore the fish. It is necessary therefore to understand relationships between river discharge, flood magnitude, floodplain inundation patterns and fish production at scales commensurate with the issues. Even though such analyses are largely in their infancy (e.g., Schramm and Eggleton 2006, K. van de Wolfshaar et al. 2011), they are key parts of an integrated and comprehensive restoration program. Large scale and seasonally appropriate experimental inundation of floodplains is just one example of how to approach this multidisciplinary research challenge

#### E.5. Threats, Knowledge Gaps, and a Strategy for Columbia River Food Webs

Key Threats to Resilience and Productivity:

- Uncertainty about the Aggregate Carrying Capacity of the Columbia River for Salmon and Steelhead...[omitted text]...
- Proliferation of Chemicals and Contaminants...[omitted text]...
- Consequences of Non-native Species: Hybrid Food Webs...[omitted text]...
- Altered Nutrient Organic Matter (Energy), Water, and Thermal Sources and Flows...[omitted text]...
- Disconnects among Critical Habitats and their Food Webs...[omitted text]...
- Environmental Change and Surprises. ...[omitted text]...
- Fill Specific Knowledge Gaps...[omitted text]...
- Data Gathering and Synthesis Modeling...[omitted text]...
- Restoration Actions and Experiments to Test Model Predictions and Assumptions...[omitted text]...
- Evaluation of Alternative Policies with Models...[omitted text]...
- A Strategy for Protecting the Best and Restoring the Rest...[omitted text]...
- Identify Properties Sustaining Desired Ecosystem States. ...[omitted text]...
- Sustaining Resilient Populations. ...[omitted text]...
- Hybrid Food Webs as Legitimate Targets, while Maintaining Productivity...[omitted text]...
- Restore for a Changing World...[omitted text]...
- The Case for a Comprehensive Food Web Model...[omitted text]...
- A Time-Prioritized Action Plan...[omitted text]...

Table E.5.1. Summary of major knowledge gaps in understanding Columbia River food webs and proposed actions  
The rationale and details for each are given in individual chapters and the appendices.

Major Knowledge Gaps, Very High Priority (detailed text omitted):

Impact of Hatchery Releases on Food Webs; Be Proactive on Non-native Species;  
Proliferation of Chemicals and Contaminants; Quantifying Food Webs and Ecological Networks

Major Knowledge Gaps, High Priority (detailed text omitted):

Physical Controls on Structure and Processes; Base of the Food Web; Growth of Juvenile Fish; Productivity Trends;  
Plume Dynamics; Land-Water Interactions; Up-slope and Up-stream;

Major Knowledge Gaps, Important (detailed text omitted):

Historical Baselines; Apex Predators; Implications for Restoration

C. **CRBLTWG (Columbia River Basin Lamprey Technical Workgroup). 2005. Critical uncertainties for lamprey in the Columbia River Basin: results from a strategic planning retreat of the Columbia River Basin Lamprey Technical Workgroup**

Extracted text relevant to prioritized research uncertainties for anadromous and resident lamprey, a copy of the original document available from CBFWA workgroup documents:

Table 1. Prioritized critical uncertainties for anadromous lamprey in the CRB.

Ranking	Critical Need	Category
1	Lamprey Status	Imminent
2	Passage	Imminent
3	Population Delineation	Highly Important
4	Limiting Factor Analysis	Highly Important
5	Restoration Activities	Important
6	Biology/Ecology	Important
7	Population Dynamics (Predictive Analyses)	Needed

Table 2. Prioritized critical uncertainties for resident lamprey in the CRB. Passage was included as a component of Limiting Factors.

Ranking	Critical Need	Category
1	Lamprey Status	Imminent
2	Restoration Activities	Imminent
3	Biology/Ecology	Important
4	Limiting Factor Analysis	Important
5	Population Dynamics (Predictive Analyses)	Needed
6	Population Delineation	Needed

The first steps in prioritizing the list of critical uncertainties were to assign numeric values to the biological benefit and knowledge gap for each critical uncertainty by consensus of the Workgroup. This exercise was performed for anadromous and resident categories separately.

The next step in prioritizing the critical uncertainties was to sort the two lists by each critical uncertainties' biological benefit. Knowledge gap scores were not ranked and were only used to break ties. Remaining ties were discussed and decisions to rank one over the other were made by Workgroup consensus. The Workgroup relied on best professional judgment of everyone present to place uncertainties into four priority categories:

Category	Biological Benefit	Definition
Imminent	4.5 – 5.0	Addressing these uncertainties immediately is imperative. Lack of addressing these uncertainties will likely result in further and considerable detrimental impacts on lamprey populations.
Highly Important	4.0 – 4.5	Addressing these uncertainties is a high priority. Lack of addressing these uncertainties will likely preclude restoration and enhancement of lamprey populations.
Important	3.0 – 3.5	Addressing these uncertainties is important, but less so than those considered imminent or highly important. Lack of addressing these uncertainties will likely limit

		opportunities for restoration and enhancement of lamprey populations.
_____		

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