

# Northwest Power and Conservation Council

## Ocean and Plume Science and Management Forum Notes

April 4, 2024 9:00 AM - 12:00 PM

Presentations available here: <https://www.nwcouncil.org/calendar/ocean-and-plume-science-and-management-forum-2024-04-04/>

### Attendees

Name (affiliation)	Name (affiliation)	Name (affiliation)
Brady Allen (BPA)	Molly Gorman (NOAA)	Chris Noyes (IDFG)
Dean Allan (DFO)	Jennifer Gosselin (UW)	Shubha Pandit (YN)
John Arterburn (CCT)	Rosie Gradoville (CRITFC)	Todd Pearsons (GCPUD)
Sarah Barnes (NPT)	Rosie Gradoville (CRITFC)	Louie Pitt (NPCC)
Brian Beckman (NOAA)	Correigh Greene (NOAA)	John Powell (IDFG)
Tim Beechie (NOAA)	Stan Gregory (OSU)	Les Purce (NPCC)
Kerry Berg (NPCC)	Steve Haeseker (USFWS)	Thomas Quinn (ISAB/ ISRP)
Mark Bierman (USACE)	Elaine Harvey (CRITFC)	Craig Rabe (NPT)
Forrest Bohlen (IDFG)	Alf Haukenes (WDFW)	Steven Richards (WDFW)
Morgan Bond (NOAA)	Maureen Hess (NPCC)	Sarah Riseman (CRITFC)
Bill Bosch (YN)	Todd Hillson (WDFW)	Andres Salazar Estrada (CRITFC)
Dale Brown (NPT)	David Huff (NOAA)	Windy Schoby (NPCC)
Brian Burke (NOAA)	Jim Irvine (ISAB)	Ed Schriever (NPCC)
Richard Bussanich (ONA)	Tom Iverson (YN)	Charles Seaton (CRITFC)
Kym Buzdygon (NPCC)	Kym Jacobson (NOAA)	Kate Self (NPCC)
Rich Carmichael (ISRP)	Amelia Johnson (LCFRB)	Greg Sieglitz (NOAA)
John Cassinelli (IDFG)	Sanjeev Joshi (CRITFC)	Joe Smith (NOAA)
Tim Copeland (IDFG)	Tom Kahler (DCPUD)	Kelcee Smith (ODFW)
Catherine Corbett (LCEP)	Ryan Kinzer (NPT)	Mark Sorel (WDFW)
Eric Crawford (TU)	Amy Kocourek (NOAA)	Johanna Stangland (NPT)
Jarrold Crow (NPT)	Lance Kruzic (NOAA)	Jesse Steele (GRMW)
Lisa Crozier (NOAA)	Jody Lando (BPA)	Howard Stiff (DFO)
Elizabeth Daly (NOAA)	James Lawonn (ODFW)	Cassie Sundquist (IDFG)
Joe DuPont (IDFG)	Bob Lessard (CRITFC)	Kelsey Swieca (NOAA)
Kara Eckley (NOAA)	Brian Leth (IDFG)	Mike Swirsky (CRITFC)
Bill Edmonds (NPCC)	Art Martin (ODFW)	Gabriel Temple (WDFW)
Mike Edmondson (IDOSC)	Andrew Matala (YN)	Lora Tennant (NPT)
Rod Engle (USFWS)	Katie McBaine (IDFG)	Shane Vatland (NPT)
John Epifanio (ISAB)	Alex McManus (WWR)	Amy Wallace (NOAA)
John Erhardt (USFWS)	K.C. Mehaffey (ND)	Laurie Weitkamp (NOAA)
Kurt Fausch (ISRP)	Erik Merrill (NPCC)	Allan Whiting (BPA)
Joseph Feldhaus (ODFW)	Jordan Messner (IDFG)	Don Whitney (IDFG)
Chris Frederiksen (YN)	Yolanda Morbey (ISAB/ ISRP)	Carol Winkel (NPCC)
Kurt Fresh (ISRP)	Cheryl Morgan (OSU)	Michael Young (ISAB)
Mark Fritsch (NPCC)	Sara Mounts (NPCC)	Jennifer Zamon (NOAA)
Jeff Fryer (CRITFC)	Andrew Murdoch (WDFW)	
Teresa Fryer (WDFW)	Jason Neuswanger (WDFW)	
Laura Gephart (CRITFC)	Helen Neville (TU)	
Summer Goodwin (BPA)	Heather Nicholson (Public)	

---

## Affiliation acronyms

BPA	Bonneville Power Administration
CCT	Confederated Colville Tribes
CRITFC	Columbia River Inter-Tribal Fish Commission
DFO	Department of Fisheries and Oceans Canada
DCPUD	Douglas County PUD
GCPUD	Grant County PUD
GRMW	Grand Ronde Model Watershed
IDFG	Idaho Department of Fish and Game
IDOSC	Idaho Office of Species Conservation
ISAB	Independent Science Advisory Board
ISRP	Independent Science Review Panel
LCEP	Lower Columbia Estuary Partnership
LCFRB	Lower Columbia Fish Recovery Board
ND	News Data
NOAA	National Oceanic and Atmospheric Administration
NPCC	Northwest Power and Conservation Council
NPT	Nez Perce Tribe
ODFW	Oregon Department of Fish and Wildlife
ONA	Okanogan Nation Alliance
OSU	Oregon State University
TU	Trout Unlimited
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
UW	University of Washington
WDFW	Washington Department of Fish and Wildlife
WWR	Wolf Water Resources
YN	Yakama Nation

## Agenda

Time	Presentation Title	Presenter
9:00 – 9:05	Welcome remarks	Chair Les Purce, NPCC Council Member
9:05 – 9:15	Logistics, introductions, purpose and history of the Ocean Forum	Council staff
9:15 - 9:45	Ocean conditions in the California current and implications for salmon and steelhead	Brian Burke, NOAA
9:45 - 10:05	CMISST: A new stock-specific indicator for salmon management	Brian Burke, NOAA
10:05 - 10:15	<i>Break</i>	
10:15 - 10:45	Marine ecosystems and how they affect salmon under historically cool conditions, recent marine heatwaves, and a variety of potential futures	Lisa Crozier, NOAA
10:45 - 11:15	Salmon distributions and marine heat waves: potential changes to survival and distributions	Laurie Weitkamp, NOAA
11:15 - 11:45	Q&A <ul style="list-style-type: none"> <li>• What are interior managers dealing with day-to-day and how might that be informed by the work NOAA is doing in ocean?</li> <li>• How do managers use information provided by NOAA? Input from managers could influence how data collected/ what data collected.</li> </ul>	Group discussion
11:45	Closing remarks	Chair Purce

### Welcome- Forum Chair Les Purce, NPCC Council Member (WA)

- Chair Purce welcomed attendees to the Ocean Forum.

### Logistics and introduction- Patty O’Toole, Director of the Fish and Wildlife Division, NPCC, and Kris Homel, Biologist, NPCC

- Patty reviewed meeting logistics.
- Kris introduced presenters and reviewed the agenda.

### History of forum- Kris Homel, Biologist, NPCC

Kris briefly summarized 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/calendar/ocean-and-plume-science-and-management-forum-2024-04-04/>

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.

## **Ocean conditions in the California current and implications for salmon and steelhead – Brian Burke, Supervisory Research Fishery Biologist, NWFSC in Seattle Washington**

### Summary:

Brian described oceanographic conditions and the various indicators, such as El Nino or PDO, that characterize variation in conditions over time. He then talked about how distant ocean conditions can affect what happens in freshwater and the survival of juvenile salmon and steelhead in different environments. He noted that over time these relationships have shifted as the marine environment has experienced substantial and extended heat waves.

- Stoplight chart: 2022-2023 mixed signals, result in average survival for salmon
- Global dynamics shape local conditions:
  - Underlying processes: sea surface temperatures, pressure, height (SST, SSP, SSH); common indicators: PDO, NPGO, ONI, and NPH
  - Local physical conditions: Wind, upwelling, coastal currents
  - Local bio conditions: copepods, krill, ichthyoplankton, predators
- Spatial teleconnections are broader than marine conditions alone: climate indices, sea surface temperatures, upwelling indices, air temperature, river flow indices – correlations between freshwater conditions and ocean ones.
- Pacific Decadal Oscillation (PDO): most used indicator in the Basin for salmon; how similar and variable is the PDO from the SST map? If the ocean in general is warming, we can have a negative PDO value that's still warm along the coastline.
- El Nino/La Nina: direct measure of warm vs cold water
- Local conditions depend on ocean currents. What happens in the Western Pacific (and North Pacific) affects what happens in the Eastern Pacific. NE Pacific marine heatwaves are increasing – areas of the ocean that are warmer than avg. Heat waves are driven by a lack of surface mixing. Pressure systems also drive upwelling. Wind patterns along the coastline tend to push water offshore in the summer. Deeper, cooler water rises to fill the void. Therefore: Currents, temp, and upwelling all drive the local food web and biological systems.
- Non-stationarity: this is a dynamic system, not a static one.
  - Changes in individual time series or in the relationship amongst time series.
  - Changing PDO-Salmon relationships. Sibling regressions are not immune – Coho Oregon production index, counts of spring chinook at Bon Dam. Can lead to overestimating adult returns.

- What forecasters can do and current focus: greater awareness of salmon marine ecology; take advantage of patterns in physical-biological relationships. Collaborators' projects cover all ecosystem components.
- Warm blob marine heatwave impacted physical changes and led to adjustments in the biological ecosystem. For example, water jellies in much higher distributions. Pacific sardine larval eggs – spawning is starting much earlier now than it did before the blob. Really good food source for salmon, but as adults are competitors and alternate prey to salmon. Sardine spawning timing is important to understanding complex pressures on salmon survival.

Discussion:

**Comment:** Can you speak more about how indices of juvenile survival correlated with total ocean survival?

**Brian:** Ocean survival was determined from adult counts at dams and other sources of information. It wasn't a measure of survival, *per se*, but was correlated with survival. Also used direct measures of survival, like PIT-tags.

**Comment:** What is the definition of a "marine heat wave"?

**Chat:** link to the BlobTracker, which has details of how "heat wave" is defined by the IEA folks... <https://www.integratedecosystemassessment.noaa.gov/regions/california-current/california-current-marine-heatwave-tracker-blobtracker>

**Comment:** What is the key driver of mortality in the ocean? Top down (predation) or bottom up (food web)?

**Brian:** Ocean monitoring and research was initially designed to focus on food web and physical drivers but NOAA recognizes the need to sample predators. Brian suspects that predation may be a key variable because there are years where there is plentiful food and the fish they catch are in good condition, but there is still high mortality. That is not an effect of starvation. Predators such as birds, marine mammals, and other predatory fish could be influencing survival and there is no real information on interannual variation in predator abundance or distribution. There are renewed efforts by OSU (and others) to study this. There is also funding through the Inflation Reduction Act to use thermal cameras to automate some predator counts in the plume/estuary.

**CMISST: A new stock-specific indicator for salmon management – Brian Burke, Supervisory Research Fishery Biologist, NWFSC in Seattle**

Summary:

Brian presented a new tool he developed, called CMISST (Covariance Map Index of Sea Surface Temperature), that generates stock-specific indices of ocean conditions using sea surface temperature or sea-surface height.

- No single metric can represent our diverse uses of ocean indicators. Current management needs can't wait for fully developed mechanistic ecosystem models. We can quickly and easily

generate a stock-specific indicator for a variety of species/management applications, such as stock-specific stoplight charts.

- Wealth of existing data sources: Satellite data (SST, SSH) – publicly available, spatially explicit. We can quantify the covariance between SST at any single location and the response variable we want. We can do the same for every grid cell in the N Pacific, such as the covariance between winter SST anomalies and counts of adult spring Chinook in the Columbia River. The correlation map represents the optimal spatial distribution of SST anomalies for a given salmon population. There's a correlative relationship with salmon returns. Can do this comparison for any season and any species/stock. Can also highlight predator abundance in space with salmon survival. Or spatial pattern of wind correlation to seabird egg-laying dates. How do we quantify and use that data?
- Covariance Map Index of Sea Surface Temperature (CMISST)
  - Measure of how similar any given year is to that optimal value.
  - Similar to how PDO is created, but it's built with the user's desired response variable. Once we have the index, we can create the regression model with the response variable. A stock specific index can be created from each map. Then, compare performance to other indicators.
  - Shiny App user interface: <https://connect.fisheries.noaa.gov/content/9df237ec-ec94-4c71-8782-8f1c7332fd77>

#### Discussion:

**Comment:** Winter sea surface temperature (SST) was one predictor of survival. What might be the mechanistic relationship be to survival back to Bonneville?

**Brian:** In running the model, looked at several seasons. Spring SST is a better predictor. However, the patterns setting up in the spring begin in the winter. This “pre-conditioning” sets the stage for subsequent productivity, or lack thereof. For conditions to be good for salmon in the late spring/ early summer, physical and biological forcing must be in place in the winter to create those subsequent survival benefits.

**Comment:** It would be interesting to see covariance maps for seabird productivity, too! Might get at some of the food web mechanisms affected by the physical processes associated with SST in winter.

**Comment from NOAA:** we do have available information on seabird spatial distributions and interannual variability for May 2003-2012 and June 2003-present (but not 2013, 2014, 2020, 2021). Covering from Cape Flattery, WA to Newport, OR. A new manuscript specifically addressing stock-specific spatial overlap for Chinook juveniles and seabird predators was just submitted to a journal yesterday.

**Comment:** In the Columbia Basin, there are lots of long term smolt-to-adult survival datasets. Can the CMISST app use SAR or SAS type data for individual populations or hatchery stocks?

**Brian:** Yes- this is the exact goal of this tool. The only caution in using it is that there may be non-stationarity in the response. This can be detected by running the model for shorter time periods and comparing the outputs.

**Comment:** Could this model apply to changing age-structure, too? Could we assemble a group to explore different applications for the tool?

**Brian:** When the model is running using SST as the index, it runs very quickly. This lends itself to exploring different applications of the model. Brian requested feedback on how the tool is working or different applications- what works well? What other options should be incorporated? SST and sea surface height (SSH) data will be uploaded annually into the CMISST app. Contemporary data should be able to predict returns two years out, if lagging the ocean entry to adult return age by two years.

**Comment:** Fraser sockeye returning in odd number years are typically in lower condition and smaller than sockeye returning in even number years, presumably because of interactions with more numerous pink salmon in odd years.

**Comment:** DFO working to reconstruct Okanagan sockeye salmon returns using Bonneville counts and to create a marine survival index; appreciate stoplight indices; is anyone else working with sockeye? Let's network! Pink salmon abundance in the N Pacific inversely proportionate to Sockeye returns. Could pink salmon abundance be added to the Stoplight Chart?

**Brian:** The stoplight chart was created over a decade ago and hasn't changed much because many people use it. The index contains a small subset of the data collected. We can use other indicators and data sets that focus on the specific fish that interest you and are always happy to work with managers on their informational needs.

## **Marine ecosystems and how they affect salmon under historically cool conditions, recent marine heatwaves, and a variety of potential futures – Lisa Crozier, Research Ecologist, NWFSC in Seattle**

### Summary:

Lisa presented qualitative and quantitative models of how the ecosystem might function under different scenarios, and how that might affect salmon. Her models explored different scenarios, such as changing prey abundance, climate change, or freshwater management actions.

- We know a lot about the ecosystem, but there are features of the food web and non-stationarity that we just don't know. How do we represent what we're missing and how do we explore uncertainties? IRA funding to develop quantitative models that reflect the complexities of the unknown.
- Why do we care? The number of salmon returning to freshwater matters. Fewer salmon return from a warmer ocean, both retrospectively and in future projections. The few that do return are younger than they historically would be. They also have fewer eggs. Fecundity is relative to body size.
  - What is driving this? Prey decline? Competition? Predation?
- Models can help us predict, manage, and adapt to climate change
- Qualitative Network Analysis (QNA) – focal species and functional groups; intermediate complexity; fast to run; use it in an exploratory context:
  - Translate any conceptual model you have of the food web into a matrix
  - Sums direct and indirect impacts on a focal species after a perturbation (such as warming temps)
  - Freedom from the constraint of fully measured interactions; treats uncertainties equally

- Helps determine which links in the network had the greatest influence on salmon outcomes. Running the scenarios can influence management actions: habitat, predation, dams, harvest, hatchery, climate – every part of the network
- If you can make salmon more resilient to pressures, they survive in greater numbers and have better outcomes
- Uncertainty about predators and competitors and climate change
- End-to-End Ecosystem Model – max complexity; data hungry; slow to run; comprehensive; constrained by diet data and subtle assumptions:
  - Very sensitive to diet data and biomass
  - About 100 functional groups! Prey, competitor, fishery, predators
    - Modeling certain key prey and predators that impacted salmon; the whole diet is accounted for
    - Functional groups reduced by 50% across the board. Specialization of predators and biomass made a difference
  - Species with the largest biomass and most specialized diets had greatest influence
- Next Steps
  - Build intermediate complexity quantitative models. Explore management interventions to mitigate negative impacts from climate change. Incorporate estuary and marine survival into lifecycle models.

Discussion:

**Comment:** Can return data used in models be parsed by hatchery and wild origin?

**Lisa:** We tried to separate them out in the qualitative analysis, but hatchery and wild fish don't have unique pathways in which they interact with different species after they enter the ocean. They eat similar things and are eaten by similar things. There are some potential differences in size-selectivity and condition that could be relevant.

**Comment:** How linked is the amount of prey in the environment to the condition of salmon in the ocean? what about protections for salmon prey/amount of prey in their environment (e.g., herring)?

**Lisa:** Some scenarios are geared toward this but the confounding effect is that prey can grow into predators. This means they may exert a positive effect on salmon when prey are small, and a negative effect on salmon when they grow into predators. Indirect effects overwhelm direct ones.

**Comment:** One management strategy in the model is flow. What is encompassed in flow management?

**Lisa:** The criterion for including something in a scenario was that it had to have a different impact than all other variables already included; flow is the most complex. Researched recovery plans for interior stocks to identify what the expected effect on survival and abundance would be from all of the different flow management actions (e.g., reservoir storage, dam removal, spill, travel time, quality of rearing habitat, how flow affects predation (birds, pinniped), etc.). Some of these effects are positive and some negative. Increased flow increases the area of the plume which might decrease the success of bird predation because salmon are more spread out. Higher flow has also resulted in lower pinniped predation. Increased spill results in faster travel times for juveniles and increased survival.



**Salmon distributions and marine heat waves: potential changes to survival and distributions? – Laurie Weitkamp, Research Fisheries Biologist, NWFSC in Newport, Oregon**

Summary:

Laurie lost her voice and will record her presentation. It will be posted on the Ocean Forum webpage, along with her slides.

**Q&A - Group discussion**

**Patty:** What feedback do managers have?

**Comment:** Thanks to Brian for elaborating upon stoplight indicators and to Lisa for her very thoughtful presentation.

**Comment** As a state fish and wildlife staffer, it's nice to get exposure to new tools which might help with forecasting.

**Comment:** This is very helpful information, specifically related to predation. One thing managers struggle with is whether management of juvenile salmon predators influences adult returns. One way to get at this could be through more sophisticated modeling techniques.

**Lisa:** One thing that was a surprise about bird dynamics was the size-selectivity at different parts of the life cycle. This will be further explored.

**Brian:** These tools are critical because systems are so complex. There are two challenges with these models. First, they are very sensitive to inputs and we are not collecting sufficient predator data to fully parameterize the models. Second, we are at capacity staff-wise to do the extra modeling needed. Lisa's current work is funded for three years through the Inflation Adjustment Act. This is a direction that we want to go but doing so required consistent funding to increase capacity.

**Patty:** The Council supports learning more about predators in the Ocean. Where do we prioritize our work? What has the most impact on survival and abundance? The Program recognizes that predation is part of the ecosystem. Salmon evolved with predation but now face a constrained environment with the hydrosystem and reduced habitat. Now there is more overlap between predators and prey. Is it this overlap driving mortality or is the climate driving mortality?

**Brian:** Climate is changing the way these relationships work, and we can incorporate some of this data into models now by measuring the amount of food available in the ocean for salmon as well as their growth. Some years, food is abundant, yet survival is low, which directly suggests that predation can have a large effect on juvenile survival in the early ocean.

**Comment:** Question on the direct effect of predators killing prey versus the indirect behavioral response of prey avoiding predators. These two responses could interact. For example: Avoid the birds by swimming lower but increase predation by sharks.

**Brian:** We think about the indirect effects, but understanding behavior takes a lot of observation. Can't evaluate behavior in the ocean consistently.

**Comment:** There is immense value in this work- linking ocean data to survival is great. It is time to start linking this information with life cycle models, even if data are imperfect. This would allow us to answer more questions with full life cycle and ocean information, combined.

**Lisa:** That's our next step!

**Mark Fritsch:** Funding? Staffing? What is missing? We want to continue this research and protect this core work.

**Brian:** Budgets provided by BPA and NOAA are flat. Less than half the staff on this project than we had a decade ago. Cost increases will leave us with half our current capacity in the future.

**Comment:** Very informative and totally germane to our research on the wild Sockeye stocks in the Columbia system. (And widely applicable to BC salmon stocks, too, of course.) Big thanks, organizers and presenters.

**Comment:** Where might inland managers get the technical assistance needed to integrate oceanic conditions into their management, monitoring, and forecasting?

**Brian:** Call us, let's work on it together. We have limits but contact me for collaboration and finding the best path forward. One option: Let's have a tailored discussion about onramps and what managers need. If we're all engaged, we'll make progress.

**Laurie Weitkamp:** <https://www.fisheries.noaa.gov/west-coast/science-data/ocean-ecosystem-indicators-pacific-salmon-marine-survival-northern>

**Patty:** the Council can help further through Amendment work and/or through facilitating conversations.

**Kris:** Core purpose of this Forum is to build research collaborations and relationships.

**Brian:** For interior managers with specific questions or who want to get involved, we invite you to participate in the steering committee as we plan the next forum.

### **Closing remarks – Forum Chair Les Purce, NPCC Council Member (WA)**

Many thanks to today's presenters. Learned much and heard the points made about concerns over ongoing good science and funding/resources in the future. These are critical issues. A recent *Seattle Times* article by Lynda Mapes about the extinction of SRKW asks, are we really in a position to allow this iconic creature to disappear? We know the connections between Chinook and orca and ecosystems and predators. Les appreciates the graph showing that what happens in the ocean bleeds into the interior/rivers. He ended with a poem that calls us to appreciate our natural resources and act to protect them.