

Northwest Power and Conservation Council
Ocean and Plume Science and Management Forum Notes

January 19, 2022

Presentations available here: <https://www.nwcouncil.org/meeting/ocean-forum-january-19-2022>

Attendees

Amelia Johnson (LCFRB)	Dianne Barton (CRITFC)	Kate Terrell (USFWS)
Andrea Carpenter (ODFW)	Don Whitney (IDFG)	Keisha Miller (NPT)
Andrew Matala (YN)	Doug Hatch (CRITFC)	Kendra Coles (NPCC)
Anne Creason (BPA)	Elizabeth Daly (OSU)	Kenny Rose (ISAB)
Anneliese Myers (CWU)	Erick Van Dyke (ODFW)	Kerry Berg (NPCC)
Bart Gamett (USFS)	Erik Merrill (NPCC)	Kevin Jackson (USDA)
Becky Johnson (NPT)	Eric Geisthardt (IDFG)	Kris Homel (NPCC)
Brent Beller (IDFG)	Erin Grinde (USDA)	Kyle Maki (IDW)
Bill Bosch (YN)	Erin Peterson (WDFW)	Kym Jacobson (NOAA)
Bill Crampton (CBB)	Ewann Berntson (NOAA)	Lara Erikson (PSMFC)
Bob Lessard (CRITFC)	Garret Visser (IDW)	Laura Brown (WDFW)
Brady Allen (BPA)	Gene Shippentower (CTUIR)	Laura Gephart (CRITFC)
Brent Beller (IDFG)	Greg Smith (BPA)	Laurie Weitkamp (NOAA)
Brian Beckman (NOAA)	Guy Norman (NPCC)	Lawrence Schwabe (CTGR)
Brian Burke (NOAA)	James Barron (BPA)	Lea Ronne (WDFW)
Bryce Glaser (WDFW)	Jason Vogel (NPT)	Leslie Naylor (CTUIR)
Cam Sharpe (ODFW)	Jeff Allen (NPCC)	Lisa Crozier (NOAA)
Carol Winkel (NPCC)	Jeff Fryer (CRITFC)	Louie Pitt (NPCC)
Catherine Corbett (LCEP)	Jen Harris (UAF)	Lynne Krasnow (NOAA)
Cathy Kellon (NPCC)	Jen Zamon (NOAA)	Madison Ellis
Cecilia Brown (BPA)	Jennifer Gosselin (UW)	Mari Williams (NOAA)
Charles Morrill (WDFW)	Jeremy Trump (WDFW)	Marisa Litz (WDFW)
Charles Seaton (CRITFC)	Jessica Buelow (IDFG)	Mark Bagdovitz (USFWS)
Charlie Waters (NOAA)	Jim Gregory (GA)	Mark Fritsch (NPCC)
Cheryl Morgan (NOAA)	Joe Bumgarner (WDFW)	Mark Robertson (USFWS)
Chris Frederiksen (YN)	Joe DuPont (IDFG)	Mark Saunders (PSMFC)
Chris Starr (USFWS)	Johanna Stangland	Mark Sorel (UW)
Chris Sullivan (IDFG)	John Arterburn (CCT)	Martin Liermann (NOAA)
Christine Petersen (BPA)	John Cassinelli (IDFG)	Matthew Gardner (WDFW)
Cody Fleenor (BSU)	John Powell (IDFG)	Maureen Hess (NPCC)
Craig Norrie (OSU)	John Shurts (NPCC)	Michael Folkes (DFO)
Cynthia Studebaker (USACE)	Jonathan Ebel (IDFG)	Michael Milstein (NOAA)
Dalton Hance (USGS)	Josua A Holowatz (WDFW)	Mike Edmondson (IDOSC)
Dan Garcia (USDA)	Justin Saydell (IDOSC)	Mitch Silvers (IDSC)
Daniel Bertram (IDOSC)	K. C. Mehaffey (ND)	Nancy Leonard (PSMFC)
Daniel Rawding (WDFW)	Kale Bentley (WDFW)	Nicole Czarnomski (WDFW)
David Schoen (USFS)	Kari Dammerman (WDFW)	Patty O'Toole (NPCC)
David Swank (USFWS)	Kat Gillies-Rector (IDFG)	Paul Wagner (EAS)

Regan McNatt (NOAA)	Sean Hommestaad (WDFW)	Tim Copeland (IDFG)
Richard Carmichael (ISAB)	Shane Scott (SSA)	Todd Hillson (WDFW)
Rick Raymond (IDWF)	Shane Vatland (NPT)	Tom Iverson (YN)
Rod Engle (USFWS)	Stacy Horton (NPCC)	Tom Wainwright (ISAB)
Russ Perry (USGS)	Stephen West (NPCC)	Tracy Bowerman (UCSRB)
Ryan Gerstenberger (CTWS)	Steve Haeseker (USFWS)	Travis Hodsdon (NPT)
Ryan Kinzer (NPT)	Steven W Gray (WDFW)	Tulley Mackey (IDOSC)
Ryan Klett (CCT)	Susan Hinton (NOAA)	Tyler Stright (NPT)
Sarah Fesenmyer (USBR)	Talia Davis (NOAA)	Virginia Preiss (BPA)
Sarah Riseman (CRITFC)	Thomas Tall Bull (NPT)	William Young (NPT)
Scott Donahue (BPA)	Théa Rachinski (DFO)	Windy Schoby (IDFG)

Affiliation acronyms

BPA	Bonneville Power Administration	LCFRB	Lower Columbia Fish Recovery Board
BSU	Boise State University	ND	News Data
CBB	Columbia Basin Bulletin	NOAA	National Oceanic and Atmospheric Administration
CCT	Confederated Colville Tribes	NPCC	Northwest Power and Conservation Council
CRITFC	Columbia River Inter-Tribal Fish Commission	NPT	Nez Perce Tribe
CTGR	Confederated Tribes of Grand Ronde	ODFW	Oregon Department of Fish and Wildlife
CTUIR	Confederated Tribes of the Umatilla Indian Reservation	OSU	Oregon State University
CTWS	Confederated Tribes of Warm Springs	PSMFC	Pacific States Marine Fisheries Commission
CWU	Central Washington University	SSA	Shane Scott and Associates
DFO	Department of Fisheries and Oceans Canada	UAF	University of Alaska, Fairbanks
EAS	Environmental Assessment Services	UCSRB	Upper Columbia Salmon Recovery Board
GA	Gregory Aquatics	USACE	U.S. Army Corps of Engineers
IDFG	Idaho Department of Fish and Game	USBR	U.S. Bureau of Reclamation
IDOSC	Idaho Office of Species Conservation	USDA	U.S. Department of Agriculture
IDSC	Idaho Senator Crapo's Office	USFS	U.S. Forest Service
IDW	Idaho Wildlife	USFWS	U.S. Fish and Wildlife Service
IDWR	Idaho Department of Water Resources	USGS	U.S. Geological Survey
ISAB	Independent Science Advisory Board	UW	University of Washington
LCEP	Lower Columbia Estuary Partnership	WDFW	Washington Department of Fish and Wildlife
		YN	Yakama Nation

Agenda

1:00 – 1:10 pm	Welcome and introductions – Guy Norman, NPCC Chair
1:10 – 1:15 pm	Purpose and history of Ocean Forum – Kris Homel, NPCC
1:15 – 1:35 pm	What is going on in the North Pacific? – Laurie Weitkamp, NWFSC
1:35 – 1:55 pm	Cycles of productivity in the ocean – Brian Burke, NWFSC
1:55 – 2:10 pm	Understanding the impacts of changing high seas ecosystems on salmon and people – Mark Saunders, NPAFC
2:10 – 2:30 pm	Carry-over effects- introduction, what are they, why are they important, examples – Lisa Crozier, NWFSC
2:30 – 2:40 pm	Break
2:40 – 3:00 pm	How do we link changes in ocean conditions now to hatchery rearing and release strategies – Brian Beckman, NWFSC
3:00 – 4:45 pm	Group discussion <ul style="list-style-type: none">• Current actions that regional and hatchery managers are taking in freshwater to improve adult returns• New research needed to understand the mechanisms driving correlative carryover effects• Adaptive management discussion- climate change and adaptation- next steps
4:45 – 4:50 pm	Next steps; future forum – Council staff, steering committee
4:50 – 5:00 pm	Closing remarks – Guy Norman- NPCC Chair

Welcome and Introductions

Chair Norman (WA) welcomed attendees to the Forum and reviewed the connections between the Power Act, the Council's Fish and Wildlife Program, and the Ocean project(s). In particular, Chair Norman emphasized these points:

- The Gorton Amendment to the Northwest Power Act was enacted in 1996 and instructed the Council to “consider the impact of ocean on fish and wildlife populations when making recommendations to Bonneville regarding projects to be funded.”
- The Council's research and monitoring efforts related to the marine environment for anadromous fish began in 1998 in response to the Gorton amendment.
- Most recently in the Council's 2020 Program amendment to the Columbia River Basin Fish and Wildlife Program, the Council identified the importance of continuing to support for research in the Ocean, recognizing that monitoring and research in the Ocean remain a core part of the program and need to be preserved.

Kris reviewed meeting logistics, introduced the Steering Committee, and introduced presenters.

Agenda item 1. History of forum

Kris Homel, Council biologist, reviewed the history of the Ocean Forum, beginning with its formation as a chartered advisory group leading up to the 2014 Fish and Wildlife Program, to its current form as a resource where ocean researchers and managers from throughout the basin can exchange ideas, develop research collaborations, and help shape science that addresses specific management needs. Through this forum, the Council hopes to continue emphasizing an ecosystem perspective, linking freshwater, estuary, and ocean habitats for anadromous species.

Full presentations are available on the Forum website here:

<https://www.nwcouncil.org/meeting/ocean-forum-january-19-2022>

The notes on presentations below represent highlights and not a full review of presented topics. For that full content, please refer to slides at the link above.

Agenda item 2. What is going on in the North Pacific? – Laurie Weitkamp, Research Fisheries Biologist, NOAA's Northwest Fisheries Science Center (NWFSC) out of Newport, Oregon

Laurie Weitkamp presented data showing how salmon and steelhead abundance throughout the North Pacific has varied both regionally and among species - some regions show increasing trends for some species but decreasing for others. This information was presented in relation to recent marine heatwaves in the North Pacific.

Discussion:

Comment: In slide of total catches across N Pacific, Russia was primarily Pink Salmon but no pattern of odd and even year catches. Is this typical?

Response: Not sure. Alaska has big odd and even years and Russia seems to have big returns both years as well

Agenda item 3. Cycles of productivity in the ocean – Brian Burke, Supervisory Research Fishery Biologist NWFSC in Seattle Washington

As part of a larger talk on ecosystem interactions, Brian Burke included results on the ecological indicators monitored by NOAA off the Oregon and Washington coast each year. Juvenile salmon and steelhead that entered the ocean in 2021 will be experiencing good to fair conditions across all monitored indicators. These conditions are dramatically better than what has been observed recently.

Discussion:

Comment: With climate change and increased variability and learning about other variables like predation, curious about hearing more about that. We have a better understanding of predation in the estuary. In the plume and ocean, how much do we know and how hard is it to fill the gaps around predation?

Response: We have some information partly from our sampling and partly from known parts of the ecosystem in other areas- like in California. However, we are missing key components of that. We know how many and where different bird species are off the coasts of Washington and Oregon, but we don't know what they are eating and how what they eat is driven by salmon abundance or by abundance of alternative prey like anchovies, sardines, or smelt. This makes it hard to implement a mechanistic model without key diet data on predators. A new survey would be needed to capture this kind of data

Comment: Are we to interpret the stoplight chart as outmigrant year? Do subyearlings and yearlings respond similarly to ocean conditions?

Response: Yes- the chart describes the conditions in the ocean during the year juvenile salmon are migrating. Not all stocks reside in ocean for the same amount of time, so when looking at adult returns, need to know which year of juvenile migration to pay attention to.

Comment: Is it your opinion that we should be focusing on factors in freshwater to maximize the number of health smolts reaching the estuary?

Response: Two things we should focus on. First- get the best quality of fish to the ocean so they have better survival (termed carryover effect). Better management of the freshwater environment could improve ocean survival. Thinking about timing and size of fish. Second- everyone thinks about ocean as black box where there is nothing we can do. Although that is true for large things like PDO, there are things we can do in the ocean. We manage forage fish species which function as alternate prey for salmon predators, and we manage salmon predators. With the limited amount of data we have right now, we are reluctant to make recommendations for how to manage these other predators. Ramping up data collection could improve our ability to make reasonable recommendations.

Comment: How do different stocks overlap in space and time on the cruises that generate the stoplight chart?

Response: We used to have a May, June, and September survey and the reason is because salmon come out at different times. Some stick around and others are gone immediately. The

goal of a stock specific stoplight chart or a mechanistic model of the system is to understand where different stocks go, when are they there, and what data correspond to where they are. This is the motivation for moving towards a more detailed model of stock-specific indicators.

Agenda item 4. Understanding the impacts of changing high seas ecosystems on salmon and people – Mark Saunders, Director for the International Year of the Salmon (IYS) Pacific Region, with the North Pacific Anadromous Fish Commission in Vancouver B.C.

Mark Saunders described a new effort underway to develop an autonomous monitoring system in the North Pacific that could help managers predict ocean conditions with greater lead time. The new monitoring system would build off existing high-seas sampling of both salmon and ecological indicators, ultimately producing data that can be fed into ecological models. This project – called Basin Events to Coastal Impacts (BECI) – was approved as part of the United Nations Decade of Ocean Science.

Discussion:

Comment: Will the monitoring system still be in place when the 10-year study wraps up?

Response: Yes- this will be an ongoing monitoring system and will be fully in place and operational by the end of the 10 years study.

Agenda item 5. Carry-over effects- introduction- what are they, why are they important, examples – Lisa Crozier, Research Ecologist NWFSC in Seattle

Lisa Crozier introduced the concept of carryover effects. In brief, marine survival is influenced by both conditions in the ocean and prior conditions experienced when juveniles migrate in freshwater. Specific carryover effects from the freshwater environment include the timing of arrival in the estuary or ocean, size at migration, or abundance/ density dependence.

Discussion:

Comment: When we talk about condition, is a typical length-weight condition factor a reliable tool from the work that you've done, or are you thinking about other physiological characteristics that you'd have to measure by sampling fish?

Response: I think we need to think more broadly than just length and weight because it doesn't always turn out as expected. This makes me think we might be measuring the wrong thing.

Comment: Fatter is not always fitter.

Comment: Is this something biochemical like hormones or is it more like measuring flow and temperature of the habitat the fish came out of for an indicator of future survival.

Response: These have been good predictors, but they are acting through different mechanisms. There are some interesting studies in CA where they've found spectacular growth in certain habitats with higher subsequent survival. Maybe measuring productivity in habitats would be good.

Agenda item 6. How do we link changes in ocean conditions now to hatchery rearing and release strategies – Brian Beckman, Physiological Ecologist NWFSC, Seattle

Brian Beckman described current hatchery release strategies in relation to changing ocean conditions and proposed a testable hypothesis. Currently, permit constraints and results from prior research have led to a narrower set of release dates and release sizes of hatchery fish than what is observed in natural origin populations. This strategy can produce excellent returns during favorable environmental conditions, but during poor river migration or ocean conditions, very low returns can also happen. Brian

presented a hypothesis that diversifying hatchery releases may result in less variation in returns over time.

Discussion:

Comment: Recognizing need for researchers evaluating ocean trends to connect with hatchery managers, who operate under a set of constraints, groups need to work together to identify where there are options to engage in research and what kind of institutional barriers need to be overcome in order to do so.

Response: Agreed- many existing constraints and hatcheries are planning years in advance of releases. If intention is to increase diversity of releases, need to plan for that diversity just as one would plan for meeting a given target.

Comment: What kind of interdisciplinary team would it take to link the ocean concept for promoting diversity at the timing of ocean entrance and link it with hatchery limitations or other limitations that influence survival- particularly for Snake River and Upper Columbia River fish (e.g., carry over effects, transport or in river fish, warming, smolt migration temperatures, etc.). All of this needs to be integrated in a conceptual framework in order to have a solid foundation for this kind of work.

Response: Start with people in a room to identify options and constraints- Forum is great but need to move beyond this- include hatchery people and ocean people and others working in the river

Comment: Many strategies for S. R. Spring Chinook hatcheries (e.g., mimicking natural migration patterns)- failed. These also created conflicts with natural populations. Lots of complexity behind what strategies can be used. Many strategies were complete failures and 0 fish returned

Response: Need to be careful about the concept of failure because occasional success may be an important part of diversity- the different modes of diversity don't do well every year. How much investment made into strategies that appear to fail vs. others that frequently do well...might all be an important part of the portfolio.

Comment: Climate predictions out six or nine months in the Northeast Pacific may be reasonable. Is there potential for these predictions to improve the odds on these "bets" being proposed?

Response: Depends on the timeframe of the prediction- good with El Nino (six months out) but for a hatchery program- would need predictions that might be two years out in order to adjust hatchery practices (e.g., release size or timing).

Comment: Question about Willamette hatchery releases in Feb-Apr and which is best.

Response: Conditions vary so success of specific releases also varies. Biggest distinction is between spring and November releases

Comment: Question on whether barge timing has an effect on survival, similar to how different migration timing does

Response: It depends- there are differences in survival between hatchery and wild fish, and it also depends on that timing relative to ocean conditions. Sometimes it is more or less advantageous to barge fish.

Comment: How much variation in size at release? Alaska systems only report average size and there could be quite a bit of variation that isn't captured by the average. Is that the case in the Columbia too?

Response: We have the advantage of using PIT-tags and having individual sizes. We also have a lot of CWT, so can compare and contrast avg vs. individual. Much greater information content from comparing different tag data.

Comment: Most of the points in Brian's talk also apply to flow management- it was developed during a period of excellent ocean conditions.

Comment: Important to think about flow management from not just upriver and fish migration perspective, but also for the estuary and bird predation because flow has a huge influence on prey availability for birds. During high flow conditions, most available prey is salmonids and sticklebacks (spring). During low flow, greater influence of ocean species like anchovies. Flow affects what food is available in the plume. All of this is connected- flow management has impacts 100 miles off the mouth of the Columbia. Real impact of management activity may happen far away from where management action done.

Comment: Returning to Lisa's description of conditions- are there ways to make sure that fish being released are in the optimum condition for the prevailing conditions occurring during release.

Comment: Lisa raised importance of fish condition when entering ocean and during migrations. Interesting sources exist on food resources flowing from wetlands and available for fish during their migration. Also, interesting point on how conditions in estuary are driven by flow (salinity intrusion influencing what is present in estuary).

Agenda item 7. Group discussion

Topic 1: Current actions that regional and hatchery managers are taking in freshwater to improve adult returns

Comment: Hatchery programs trying to get smolts to a certain size at release. Temperatures at release site may be cooler than what's seen in the mainstem. Is this considered an issue?

Comment: Constrained to established release timing, and temperatures in the mainstem are not a principal consideration. Limited by permitting, and bioprogramming limitations in the hatchery itself.

Comment: Hatcheries have modified operations significantly especially in the last 20 years. Most modifications not linked to purposes of linking survival and timing of arrival in estuary or ocean. It has been other things like broodstock management, supplementation, minimizing impacts to natural populations, acclimation to improve SARs, release time changes to match water flow management. Maybe it's time to think more about how hatchery operations could be linked to what's happening in the ocean or spread the risk- e.g., in ocean entrance time or considering warming conditions during outmigration conditions...these things also help in improving natural populations, too.

Comment: There may be years where we have losses, and some years that will be good for fish. How do we maximize wins each year?

Comment: Trying to be able to predict what's going to happen in a given year is difficult, we need to maximize variability and diversity. Each marine heatwave has been unique and fish response to each is also unique, so variability is our winning ticket in the long term.

Comment: We need to provide suitable spawning habitat for these fish when they return. This is a key investment to providing successful reproduction for natural populations and may buffer against poor ocean years.

Comment: Not all hatchery populations are uniform, there is a lot of variability already in the estuary. Condition factors, IGF, date and location captured- lots of different kinds of variability already exists within hatchery fish. The more opportunities we can give fish to expand the suite of habitat characteristics available to them gives them the best chance.

Comment – Programs do have the ability to adaptively manage, but there are some constraints (i.e., permitting, logistics, economic). Rearing hatchery fish as similar as possible to natural fish- well natural fish migrate when they are ready (sometimes in fall or winter months), but hatchery fish have to be released according to permits- not necessarily ready at release time. Volitional migration is not possible (permit constraints, is water available, etc.). A lot of hatcheries are looking at indoor hatcheries with circular tanks or recirculating technology. Funding to upgrade and modernize infrastructure will be important too. Variability in size is something being looking at. It has impacts later on in the life of fish, particularly at age of return.

Comment – Would be short-sighted to not include natural origin fish in this conversation. We can tweak our hatcheries for size, time, etc. but we need to consider natural-origin fish too. If thinking about carry-over effects, river management, barging, flow, should also be thinking about how these changes might affect natural origin fish and when they arrive at the estuary or ocean. Want to think about viability of natural – origin fish.

Comment: Who needs to be part of a conversation about experimental hatchery releases and diversification?

Response: Adding that analysts need to be part of this conversation, along with policy people and hatchery managers. Need to analyze results of various hatchery release experiments to inform what we can do next.

Topic 2: New research needed to understand the mechanisms driving correlative carryover effects

Estuary research

Comment: All fish must travel through the estuary, recommend focusing efforts here. Lots of diversity in how fish engage with estuary- e.g., yearling smolts don't just migrate through. Need to learn more about this. Can take advantage of PIT-tag technology already in place. Need to get people in a room talking about their needs.

Comment: Dedicated sampling in the estuary would be great, somewhere between 2-4% of catch have PIT-tags. This is a tiny fraction and not representative, but these fish are handled and a lot can be learned for them. Need for funding for this effort (to expand surveys).

Comment: How are yearling migrants using the estuary/ moving through the estuary? We have information from past surveys that can be used to help focus surveys in future. Yearling fish coming in at higher tides when nets not in place- knowing that, can modify sampling methods to capture them. Likely that yearlings use shallow habitats more often than thought. New technology being developed to be able to sample other types of habitat (not currently being sampled) to better learn about alternate migration pathways through estuary and how diverse habitats support diverse life history strategies.

Comment: Recalled a slide that showed hatchery fish have lower survival in the ocean than wild fish? Why is that? What can be done to evaluate that, considering that ~90% of fish leaving Columbia are hatchery-origin fish. Is improvement possible? Could it be timing of arrival to estuary, fish size, different predator-avoidance instincts, does marking affect survival?

Comment: Interesting point. Results showed that hatchery fish had lower survival overall but were less specifically sensitive to temperature. Maybe they are just responding to different factors. Possible size-selective predation as hatchery fish are generally larger than natural origin and some predators prefer larger smolts.

Comment: Agrees with increased estuary sampling. Very few PIT-tags used in lower Columbia Washington region- lots of CWT though. If only PIT tag data is used for this research, will not be able to say anything about these lower river Washington programs. Also, lower-river integrated hatchery programs don't survive as well as segregated programs. Possibly it is because the natural origin fish, once brought into the hatchery environment- just don't seem to survive as well. Hatchery fish with traits selected for over time seem to survive better in hatchery environment.

Hatchery experiments

Comment: NPTH, Clearwater, and Dworshak are currently doing a study on spring chinook release groups. In 2021, groups of fish released two weeks apart. Early release moved a little slower than the later release group, but all arrived at LGD around the same time. There are environmental cues that these fish are keying into, they don't always do what we want them to do. Fish migrate when they are ready, not necessarily right when released.

Comment: We've been modeling the survival and run timing of Snake River Fall Chinook (subyearling fish) and seeing basically the same thing. Spikes in arrival probabilities in the estuary for different release groups even though released at different times.

Comment: It would be interesting to keep track of this data in release database. Even though arriving at the same time, could have different survival impacts. Some have more time for in river growth during migration. Maybe fish in estuary longer are seeing some kind of benefit from this different length migration period. Those are exactly the kinds of experiments that we should be doing. Arrival day shouldn't be the only indication of whether the experiment has been successful. Other indicators like growth or eventual survival are also important.

Comment: We have collaborated with many agencies to do control/treatment studies with spring Chinook at the Cle Elum Supplementation and Research Facility. One of the objectives of the facility from the beginning was to help address these types of regional questions

Comment: Critical need to increase PIT-tag detection at McNary and Bonneville Dams to obtain this information

Habitat research needs

Comment: Have a robust estuary habitat restoration program and Council's program tracks this. Principle tool is reconstructing the floodplain. Important to learn more about fish down there but also need more opportunities to reconnect flood plain habitat working with watershed councils and county commissioners. Always wondered whether pre-hydro, fish interacted much with the Columbia floodplain above Bonneville (now inundated). Wildlife refuge and wetlands there. Is there a future in enhancing habitat in reservoir reaches even though river levels to go up and down here?

Comment: CRITFC and Yakama Tribe are starting to look at reconstructing confluence habitat. Confluences post-hydro are completely different than how historically structured. A lot of these areas

are currently very shallow and flat and warm- ideal habitat for predator fish and birds but not great habitat for salmon and lamprey.

Comment: What restoration opportunities are possible in estuary? Need multiple diverse habitats to support diverse life history strategies. Reconnection has been a narrow focus but essentially flooding private property. Can restoration keep up with development in the estuary as there is rapid urbanization? Referencing comment on mid-Columbia- has been trying to find money to inventory restoration opportunities from Bonneville Dam to John Day Dam on Oregon side to supplement what fish enhancement already did with their surveys on the Washington side from the Wind River, upstream. A lot of people think this area is too degraded to have value, but there may be restoration opportunities there and they could have benefits for migrating salmon.

Comment: USFWS in their 2020 CRS BiOp calls for mapping riparian areas along the mainstem (to benefit bull trout) as an initial step towards understanding opportunities, but arguably these surveys could be insightful for benefits for salmon and steelhead - this initial baseline assessment is in-planning, funded by BPA.

Topic 3: Adaptive management discussion- climate change and adaptation- next steps

Comment: Impacts are different for specific stocks; how can we factor in some of these ocean metrics and outmigrant metrics into life-cycle models? How do we figure out where the bottlenecks are for individual stocks? Need to develop representative life cycle models for the various MPGs. Need to ask modelers how detailed they're getting with ocean survival metrics and the mainstem survival piece. Also need better PIT-tag monitoring at McNary or for the upper Columbia at Wanapum. Need a better monitoring system need to lay out a coordinated monitoring strategy focused on the different stocks. – big collaborative effort needed.

Comment: We're trying to incorporate more ecosystem-based perspective on understanding salmon marine survival instead of just using freshwater covariates. This includes analyzing survival not for just individual populations but to characterize interspecific dynamics. What are other species doing when salmon are entering ocean and how does that affect salmon. Ecosystem and network models can account for how other species interact with salmon life history. These are data-hungry models. There's a big gap particularly for wild subyearlings in terms of where they go and for how long during migration. Genetic stock ID is critical information – can use some of this information. These techniques are less biased by tagging patterns. Some limitations in these techniques- not all stocks can be told apart. Why is that? Is there a way to facilitate more genetic ID application?

Comment: When fish caught in ocean, use GSI and PBT analyses. These are helpful but can also be confusing because these tools don't always agree. GSI is historical genetic source of fish and PBT is about where parents are now. In terms of understanding ocean behavior and distribution, imperative to understand where fish came from. Ideally would use PIT-tag data and have individual-specific data, but most fish not PIT tagged. As such, lots of reliance on GSI and PBT.

Comment: Appreciated presentations. Two take-aways (1) condition of juvenile fish released from hatchery or condition of outmigrating wild fish- need to know what is most important in terms of their survival to the estuary and (2) little we can do in the ocean but lots we can do in freshwater. Key investment is improved PIT-tag detection at McNary and Bonneville Dams and take advantage of newer technology in the estuary. These two together would help improve accuracy and precision of survival estimates and knowledge of condition, timing of release- both affecting management in future.

Agenda item 8. Plans for the next forum

The next Ocean and Plume Science and Management Forum will be scheduled in January 2023.

Attendees suggested the following topics:

- What can we learn from the bad ocean conditions and how fish respond?
- What were (if any) the successes?
- Where are fish going in the ocean? Migration patterns overlayed on ocean conditions.
- Update on estuary science
- Protecting diversity and protecting intact habitat is critical. What can we do to further the dialogue and understanding? How can we take what we're learning and put it into practice?

Agenda item 9. Closing remarks

Guy Norman (WA)