

## Staff summary of Issues & Recommendations Ocean, Estuary and Plume

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

10/29/2013 10:08 AM

### 2009 Fish and Wildlife Program Sections

- II. D. Basinwide Provisions Sec A. Planning Assumptions, Sec B Science Principles (7-9)
- IV. Ocean strategies (31)
- V. Columbia River Estuary Strategies (32)
- VI. Mainstem Plan, D. Mainstem Strategies, Water Management (48)
- II. D. 9. Monitoring, Evaluation, Research and Reporting: Research Plan

### Overview

*Columbia River Estuary* - The Council received many recommendations to continue and advance our endorsement of restoration activities in the Lower Columbia River estuary. New recommendations included; the development of an estuary plan, research and monitoring to address critical uncertainties regarding the effectiveness of estuarine habitat types and restoration, reassessment of limiting factors in the estuary (especially contaminants), review of the NOAA Estuary Module, redefinition of estuary boundaries, inclusion of lamprey in estuary language, inclusion of provisions for habitat mitigation in the Lower River tributaries, acknowledgement of strategies and priorities identified in the Columbia Estuary Ecosystem Restoration Program, and development of biological objectives specific to the Lower River.

*Plume and Near shore Ocean* - The Council received many recommendations for the Program to further acknowledge the importance of the plume and nearshore ocean as critical habitat in the lifecycle of anadromous fish. Various entities recommended the Program support ongoing research and monitoring in order to understand; the effects of ocean and plume conditions on anadromous fish, limits to restoration potential in the CRB due to variability in ocean conditions, and to provide the data necessary to predict future ocean and plume conditions. Some specific research supported in recommendations included; the collection of data needed to optimize forecasts of adult returns, research on forage fish habitat needs and food-web impacts in the estuary and nearshore ocean, experiments on variable release times to measure stock specific growth in the ocean vs freshwater. Broad support was expressed for the Council to continue to sponsor an ocean and plume forum to enhance collaboration and information sharing between scientists and managers. The Council also received one recommendation to limit inclusion of measures in the ocean and plume.

## Staff summary of Recommendations

### II. Basinwide Provisions

#### **B. Science Principles (p9-10)**

1. *Add language to the Scientific Principles*, pg 9-10: “The Columbia River ecosystem includes the estuary, plume, and near shore ocean environments. Salmon, steelhead, lamprey, sturgeon and eulachon accommodate ocean mortality and environmental variability by having life histories that have a sufficient level of productivity and a wide range of biological diversity (i.e., resiliency).” (COWLITZ, GSRO, ODFW, USRT , WDFW, NOAA , LCREP)

#### **C. Biological Objectives (p11-13)**

1. *Ecosystem objective*: Include the goal of a “restored, resilient and healthy CRB that includes ecosystem-based function.” Plume and near shore ocean should be enhanced through higher spring and summer flows and lessened duration of hypoxia. Improving ecosystem-based function in the estuary will enhance food web and increase juvenile fish survival. (UCUT)
2. *Lower River Objectives*: Include biological objectives specific to the Lower Columbia River salmon and steelhead on par with those above Bonneville Dam. Start with CB F&W Managers Roundtable recommendation (Sec 2.2): establish biological objectives for total adult runs for listed lower Columbia salmon and steelhead to achieve 75% of recovery goals (NOAA 2013) by 2025. (LCREP)

#### **D. Basinwide Strategies (p14)**

1. Insert the following language into the Program: “Management of the Columbia River Basin hydropower system directly affects the ocean environment primarily in two ways: 1) it changes the natural hydrograph by development of the hydro-system, and changes estuary and plume habitats along with the timing and quantity of natural flows; and 2) the releases of large numbers of hatchery fish from Columbia River hatcheries may trigger density dependent effects in the estuary, plume and ocean.” (COWLITZ, GSRO, ODFW, USRT, WDFW, NOAA, LCREP)
2. *Future planning*: Program should plan for management under conditions that intensify landscape scale stressors such as climate change, water shortages, contaminants, invasives, changes in water temperatures, hypoxia and acidification in our estuary, and wildfire. (USGS)
3. *Life Cycle*:
  - a. Consider the complete anadromous fish life cycle and critical habitat needs, including the estuary, plume and nearshore ocean when making management decisions. Integrate the effects of future climate change into these decisions and develop adaptation strategies to address these effects. (COWLITZ, GSRO, ODFW, USRT, WDFW, NOAA, LCREP)
  - b. Add lifecycle strategy: “consider the entire life cycle when evaluating the benefit of mitigation actions.” The Program is organized by sector, i.e. habitat, AP, harvest, passage, mainstem, ocean, and estuary. It is important that strategies and actions in each sector not be considered in isolation. (NOAA)
  - c. Wild salmonids: To address recovery of wild salmonids, restoration investments should be designed to maintain the chain of habitat requirements for each species to complete their life history in freshwater including structure, temperature, flow and retention of gravel and nutrients. This should include the entire habitat from to estuary and near-shore ocean habitats. (NATIVE FISH SOCIETY)

## **IV. Ocean (p31)**

1. *Title:* Change to “Plume and Nearshore Ocean” (NOAA)
2. *Primary strategy:*
  - a. Expand beyond survival to include ocean effects on growth and viability (abundance, productivity, spatial structure and diversity) and recognize interaction effects among these processes. (ISAB, LCREP)
  - b. Emphasize that anadromous populations in all subbasins of the CRB are affected by physical, biological, and ecological conditions in the ocean. (ISAB, LCREP)
  - c. Add language “It is important to continue basic monitoring over time to increase understanding of the estuary, plume and Nearshore Ocean’s role in anadromous fish survival and to have both baseline and real time information that can assist inland management decisions.” (COWLITZ, GSRO, ODFW, USRT, WDFW, NOAA, LCREP)
  - d. Add sentence to opening paragraph of primary strategy: “Identify the effects of ocean conditions on anadromous fish survival and use this information to evaluate and adjust inland actions. This should include evaluating the effects of ocean harvest on Pacific lamprey food resources.” Also add: “it is important to continue basic monitoring over time to increase understanding of the plume and nearshore ocean's role in anadromous fish survival and to have both baseline and real-time information that can assist inland management decisions.” (GRAND RONDE)
  - e. Update to reflect important recent advances in scientific understanding of the effects of ocean conditions on salmonid survival. Recognize that the CRB and ocean are linked ecosystems that determine the survival and growth of anadromous fishes in the Basin and ocean and should emphasize the importance of healthy CRB ecosystem during poor ocean condition cycles. It should also confirm the importance of monitoring and understanding ocean conditions and establishing management systems that can adapt accordingly. (NOAA)
3. *Ocean Strategies*
  - a. Revise/ reorder the ocean strategies as follows: a) understand and isolate effects of ocean conditions on anadromous fish survival and growth to increase the power of analyses to detect the effects of restoration actions in CRB; b) determine limits to restoration potential or the effectiveness of actions taken in the Basin given the variability of ocean conditions that affect anadromous fishes; c) predict future ocean conditions to adjust actions in CRB to achieve greater benefits and efficiencies. (ISAB, LCREP)
  - b. Exclude measures outside the CRB, specifically ocean-based studies; coded wire tagging for catch-sampling and harvest management, ocean-based research, mitigation, protection, or enhancement measures, including those attempting to address ocean conditions such as acidification. (CUSTOMERS)
  - c. Emphasize coordination of ocean strategies across subbasins and ecosystems to increase benefits from RM&E. (ISAB, LCREP)
  - d. Add “Ocean Strategy 3 - Identify the effects of ocean conditions on anadromous fish survival and use this information to evaluate and adjust inland management actions.” (COWLITZ, GSRO, ODFW, USRT, WDFW, NOAA, LCREP, GRAND RONDE)
  - e. Ocean and Plume Science Management Forum: Fund a collaborative forum of scientists and managers to: 1) identify key management questions, 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 NPCC ways to improve freshwater management benefits of ongoing and proposed ocean, estuary and plume research conducted under the Program. (COWLITZ, GSRO, ODFW, USRT, WDFW, NOAA, LCF&WRB, LCREP)

## **V. Estuary Strategies (p32)**

1. *Estuary Plan*: Develop a coordinated Estuary Plan that includes detailed strategies for the estuary in conjunction with the mainstem and ocean and a plan for monitoring long-term effectiveness of estuary restoration for adaptive management. (ISAB, NOAA, LCREP)
2. *Methods*: Develop methods to measure the potential increase in survival of Chinook and steelhead that benefit from estuary restoration. Develop methods to monitor diversity in the estuary to track diversity over time. (ISAB, NOAA, LCREP)
3. *Reassess estuary limiting factors*, including contaminants, in light of new research. (ISAB, NOAA, LCREP)
4. *Estuary Module*: update and peer review the Estuary Module. (ISAB, NOAA, LCREP)
5. *Redefine estuary boundaries*: to include the tidal regions at the mouth of tributaries draining into the estuary. (ISAB, NOAA, LCREP)
6. *CEERP*: Acknowledge strategies, priorities, and benefits identified in the Columbia Estuary Ecosystem Restoration Program, including restoring areas of tidal influence. (BPA)
7. *Lamprey*: Revise third bullet under Estuary Strategies on Page 32 to include Pacific Lamprey. (GRAND RONDE, NEZ PERCE, YAKIMA, PFMC)
8. *Continue endorsement of restoration activities in the Lower Columbia River estuary* to accelerate recovery of both up-river runs and lower-river priority salmon runs. (PFMC)
9. *Lower Columbia tributary habitat mitigation*: Provide for restoration of Lower Columbia tributary habitat as off site mitigation for hydrosystem impacts on estuary habitat for Lower Columbia Chinook, Coho, Chum and Steelhead and Coho populations across the Basin. (LCF&WRB)
11. *Flow Regime*: Include strategies specific to the region that provide normative hydrologic or environmental flows to the estuary and plume, allowing overbank flows, similar to hydro management in other highly controlled systems (e.g. Colorado River). (LCREP)
12. Add to estuary strategies p32: “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.” (USGS)

## **VI. Mainstem Plan, D. Mainstem Strategies**

### **Water Management (p48)**

1. Instead of “Hanford Reach/ mainstem and estuary spawning, rearing and resting habitat” Change title to “Columbia River mainstem and estuary, spawning, rearing, and resting habitat.” Current program: p 48. (WDFW)

### **Research Plan**

1. *Optimize forecasts of adult returns*. Continue to support ocean research such as the NOAA and DFO ocean indicators which can be used to further salmon run forecasting. (COWLITZ, GSRO, ODFW, USRT, WDFW, NOAA, LCREP)
2. *Direct and indirect FCRPS impacts*: Continue to research direct and indirect hydrosystem effects on anadromous fish habitat, considering life histories and productivity. (COWLITZ, GSRO, ODFW, USRT, WDFW, NOAA, LCREP)
3. *Effectiveness of estuary restoration*: Address the uncertainty regarding the effectiveness of estuarine restoration projects of varying habitat types and their contribution to juvenile survival and increased adult returns. Key information needs include; estimates

of residence time in rearing habitat, quantity and quality of rearing habitat, movement between rearing habitats, importance of habitat connectivity and spatial distribution, quantity and quality of fish habitat, fish use of habitat by habitat type, distribution of habitat by type in the Lower Columbia River and estuary. 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.

(COWLITZ, GSRO, ODFW, USRT, WDFW, NOAA, LCREP, USGS)

4. *Forage fish*: support research on forage fish in the lower estuary and nearshore area through the following measures; a) identify spawning and rearing life history attributes of forage fish in the estuary, b) determine the role of forage fish as alternate prey for birds in the lower estuary, c) elucidate the role eulachon may have as an alternative prey for sea lions, d) determine how restoration projects in the estuary may contribute to reproductive success and rearing of forage fish, e) identify the relation between Columbia River flow and forage fish abundance in the estuary, f) identify role forage fish have in survival of juvenile Chinook salmon, coho, and steelhead, g) determine how climate change, ocean acidification, salinity, estuary turbidity maximum (ETM), and localized hypoxia are likely to affect forage fish in the coming decades. (COWLITZ, GSRO, ODFW, USRT, WDFW, NOAA, LCREP, USGS)
5. *Adaptive management*: Explore and implement adaptive management experiments to improve survival of anadromous fish. Support experiments on variable release timing and evaluation of stock-specific growth and survival in the ocean compared to freshwater management. (COWLITZ, GSRO, ODFW, USRT, WDFW, NOAA, LCREP)
6. *Life cycle*: Support continued research/ life cycle modeling to inform decision makers of the biological benefits from implementing or synchronizing different suites of actions across the life cycle. (NOAA)

## Full Recommendations by Entity

---

### ISAB

#### **Estuary** strategies:

1. Develop detailed strategies for the estuary in conjunction with the mainstem and ocean. Consider developing a coordinated Estuary Plan.
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 over time.
4. Develop a comprehensive plan for monitoring long-term effectiveness of estuary restoration for adaptive management.
5. Reassess factors limiting production in the estuary, including contaminants, in light of new research.
6. Update and peer review the Estuary Module.
7. Consider redefining estuary boundaries to include the tidal regions at the mouth of tributaries draining into the estuary.

#### **Ocean** strategies:

1. Emphasize that the productivity of anadromous populations in all subbasins of the CRB is affected by physical, biological, and ecological conditions in the ocean. Expand the primary strategy beyond survival to include ocean effects on growth and viability (abundance, productivity, spatial structure and diversity) and recognize interaction effects among these processes.
2. Revise and reorder the ocean strategies as follows: a) first priority, to understand and isolate effects of ocean conditions on anadromous fish survival and growth to increase the power of analyses to detect the effects of restoration actions in the Basin; b) second priority, to determine limits to restoration potential or the effectiveness of actions taken in the Basin given the variability of ocean conditions that affect anadromous fishes; c) third priority, to predict future ocean conditions with a view to adjusting actions in the Basin to achieve greater benefits and/or efficiencies.
3. Emphasize coordination of ocean strategies across subbasins and ecosystems to increase benefits from RM&E.

---

### CUSTOMERS (p3)

Ocean: Exclude measures outside the CRB, specifically ocean-based studies. Examples of measures to exclude; coded wire tagging for catch-sampling and harvest management, ocean-based research, mitigation, protection, or enhancement measures, including those attempting to address ocean conditions such as acidification.

---

### BPA (p3)

Estuary: Estuary habitat restoration actions have been shown to benefit to juvenile salmonids. Acknowledge strategies, priorities, and benefits identified in the Columbia Estuary Ecosystem Restoration Program, including restoring areas of tidal influence.

---

### COWLITZ (p33), GSRO (p17-19), ODFW (p35), USRT (p33), WDFW (p47), NOAA (p20)

Fully Incorporate Estuary, Plume and Nearshore Ocean in Program

1. Add language to the *Scientific Principles*, pg 9-10: *The Columbia River ecosystem includes the estuary, plume, and near shore ocean environments. Salmon, steelhead, lamprey, sturgeon and*

*eulachon accommodate ocean mortality and environmental variability by having life histories that have a sufficient level of productivity and a wide range of biological diversity (i.e., resiliency).*

2. Add language to *Plume and Nearshore Ocean Strategies*, pg 31. Retain the *Ocean strategies* and add: To Primary strategy, *“It is important to continue basic monitoring over time to increase understanding of the estuary, plume and nearshore ocean’s role in anadromous fish survival and to have both baseline and real time information that can assist inland management decisions.”* Add *“Ocean Strategy 3 - Identify the effects of ocean conditions on anadromous fish survival and use this information to evaluate and adjust inland management actions.”*

3. Insert the following language into the Program: *“Management of the Columbia River Basin hydropower system directly affects the ocean environment primarily in two ways: 1) it changes the natural hydrograph by development of the hydro-system, and changes estuary and plume habitats along with the timing and quantity of natural flows; and 2) the releases of large numbers of hatchery fish from Columbia River hatcheries may trigger density dependent effects in the estuary, plume and ocean.”*

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 2: Consider the complete anadromous fish life cycle and critical habitat needs, including the estuary, plume and nearshore ocean when making management decisions. Integrate the effects of future climate change into these decisions and develop adaptation strategies to address these effects.

Measure 3: Optimize forecasts of adult returns. Continue to support ocean research such as the NOAA and DFO ocean indicators which can be used to further salmon run forecasting.

Measure 4: Explore and implement adaptive management experiments to improve survival of anadromous fish. Support experiments on variable release timing and evaluation of stock-specific growth and survival in the ocean compared to freshwater management.

Measure 5: Continue to research direct and indirect hydrosystem effects on anadromous fish habitat, considering life histories and productivity.

Measure 6: Address the uncertainty regarding the effectiveness of estuarine restoration projects of varying habitat types and their contribution to juvenile survival and increased adult returns.

Key information needs include; estimates of residence time in rearing habitat, quantity and quality of rearing habitat, movement between rearing habitats, importance of habitat connectivity and spatial distribution, quantity and quality of fish habitat, fish use of habitat by habitat type, distribution of habitat by type in the Lower Columbia River and estuary. 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: In order to move towards an ecosystem management approach, the Program should support research 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.

---

#### CONFEDERATED TRIBES OF THE GRAND RONDE (p18-19)

##### **Ocean**

1. Add sentence to opening paragraph for *Primary Strategy* on Page 31 as follows: *Identify the effects of ocean conditions on anadromous fish survival and use this information to evaluate and adjust inland actions. This should include evaluating the effects of ocean harvest on Pacific lamprey food resources. Also add: it is important to continue basic monitoring over time to increase understanding of the plume and nearshore ocean's role in anadromous fish survival and to have both baseline and real time information that can assist inland management decisions.*
2. Add to Ocean Strategy on page 31, Identify the effects of ocean conditions on anadromous fish survival and use this information to evaluate and adjust inland management actions.  
And revise *Manage for Variability* on Page 31 to include Pacific Lamprey in the text.

##### **Estuary**

1. Revise third bullet under *Estuary Strategies* on Page 32 to include Pacific Lamprey.
- 

#### NEZ PERCE (p12)

**Estuary Strategies** Pg 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.*"

---

#### NATIVE FISH SOCIETY (p4)

G. Habitat protection and restoration investments would be designed to maintain the chain of habitat requirements for each species of wild salmon and steelhead to complete their life history requirements in freshwater. This would include structure, temperature, flow and retention of gravel and nutrients. To be effective this would include the entire habitat utilized by salmonids from headwater stream protection, mainstem tributaries, mainstem Columbia River, estuary and near-shore ocean habitats.

---

#### NOAA (p4)

**Life Cycle Context:** The Council should add a strategies section to the Program that says to use an integrated life cycle approach to survival improvements. The primary strategy would be to consider the entire life cycle when evaluating the benefit of mitigation actions. 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.

**Ocean:** The ocean section in the Program should be updated to reflect important recent advances in scientific understanding of the effects of ocean conditions on salmonid survival.



The Program should recognize that the Columbia River and the ocean are linked ecosystems that determine the survival and growth of anadromous fishes in the Basin and ocean. Ocean conditions influence survival for all salmon and steelhead species and life-history strategies. The Program should emphasize the importance of healthy Columbia River ecosystems during poor ocean condition cycles. It should also confirm the importance of monitoring and understanding ocean conditions and establishing management systems that can adapt accordingly. NOAA commends the Council for the establishment of the Ocean and Plume Science and Management Charter.

**Estuary:** We endorse the ISAB Program review recommendations for estuary strategies because these could further the estuary's role in providing for recovery of all 13 ESA-listed Columbia River salmon and steelhead species.

IV. Ocean page 31 (p20 of NOAA Rec) - Change title to “Plume and Nearshore Ocean” (plus joint Plume, Estuary and Nearshore Ocean recommendations)

V. The Columbia River Estuary, page 32 (p24 of NOAA Recs: 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 5th recommendation.

---

PFMC (p4)

Estuary habitat

Council-managed ocean salmon fisheries north of Cape Falcon are highly dependent on salmon production from lower Columbia River populations.

Recommendation: The Council recommends continued endorsement of restoration activities in the Lower Columbia River estuary to accelerate recovery of both up-river runs and lower-river priority salmon runs. In addition, the estuary and lower river habitat is thought to be important to eulachon smelt, a species listed as threatened under the Endangered Species Act and not an apparent consideration in the 2009 Fish and Wildlife Program.

---

UCUT (p8)

The UCUT propose that the new Program include a goal of a restored, resilient and healthy Columbia River Basin that includes ecosystem-based function such as: Columbia River plume and near shore ocean enhanced through higher spring and summer flows and lessened duration of hypoxia. Improved ecosystem-based function in the Columbia Basin Watershed is expected to result in An estuary with an enhanced food web and increased juvenile fish survival.

---

USGS

NPCC, management, and regulatory agencies should instead be preparing to manage natural resources under future conditions that will intensify the current landscape scale stressors such as climate change, water shortages, contaminants, invasive species, changes in water temperatures, hypoxia and acidification in our estuary, and wildfire. (p1)

Forage Fish in the Estuary and Nearshore Ocean (p8): Research is needed on forage fish in the lower estuary and nearshore ocean areas. We recommend the Fish and Wildlife Program include the following:

- Identify spawning and rearing habits 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, and localized hypoxia are likely to affect forage fish in the coming decades

Estuary (p9) revise Current Fish and Wildlife Program: Page 32: 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.

Sediment Budget for Lower Columbia River (p10)

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.
- 

#### WDFW

(p47) *Fully implement Estuary, Plume and Nearshore Ocean.* (part of joint recommendation above)  
(p44) Recommendation 1: Change title to “Columbia River mainstem and estuary, spawning, rearing, and resting habitat.” Current program: page 48.

---

#### YAKIMA NATION

(p8) Revise third bullet under *Estuary Strategies* on Page 32 to include Pacific Lamprey.

---

#### LCF&WRB

Estuary: (p3) Amend the F&W program and associated implementation measures to provide for restoration of Lower Columbia tributary habitat as an appropriate off site mitigation strategy for

the estuary impacts on Lower Columbia Chinook, Coho, Chum and Steelhead. Amend the F&W program and associated implementation measures to provide for restoration of Lower Columbia tributary habitat as an appropriate mitigation strategy for the impact of the Columbia hydropower system on Coho populations across the Basin.

Estuary Ocean and Nearshore (p5): 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.

---

#### LCREP

Fully integrate Lower Columbia River, estuary, ocean and plume in the Program. Integrate ISAB acknowledgement of the importance of the estuary, ocean and plume for ecosystem management approach. The Council should act on these recommendations and those of the CB F&W Roundtable Sec 7.1 (2013). We recommend that the Council include biological objectives specific to the lower Columbia river salmon and steelhead on par with those above Bonneville Dam rather than solely focus on species upriver of Bonneville Dam. The CB F&W Managers Roundtable recommendation Sec 2.2 regarding biological objectives on total adult runs for listed lower Columbia salmon and steelhead to achieve 75% of recovery goals (NOAA 2013) by 2025 are a good start. Additionally, we recommend the Council include strategies specific to this region that provide normative hydrologic or environmental flows to the estuary and plume, allowing overbank flows, similar to hydro management in other highly controlled systems (e.g. Colorado River).