Northwest Power and Conservation Council

February 4, 2014

To: Fish and Wildlife Committee

From: Erik Merrill, ISAB Coordinator; Jim Ruff, ISAB Ex Officio; and Laura Robinson, Program Implementation and Liaison Specialist

Subject: Independent Scientific Advisory Board (ISAB) Proposed Review Topics for Fiscal Year 2014

ISAB Vice-chair Greg Ruggerone and Council staff would like to discuss with the Council's Fish and Wildlife Committee three potential ISAB assignments concerning:

1. Novel Ecosystems
2. Density Dependence and the Integration of Hatcheries, Habitat, and Harvests in the Columbia Basin
3. Measuring, Monitoring, and Managing Life History Diversity for Sustainable Restoration of Anadromous and Resident Fish Species

This discussion is intended to aid Chair Bill Bradbury in his deliberations with the ISAB Administrative Oversight Panel in its decision to approve, modify, or disapprove of the proposed assignments. In addition to the Council Chair, the Oversight Panel includes Paul Lumley (Executive Director, Columbia River Inter-Tribal Fish Commission) and John Stein (Science Director, National Marine Fisheries Service, Northwest Fisheries Science Center).

See the attached memo for more details.

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Independent Scientific Advisory Board
for the Northwest Power and Conservation Council,
Columbia River Basin Indian Tribes,
and National Marine Fisheries Service
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204

February 3, 2014

To: ISAB Administrative Oversight Panel
Bill Bradbury, Chair, Northwest Power and Conservation Council
Paul Lumley, Executive Director, Columbia River Inter-Tribal Fish Commission
John Stein, Science Director, National Marine Fisheries Service, Northwest Fisheries Science Center

From: Bob Naiman, ISAB Chair, and Greg Ruggerone, ISAB Vice-chair

Subject: ISAB Proposed Review Topics for Fiscal Year 2014

Requested Action

The ISAB seeks the ISAB Administrative Oversight Panel's input and subsequent approval to undertake one or more of the following three reviews:

1. Novel Ecosystems
2. Density Dependence and the Integration of Hatcheries, Habitat, and Harvests in the Columbia Basin
3. Measuring, Monitoring, and Managing Life History Diversity for Sustainable Restoration of Anadromous and Resident Fish Species

Comments or additional questions from the Oversight Panel for the ISAB are welcomed. The ISAB expects that the ISAB Ex Officios can inform the ISAB of the Oversight Panel's input and decision on the review. However, the ISAB understands that the Oversight Panel may meet by teleconference to discuss these topics. Please let us know if you want us to participate or provide further information. The ISAB would appreciate a decision on any potential assignment by early March, in time to organize an agenda for our April 18 meeting. If more than one topic is approved, the ISAB would also appreciate feedback on which assignment should take priority and preferred deadlines for completion.

On February 11, 2014, the ISAB will discuss these topics with the Council's Fish and Wildlife Committee to provide an opportunity for further comments and public discourse. This committee discussion is also intended to aid Chair Bradbury in his deliberations with the Administrative Oversight Panel.

Background

The ISAB's terms of reference and review protocols establish how ISAB assignments are generated and conducted. Generally, the Council, NOAA Fisheries, or Tribes request reviews. In addition, regional entities can make requests and the ISAB can self-generate assignments. Review strategies and questions are developed in an iterative process between the ISAB and Ex Officio representatives from the Council, NOAA Fisheries, and Tribes. The Oversight Panel decides to approve, modify, or disapprove assignments requested by the region or generated by the ISAB.

The ISAB selected and developed these three topics from more than twenty topics identified during recent ISAB reviews as deserving more in-depth evaluations. The ISAB considers the selected topics to be highly important for a variety of reasons. Recent ISAB reviews of the 2009 Fish and Wildlife Program (ISAB 2013-1), NOAA's life-cycle models (ISAB 2013-5), Columbia River food webs (ISAB 2011-1), and landscape-scale restoration (ISAB 2011-4) highlight the critical issues of novel ecosystems, density dependence, and life history diversity. These topics also have been highlighted by the Independent Scientific Review Panel (ISRP) during reviews of habitat restoration and artificial production projects. In addition, the current expertise on the ISAB is well suited to efficiently address these topics. Review summaries are provided below that describe the rationale, questions, methods, end products, and timelines for each topic. In sum, the ISAB believes these reviews should improve development and implementation of the Council's Fish and Wildlife Program as well as NOAA Fisheries' and the Tribes' management and planning efforts.

Workload and Budgetary Impacts

In addition to these assignments, the ISAB will continue to be available to conduct timely scientific reviews on pressing fish passage, biological opinion development, and recovery planning issues. Upcoming reviews will likely include a review of NOAA's Life Cycle Model for the Willamette River beginning in June 2014.

The ISAB is on schedule to complete, by the end of February 2014, its current reviews of the proposed spill experiment and the Expert Regional Technical Group's process for assessing benefits of habitat restoration projects in the estuary.

The ISAB operates on an annual budget – independent of the Council, NOAA, or CRITFC budgets – funded by the Bonneville Power Administration through the Fish and Wildlife Program. Costs associated with ISAB and ad hoc member services and travel to complete the reviews will be covered under the ISAB's existing budget of $550,000 for Fiscal Year 2014. In the event the reviews are not complete by September 30, 2014, costs will be covered under the ISAB's Fiscal Year 2015 budget. No additional funds are requested. Based on similar past projects, the estimated costs should range from $50,000 to $150,000 per review depending on questions asked and the final scope of the review.

1. Novel Ecosystems

Summary Request: Novel ecosystems (also called hybrid or no-analogue ecosystems) are defined as those with species composition and abundance unlike any that have occurred previously in the region. The ISAB proposes to evaluate how novel ecosystems in the Columbia River Basin can be best managed to protect and enhance native species affected by the Federal Columbia River Power System (FCRPS). The report will focus on identifying management approaches that are practical and effective under changing conditions, and identify key metrics for measuring the benefits and costs to society of ecological services provided by native versus hybridized and nonnative species that are prevalent in novel ecosystems.

Rationale: A major issue confronting federal, state, and tribal managers in the Columbia River Basin is determining the extent to which ecosystems are irreversibly changed and how best to evaluate and manage these novel ecosystems. For much of the Columbia River mainstem and the larger tributaries, dams and reservoirs have produced standing water habitat, which combined with altered flows and climate change have favored introduced species such as American shad, walleye, and bass. These and other widespread changes (e.g., sedimentation, land use) have resulted in fundamentally altered aquatic communities and associated ecological processes (e.g., food web dynamics, toxic chemicals). These "no-analogue" communities are challenging agencies to develop appropriate philosophies and management approaches for rapidly changing ecosystems. Effective management of novel ecosystems requires well-reasoned guidelines to meet Fish and Wildlife Program goals.

Perhaps the most pressing issue is associated with established non-native species (e.g., lake trout, walleye, and bass) that cause harm in some situations but have perceived benefits in others. In some situations, managers actively remove or suppress non-native species, whereas in other cases they are accepted and managed, or even stocked. Unfortunately, the effects of non-natives on food webs are often not well understood, resulting in no action to manage for or against them, and effective policies to prevent illegal introductions often fall outside the expertise of natural resource managers.

Science-based methods are urgently needed to assess the evolutionary potential, ecological function, and the social costs and benefits (e.g., ecological services) of novel biotic communities. As well, managing novel ecosystems requires understanding and integrating human values into decision making. While non-native species may cause ecological problems, they may have value in a human social context and in the face of climate change, but also engender divergent public opinions, and these factors must be integrated into any assessment. Overall, there may be ecological and social value to species, populations, and communities that are self-sustaining, resilient, and adaptable because they do not require continual input of resources and energy to maintain them.

This activity will build on past ISAB reports that have identified managing novel ecosystems as an important emerging issue, including recent reports on non-native species (ISAB 2008-4),

food webs (ISAB 2011-1; Naiman et al. 2012), and a landscape approach (ISAB 2011-4). This review will use the questions presented there as starting points for the report.

Review Questions:

1. How are aquatic communities expected to change in the near future in response to changes in climate, flow, habitat, land use, and artificial chemicals?
2. What key ecological and socioeconomic principles support managing novel ecosystems and their nonnative species, versus restoring native species and associated biophysical elements supporting them?
3. What is the likely feasibility and cost of continuing to protect and enhance native species affected by the FCRPS? What options exist for practical and effective management of novel ecosystems?
4. What evolutionary, ecological, and socioeconomic values provided by the remaining native community are irreplaceable and should not be foregone by accepting and managing for non-native species or altered ecosystems?
5. What key metrics can be used to measure integrity and health of novel ecosystems, and the relative benefits and costs of ecological services provided by native, hybridized, and nonnative species prevalent in the Columbia River habitats?

Product: Full report and presentation to the Council, NOAA Fisheries, and Tribes. The authors would also likely publish a summary of the report in a peer-reviewed journal, to ensure wide access and distribution.

Methods: Literature review, briefings with federal, state, and tribal co-managers, tour to representative novel ecosystems. Ad-hoc members: Dr. Bruce Rieman, Dr. Courtland Smith

Timeline: 20 months

2. Density Dependence and the Integration of Hatcheries, Habitat, and Harvests in the Columbia Basin

Summary Request: This ISAB report will highlight the fundamental biological issue of density dependence among salmon in the Basin and how measuring and analyzing density dependent interactions may be used to diagnose limiting factors and improve the effectiveness of hatcheries, habitat restoration, and harvest management. Density-dependence occurs when salmon growth, age, or survival change in response to population density. Density dependence is typically weak when population density is low. Recent project reviews by the ISAB and ISRP found strong density dependence in areas of relatively low densities. This information has not been used for identifying and prioritizing restoration of rearing versus spawning habitat, for example, indicating the need to inform biologists about the utility of density-dependent information.

Rationale: The 2009 Fish and Wildlife Program recognizes the need to integrate hatcheries with habitat such that hatchery production should not exceed the capacity of the natural environment to support both natural and hatchery salmonids. Furthermore, the Program indicates that hatchery fish in surplus of the needs for broodstock and spawning ground supplementation should be utilized for harvest to the extent possible. The Hatchery Scientific Review Group (HSRG; Paquet et al. 2011) suggests that integrated hatchery programs can be viewed as an extension of the natural habitat, but recent reviews by the ISRP did not reveal basinwide coordination and integration of hatchery, habitat, and harvest programs.

Abundance of adult anadromous natural salmonids in the Columbia Basin is low compared to historical levels, suggesting that competitive interactions among salmonids might only weakly affect their growth and survival. However, recent reviews of Columbia Basin programs by the ISRP and ISAB indicate that strong density-dependent interactions in many monitored streams may be constraining population growth even at current relatively low abundances in some watersheds (ISRP 2011-14, ISAB 2011-1, 2013-5). Density-dependence stems, in part, from competition for limited resources such as spawning habitat, food, or rearing habitat. The outcomes of density dependence (e.g., changes in juvenile growth, age, and survival) can be used to identify the limiting factors such as habitat (e.g., spawning, rearing) or food supply that are constraining salmon population growth. Such information could be used to guide and improve habitat restoration efforts. Density dependent relationships also may be used to establish spawning escapement goals and juvenile abundance targets. However, the strong density dependence observed in some watersheds was unforeseen by hatchery managers and many habitat restoration efforts do not appear to be measuring or analyzing this key information. As a result, some hatchery operations have not been well integrated with habitat restoration efforts.

Review Questions:

1. Where has density-dependence been examined in the Basin?
2. Does the evidence indicate food, spawning habitat, or rearing habitat limitations?

3. Have findings been used to develop targets or guidelines for adult spawning abundances, juvenile production, and habitat restoration?
4. Could management and Fish and Wildlife Program restoration goals be improved by measuring and analyzing density dependent interactions?
5. How do historical adult salmon abundance estimates inform current and future carrying capacity of salmon in the Basin?

Products: Report (~75 p.) and presentations to the Council and professional forums in the Basin. The authors would also likely publish a summary of the report in a peer-reviewed journal, to ensure wide access and distribution.

Methods: This report would benefit from hatchery and habitat project reports, ISAB/ISRP reviews of hatchery programs (e.g., Lower Snake Compensation Program, Geographic Review), and briefings by specific individuals in federal, tribal, and state agencies. Historical estimates of salmon abundance would be examined and evaluated as a basis for potential carrying capacity of the Basin.

Timeline: 12 months

3. Measuring, Monitoring, and Managing Life History Diversity for Sustainable Restoration of Anadromous and Resident Fish Species

Summary Request: This ISAB review will provide indepth information on what is known and needs to be known about basin-scale trends in loss of life history diversity of key anadromous and resident fish species in the Basin. It will also provide recommendations for specific quantitative measures and methods to monitor and manage life history diversity. This review is needed to better incorporate life history diversity into management, conservation, and restoration goals and objectives.

Rationale: The ISAB has repeatedly recommended that the Council and others "rebalance the vision for restoration" by giving greater attention to the value of diversity and resilience (e.g., ISAB 2011-4, 2012-2), and has recently identified loss of biological diversity as one of the major threats to sustainability of the Columbia River ecosystem and to the success of the Fish and Wildlife Program (ISAB 2013-1). This review will result in an improved understanding of the availability, utility, and limitations of information on life history diversity of anadromous and resident fish species in the Basin. Data gaps will be identified and prioritized, and strategies for filling these gaps will be recommended. Information that quantifies the links between life history diversity and abundance, productivity, and resilience of species will be emphasized.

Review Questions:

1. What major trends or changes in life history diversity can be linked to human actions in the Basin?
2. What specific quantitative measures of life history diversity can be obtained from existing data and ongoing efforts in the Basin, and what new methods can be used to measure, monitor, and manage life history diversity and guide further investment?
3. What are the most important knowledge gaps?
4. What key species and leading indicators of life history diversity (morphological, behavioral, physiological, phenological) need to be measured, monitored, and managed?

Products: Report and oral presentations to the Council and professional and public forums in the Basin. The authors would also likely publish a summary of the report in a peer-reviewed journal, to ensure wide access and distribution.

Methods: This review will require briefings from ongoing projects and programs, literature reviews, site visits and/or focused workshops, and ad hoc members to fill any major gaps in expertise.

Timeline: 18 months

ISAB Proposed Review Topics for FY 2014

February 11, 2014

or the
e Northwest
Power and Conservation Council, NOAA Fisheries,
and the Columbia River Basin Indian Tribes.

Three Proposed Review Topics
-based on ISAB Fish & Wildlife Plan recommendations

- Novel ecosystems: Non-native species & habitat
- Carrying capacity of watersheds to support salmonids
- Life history diversity

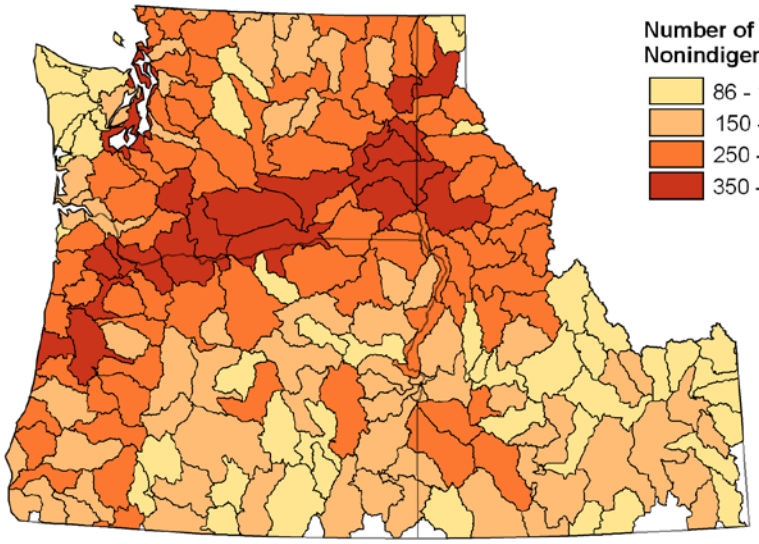
Novel Ecosystems

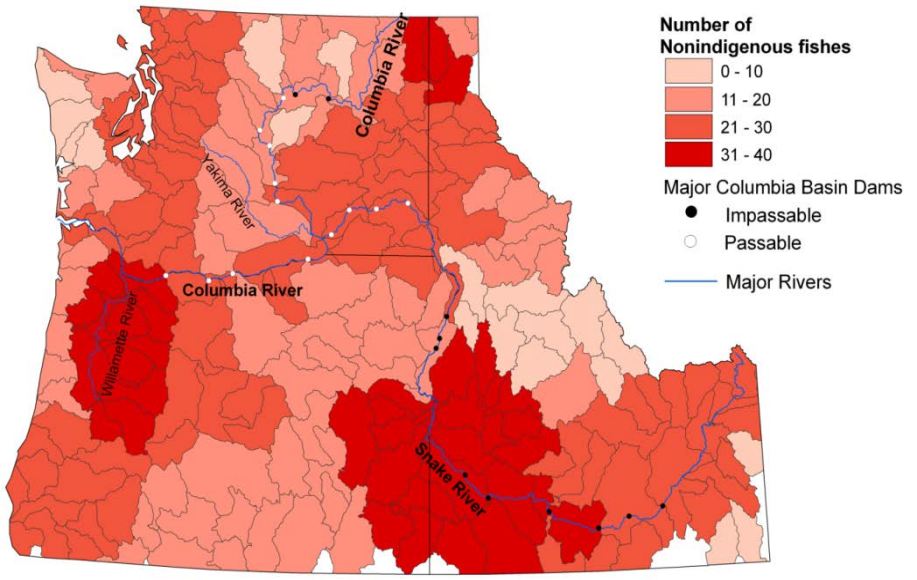
-nonnative species, altered habitat, toxics, climate change

Articles

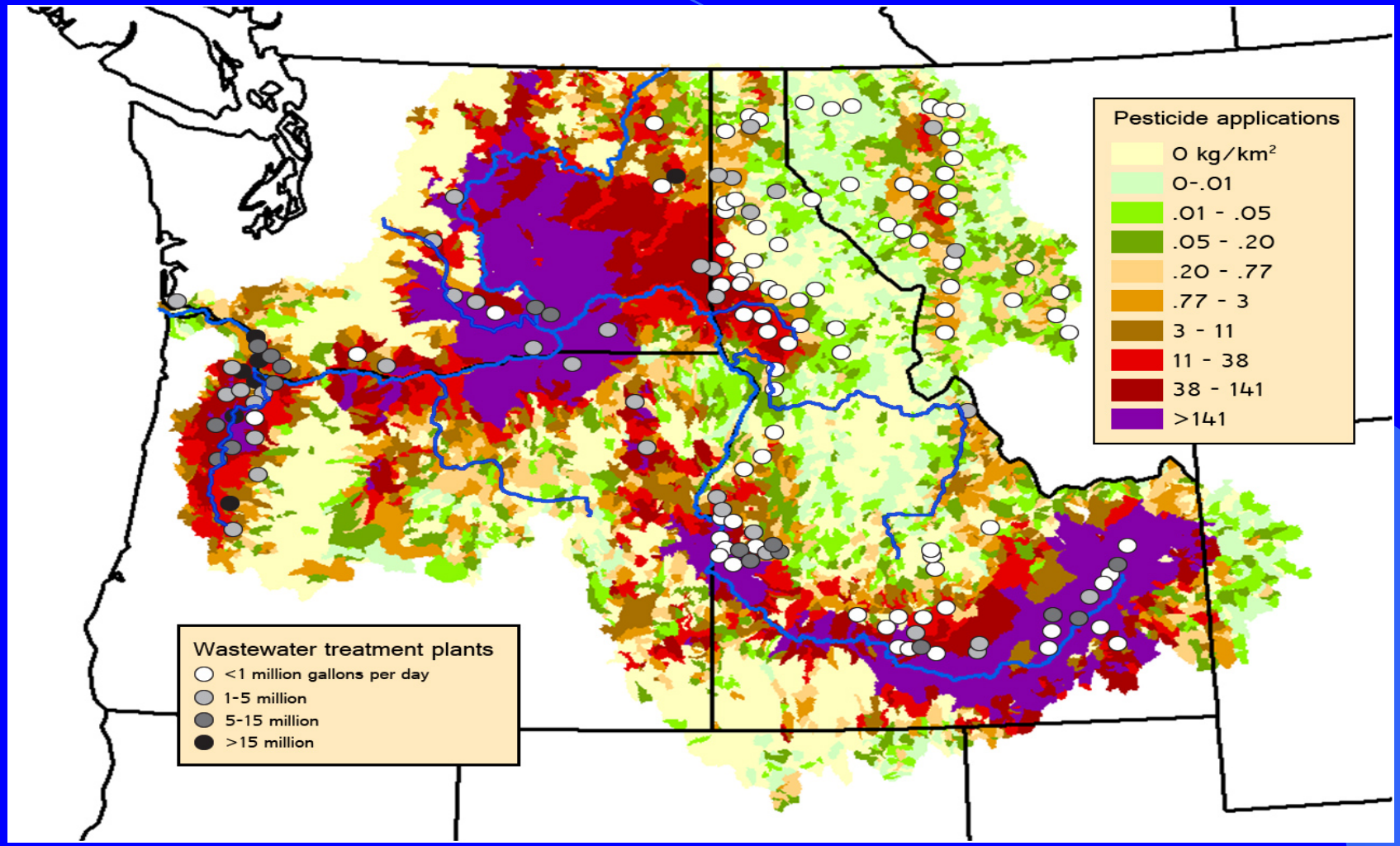
Nonindigenous Species of the Pacific Northwest: An Overlooked Risk to Endangered Salmon?

But some invasive fishes support significant sport fisheries





Over 169 wastewater treatment plants and pesticide application ~46,000 mt active compounds per year



(246 compounds evaluated; average 1999-2004; data obtained from USGS, National Water Quality Assessment Project)
See ISAB 2011-1; Naiman et al. 2012.

Novel Ecosystem Proposal

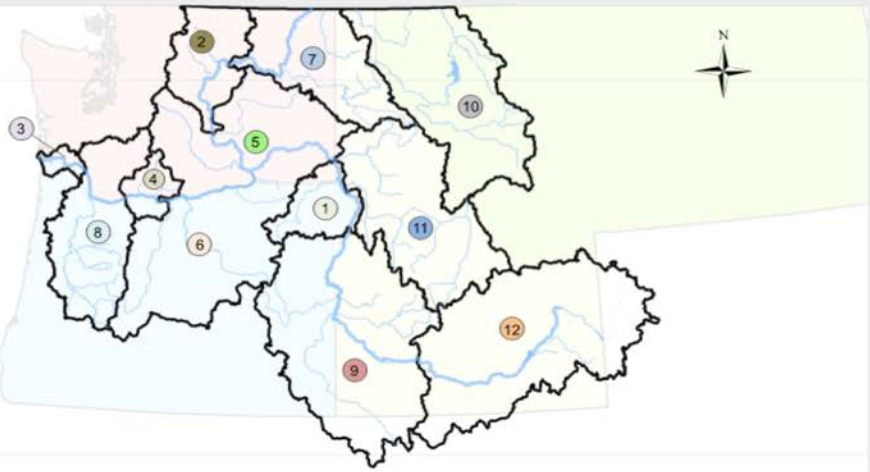
- Evaluate how novel ecosystems in the Basin can be best managed to protect & enhance native species affected by the FCRPS.
- Identify key metrics for measuring benefits and costs of managing native versus hybrid & non-native species.
  - Social
  - Ecological
- Evaluate options for practical & effective management of novel ecosystems.
  - consider habitat alterations

Novel Ecosystems - Questions

- How are aquatic communities expected to change in the future, e.g., climate, land use, chemicals?
- What key ecological and socioeconomic principles support managing novel ecosystems & nonnative species vs. restoring native species and associated habitat?
- What are options for practical and effective management?
- What evolutionary, ecological & socioeconomic values of the native species are irreplaceable?
- What key metrics can be used to monitor benefits & costs of ecological services provided by native, hybridized, and nonnative species?

Stocking of Non-native Fishes in Basin

Species	Number	Native / Non-native	Agency / Tribe	FWP Funded
BLUE MOUNTAIN (1)				
Rainbow Trout	175,139	N/NN	State	
COLUMBIA CASCADE (2)				
Brook Trout	537,402	NN	State	
Brown Trout	365,230	NN	State	
Cutthroat Trout	367,830	N/NN	State	
Kokanee	38,700	N/NN	State	
Rainbow Trout	1,136,189	N/NN	State	
Tiger Trout	22,500	NN	State	
COLUMBIA ESTUARY (3)				
Rainbow Trout	3,096	N/NN	State	
COLUMBIA GORGE (4)				
Brook Trout	30,756	NN	State	
Brown Trout	13,972	NN	State	
Cutthroat Trout	17,870	N	State	
Rainbow Trout	161,452	N/NN	State	
COLUMBIA PLATEAU - NORTH (5)				
Brook Trout	9,083	NN	State	
Brown Trout	147,677	NN	State	
Cutthroat Trout	273,774	N	State	
Golden Trout	4,512	NN	State	
Kokanee	703,767	NN	State	
Rainbow Trout	2,428,342	N/NN	State	
Tiger Muskie	300	NN	State	
Tiger Trout	26,151	NN	State	
COLUMBIA PLATEAU - SOUTH (6)				
Bluegill	325	NN	State	
Brook Trout	94,747	NN	State	
Brown Trout	39,047	NN	State	
Cutthroat Trout	62,084	N	State	
Kokanee	182,443	N	State	
Largemouth Bass	800	NN	State	
Rainbow Trout	648,673	N/NN	State	
INTERMOUNTAIN (7)				
Arctic Grayling	3,700	NN	State	
Brook Trout	177,833	NN	State/Tribe	Part
Brown Trout	212,050	NN	State	
Channel Catfish	11,552	NN	State	
Cutthroat Trout	428,696	N/NN	State	
Golden Trout	2,100	NN	State	
Kokanee	1,262,684	N	State/Tribe	Part
Rainbow Trout	3,034,217	N/NN	State/Tribe	Part
Tiger Muskie	1,450	NN	State	
Tiger Trout	75,000	NN	State	
Walleye	20,000	NN	State	
White Sturgeon	3,990	N	State	Yes
LOWER COLUMBIA (8)				
Bluegill	100	NN	State	
Brook Trout	89,547	NN	State	
Brown Trout	67,575	NN	State	
Channel Catfish	3,755	NN	State	
Cutthroat Trout	83,356	N	State	
Kokanee	311,743	NN	State	
Largemouth Bass	325	NN	State	
Rainbow Trout	2,259,251	N/NN	State	
Tiger Muskie	3,050	NN	State	



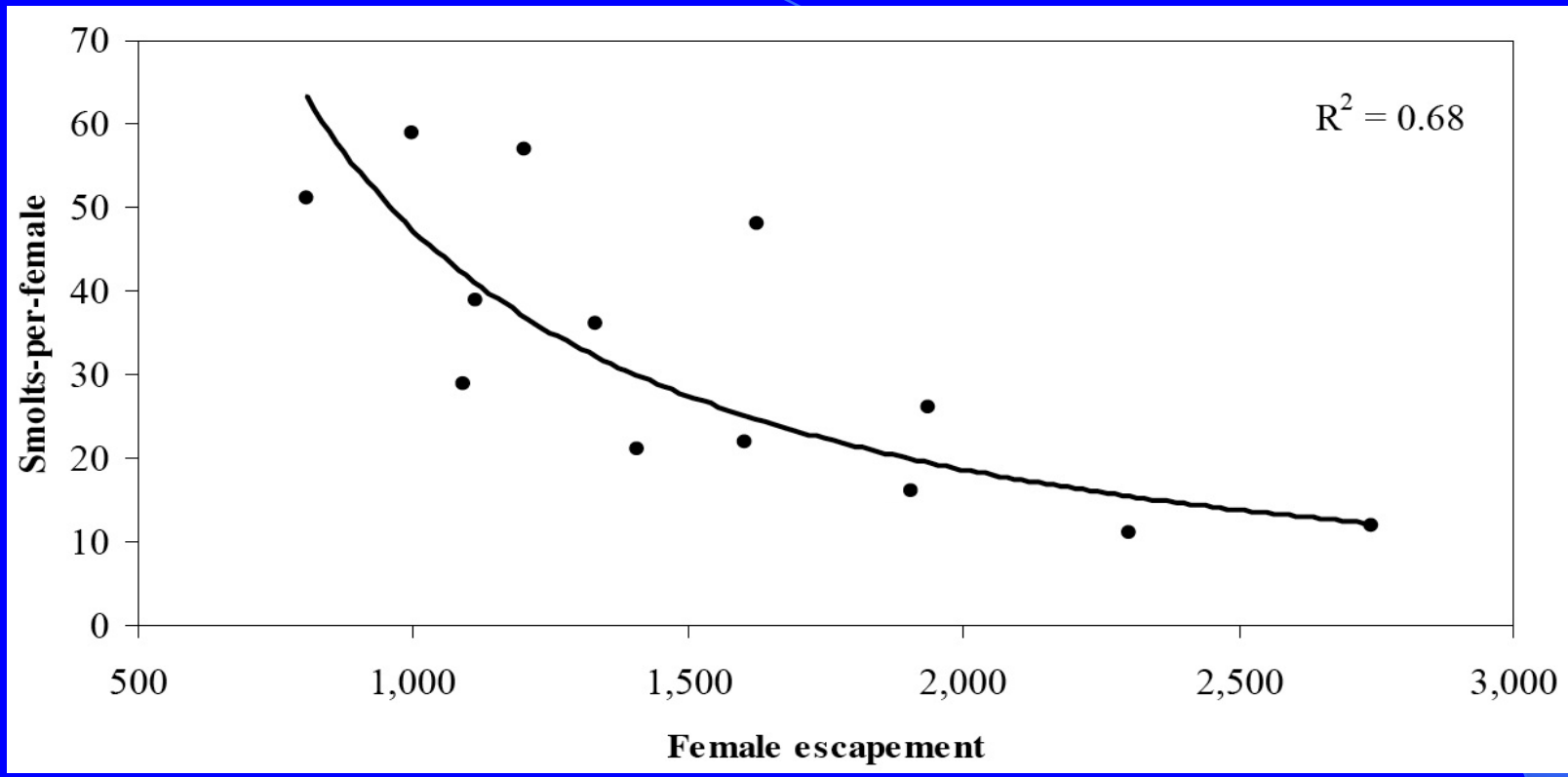
Species	Number	Native / Non-native	Agency / Tribe	FWP Funded
MIDDLE SNAKE (9)				
Arctic Grayling	11,471	NN	State	
Black Crappie	51	NN	State	
Bluegill	2,951	NN	State	
Brown Trout	52,425	NN	State	
Channel Catfish	12,460	NN	State	
Cutthroat Trout	91,891	N/NN	State	
Golden Trout	21,979	NN	State	
Kokanee	838,023	NN	State	
Largemouth Bass	655	NN	State	
Rainbow Trout	2,499,402	N/NN	State	
Smallmouth Bass	849	NN	State	
Tiger Trout	1,600	NN	State	
MOUNTAIN COLUMBIA (10)				
Arctic Grayling	135,000	N	State	
Brook Trout	58,643	NN	State	
Brown Trout	5,002	NN	State	
Channel Catfish	8,663	NN	State	
Golden Trout	1,800	NN	State	
Kokanee	11,856,694	NN	State	
Largemouth Bass	95,700	NN	State	
Rainbow Trout	939,058	N/NN	State/Federal	Part
Rainbow Trout x Westslope	36,000	NN	State	
Smallmouth Bass Westslope	31,500	NN	State	
Cutthroat Trout	355,353	N	State/Federal	Part
White Sturgeon	14,000	N	Tribe	Yes

Species	Number	Native / Non-native	Agency / Tribe	FWP Funded
MOUNTAIN SNAKE (11)				
Arctic Grayling	4,544	NN	State	
Channel Catfish	4,177	NN	State	
Cutthroat Trout	135,318	N/NN	State	
Golden Trout	11,420	NN	State	
Rainbow Trout	651,318	N/NN	Tribe	Yes
UPPER SNAKE (12)				
Arctic Grayling	7003	NN	State	
Brook Trout	100,007	NN	State	
Brown Trout	40,793	NN	State	
Channel Catfish	42,993	NN	State	
Cutthroat Trout	1,353,659	N/NN	State	
Golden Trout	1,507	NN	State	
Kokanee	224,387	NN	State	
Rainbow Trout	2,946,302	N/NN	State	
RainbowTrout x Cutthroat Trout	221,419	NN	State	
Walleye	1,050,000	NN	State	

Density Dependence as a Tool

- Density dependence: reduced growth & survival with greater abundance.
- Density dependence occurs in the Basin even though spawning abundances are relatively low (ISAB 2011-1, ISRP 2013-11).
- This information is essential for establishing restoration priorities & effective management of salmonids.

Example of Density Dependence



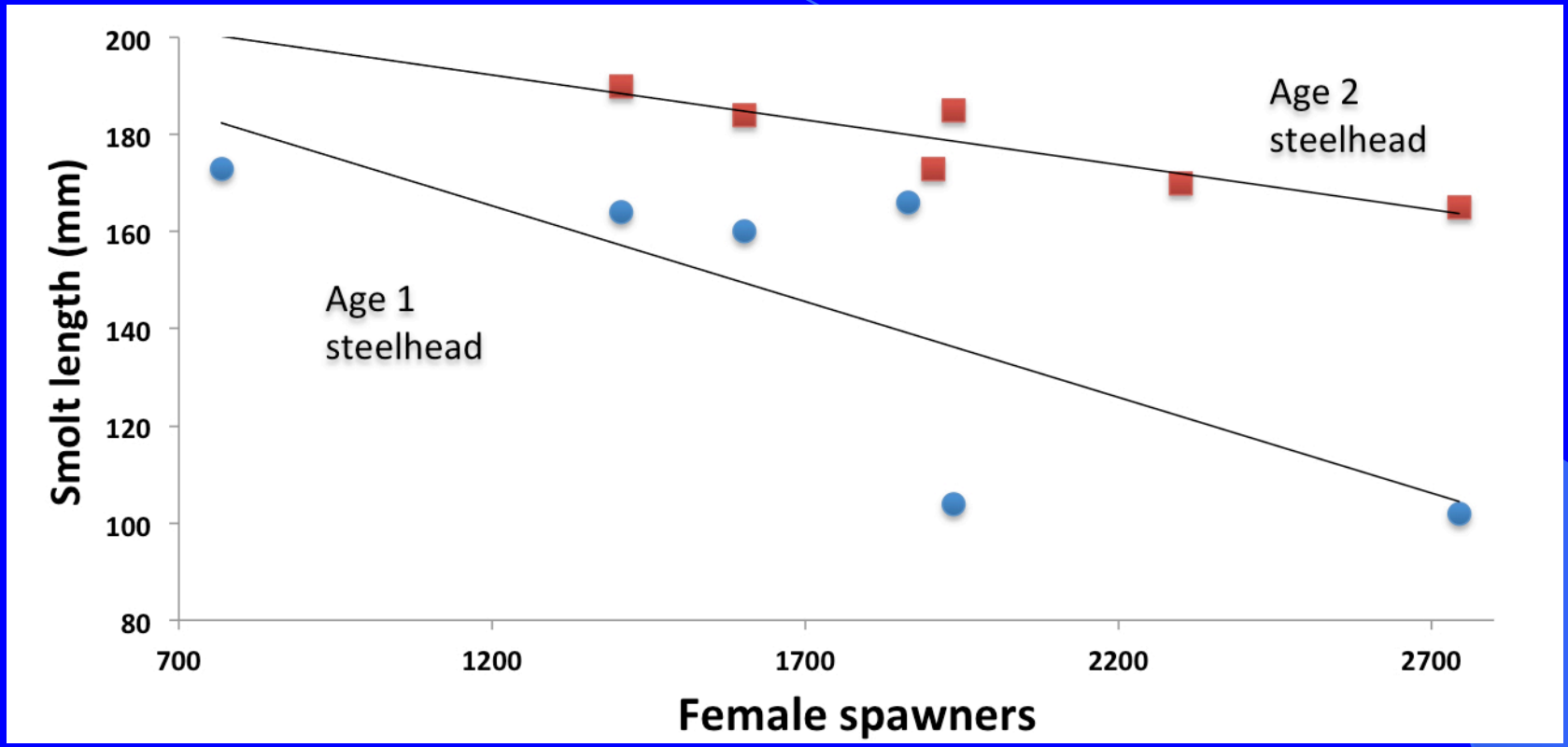
Productivity of Umatilla smolts declined with increasing parent spawner abundance.

Is density-dependence due to spawning habitat or rearing habitat limitations?

Hanson et al. 2010

Additional Diagnostic Evidence

-growth reduction implies rearing habitat limitation



Smolt length declined with parent spawner abundance

Age at smoltification increased with parent spawners

Suggests rearing habitat limitation (food-related).

Hanson et al. 2010

Density Dependence Questions

- Where has density-dependence been searched for and found in the Basin?
- Does the evidence indicate food, spawning habitat, or rearing habitat limitations?
- Have findings been used to develop targets for adult spawning abundances, juvenile production, and habitat restoration?
- How do historical adult salmon abundance estimates inform current and future carrying capacity of salmon in the Basin?

Measuring, Monitoring, & Managing Life History Diversity

Diversity in body size of Chinook salmon smolts
Source: StreamNet

Diversity promotes population stability, resilience, and abundance & may be key to climate change:

"Portfolio effect"

Diversity enables salmonids to reduce competition and more efficiently utilize a variety of habitats.

Life History Diversity - Questions

- What changes in life history diversity are linked to human actions?
- Which existing or new measures can be used to monitor and manage life history diversity?
- What are key information gaps?
- How can this information improve restoration actions?

Any Thoughts or Questions?