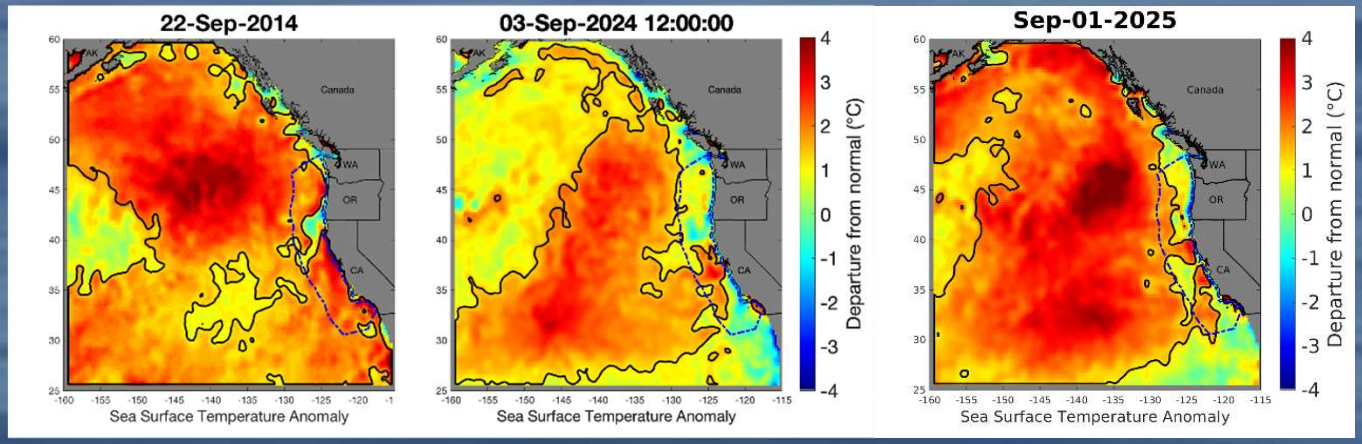
Juvenile salmon, steelhead, and ecological responses to a warming northeast Pacific Ocean

2025 Pacific Coast Steelhead Management Meeting

Elizabeth Daly, Toby Auth, Cheryl Morgan, Guy Fleischer, and Brian Burke



Oregon State University

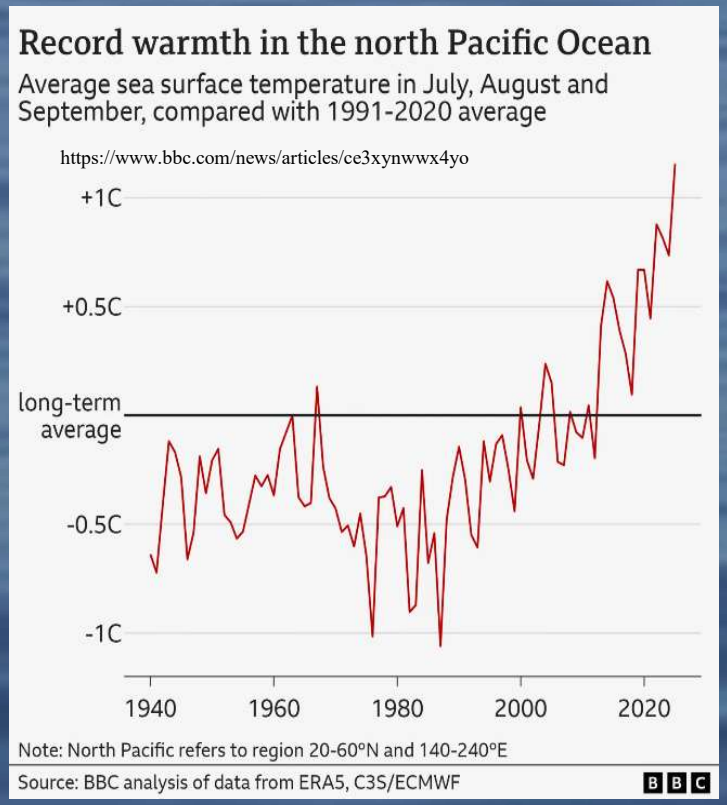
CIMERS
Cooperative Institute for Marine Ecosystem and Resources Studies

WILDSTEELHEAD COALITION

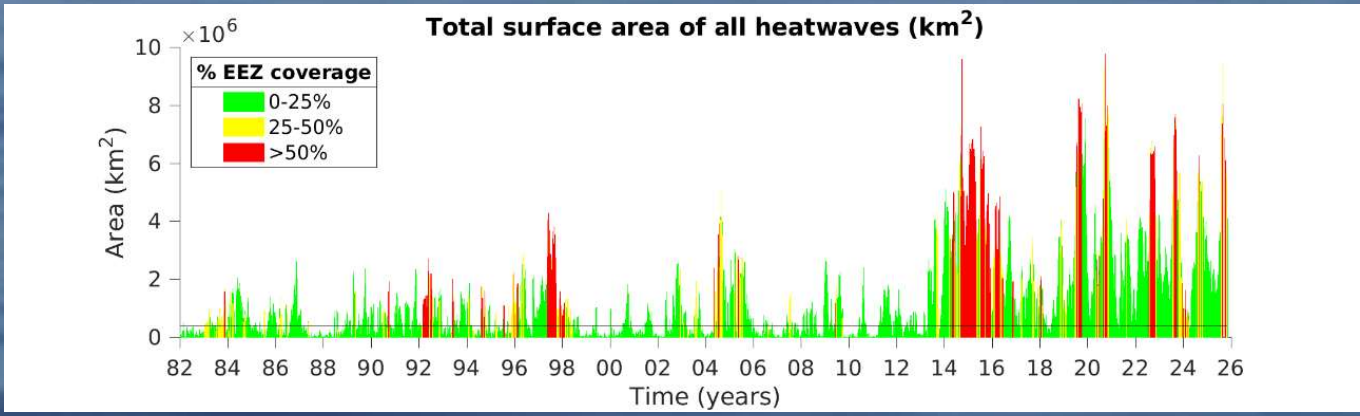
NOAA

NWFSC
NORTHWEST FISHERIES SCIENCE CENTER

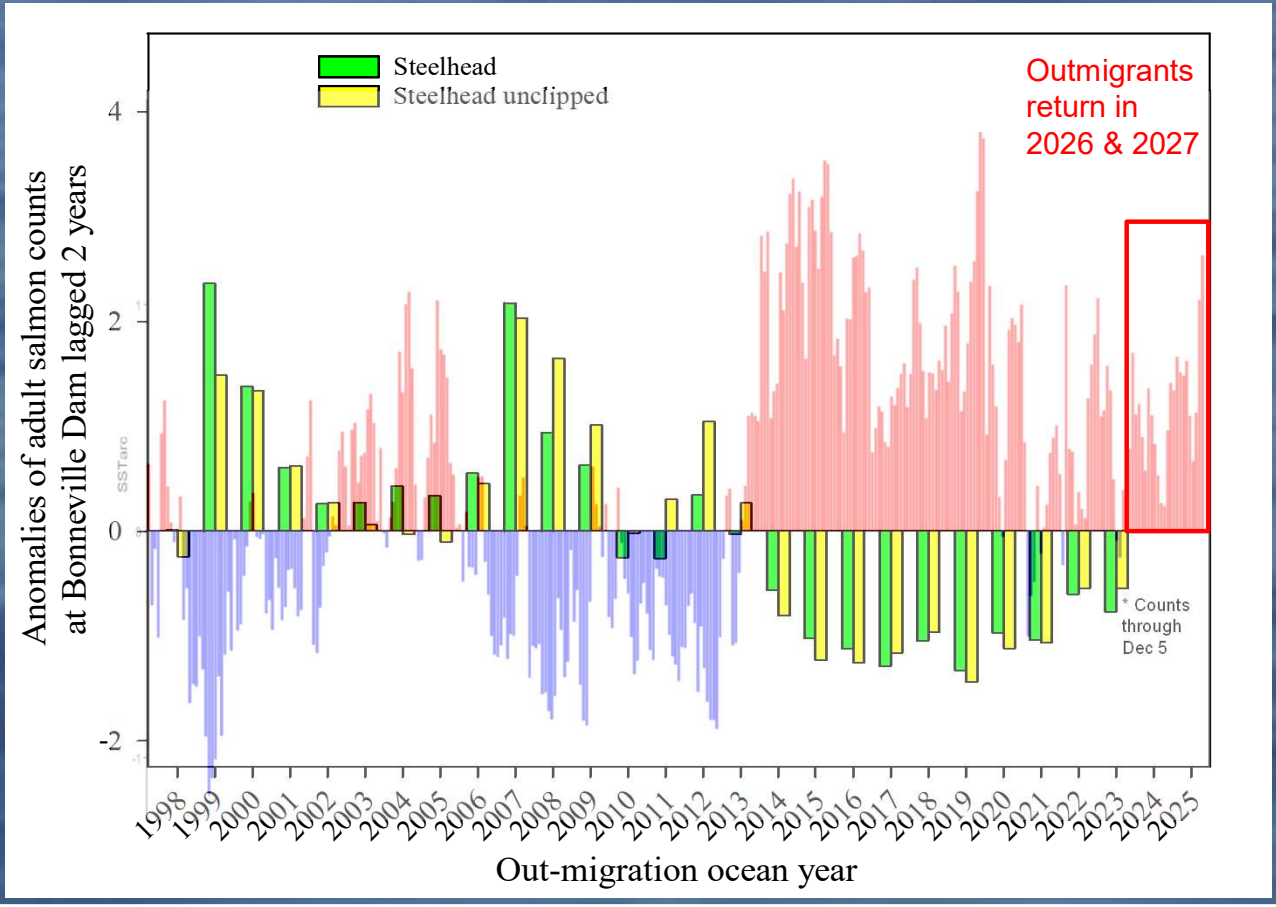
A decade of steady increased warming in the Pacific Ocean



Marine Heat Waves (MHWs)
California current (CA-WA)



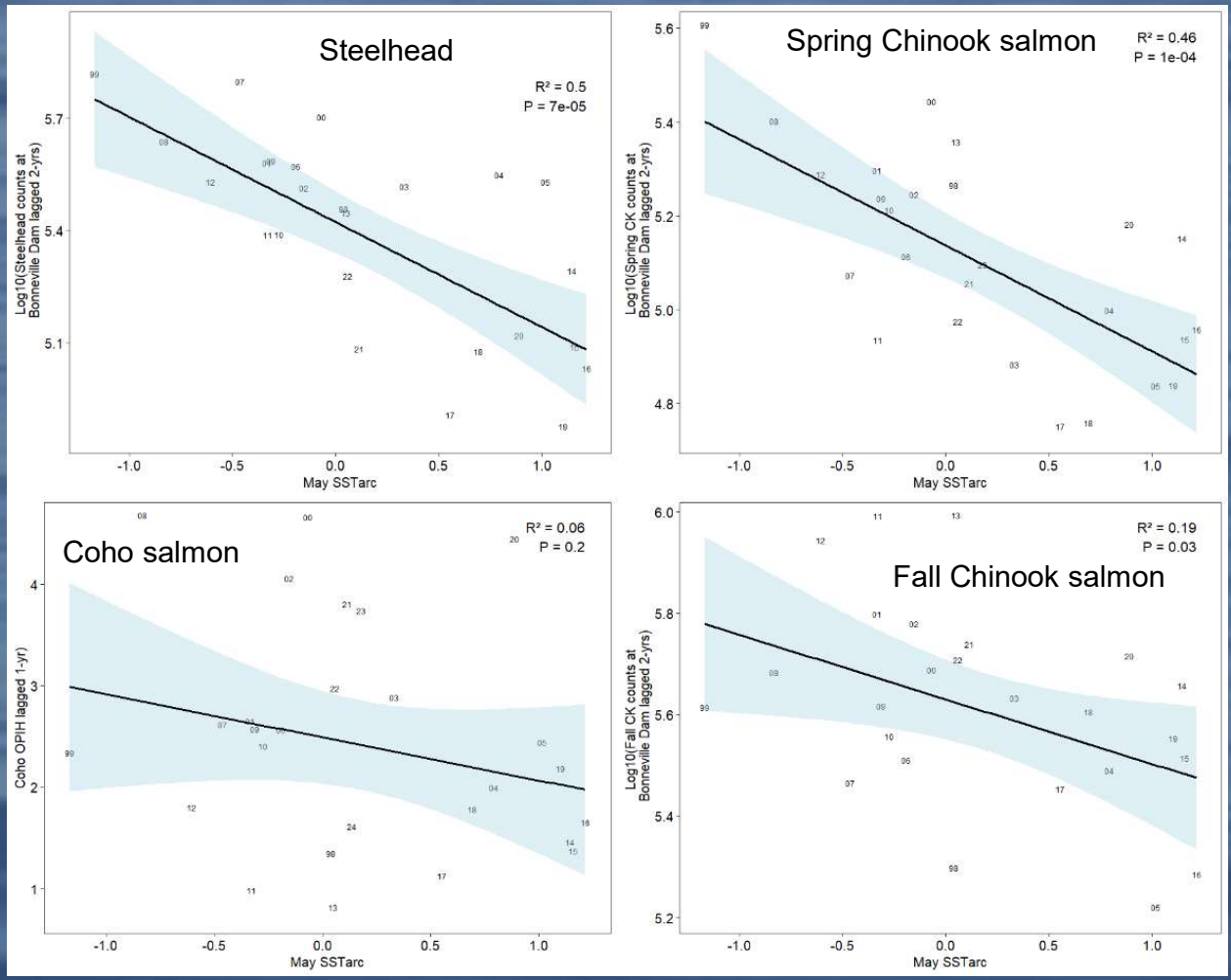
SST at outmigration and subsequent returns of Steelhead



Monthly sea surface temperatures have been warmer than average in more than 94% of the months since 2014

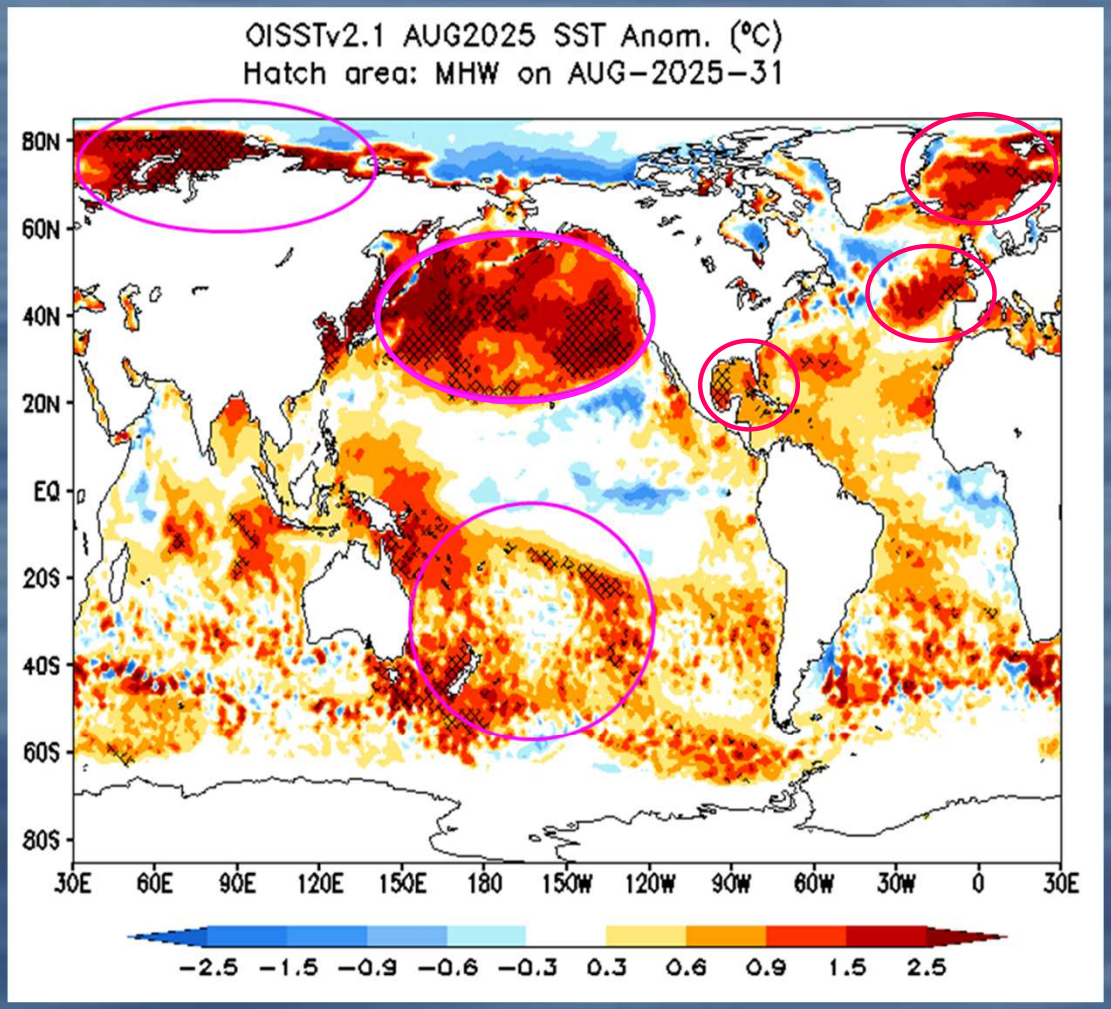
Fewer age-0 steelhead and salmon return to spawn when they out-migrate into warm ocean conditions

Spawner returns



Warmer ocean temperatures

We are not alone in the hot tub!



"… sea surface temperature increase in the global ocean exhibits marked spatial and temporal variations, ***with warming in the North Pacific significantly higher than in other basins since 2013.***"

Hu, ZZ., McPhaden, M.J., Huang, B. et al. Accelerated warming in the North Pacific since 2013. Nat. Clim. Chang. 14, 929–931 (2024).

Washington coast juvenile steelhead marine survival has been declining, primarily in relation with rising ocean SST over the last 50-yrs

Declining Marine Survival of Steelhead Trout Linked to Climate and Ecosystem Change

Jan Ohlberger[1] | Eric R. Buhle[2,3] | Thomas W. Buehrens[1] | Neala W. Kendall[1] | Toby Harbison[1] | Andrew M. Claiborne[1] | James P. Losee[4,5] | Jennifer Whitney[1] | Mark D. Scheuerell[6]

Opening the black box: New insights into the role of temperature in the marine distributions of Pacific salmon

Joseph A. Langan[1,2] | Curry J. Cunningham[1] | Jordan T. Watson[3] | Skip McKinnell[4]

Steelhead had the narrowest marine temperature preference relative to other Pacific salmon

"Interspecific competition has implications for future returns of steelhead from the ocean, especially as metabolic demands for steelhead increase as the ocean warms"

Canadian Journal of Fisheries and Aquatic Sciences

Research Article

Cycles in adult steelhead length suggest interspecific competition in the North Pacific Ocean

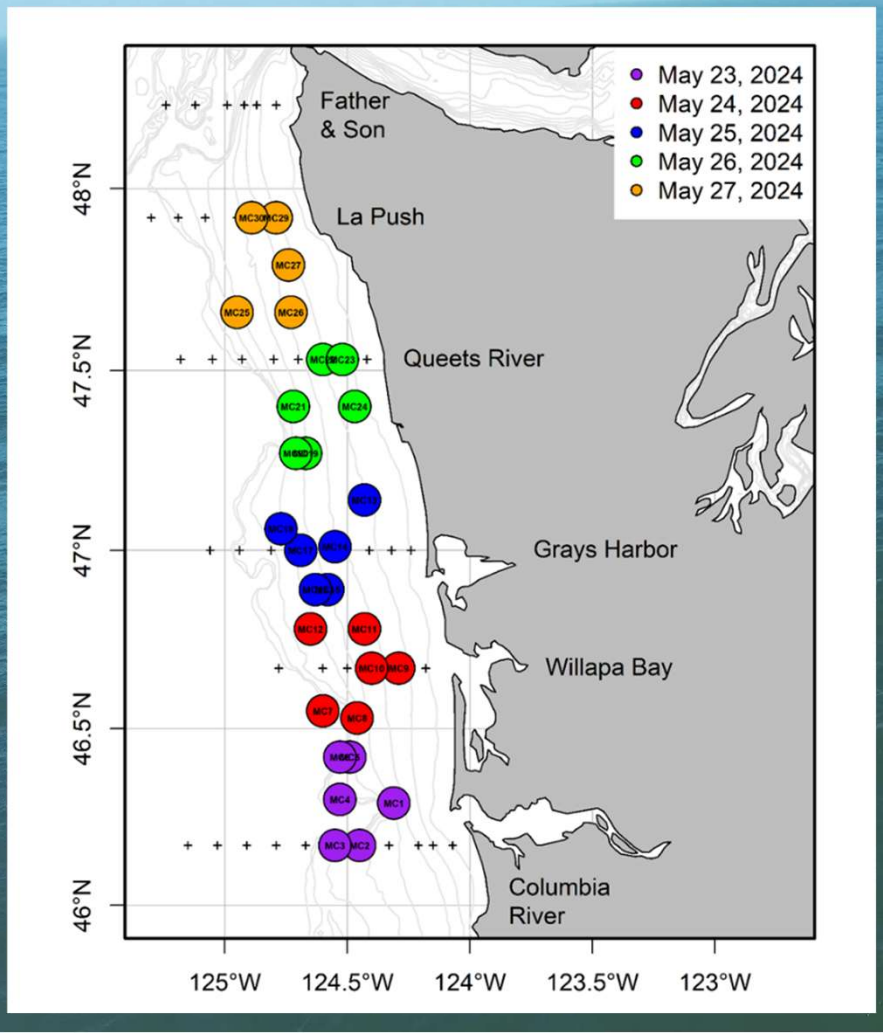
Ryan Vosbigian[a], Logan Wendling[b,c], Timothy Copeland[d], and Matthew R. Falcy[e]

Ohlberger et al. 2024 Declining marine survival of steelhead trout linked to climate and ecosystem change. *Fish and Fisheries*

Langan et al. 2024 Opening the black box: New insights into the role of temperature in the marine distribution of Pacific salmon. *Fish and Fisheries*

Vosbigian et al. 2024 Cycle in adult steelhead length suggest interspecific competition in the North Pacific Ocean. *Canadian journal of Fisheries and aquatic sciences*

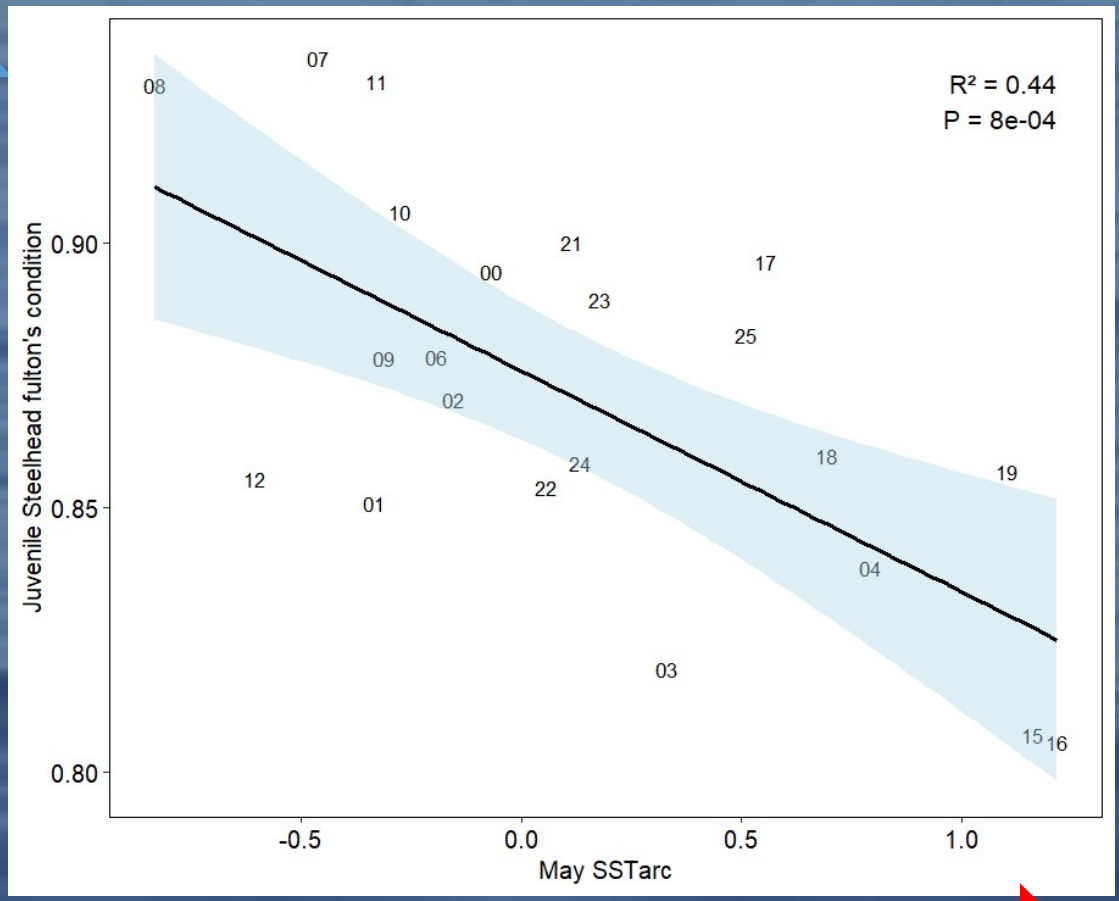
May 2024 JSOES sampling stations



Juvenile Salmon Ocean Ecosystem Survey (JSOES)

First days/weeks at sea:
Ocean Age-0 Steelhead condition and ocean temperature

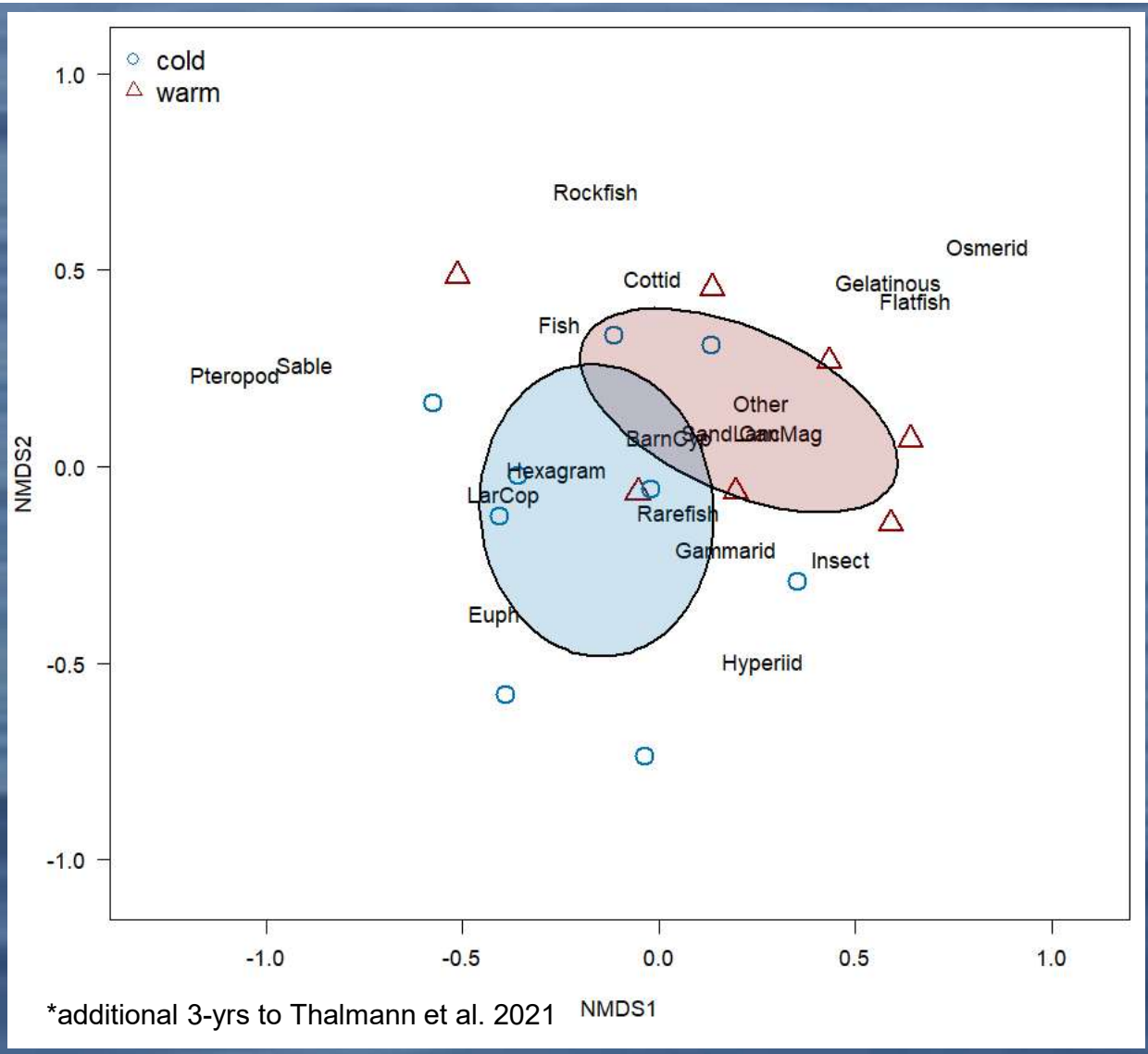
Steelhead conidtion



Warmer ocean temperatures

Steelhead diet composition ordination

Ocean age-0 steelhead diets differ in cold and warm ocean conditions



*additional 3-yrs to Thalmann et al. 2021

Two Anomalously Warm Years in the Northern California Current: Impacts on Early Marine Steelhead Diet Composition, Morphology, and Potential Survival

Hillary L. Thalmann*
Oregon State University, Department of Fisheries and Wildlife, Coastal Oregon Marine Experiment Station, Hatfield Marine Science Center, Newport, Oregon 97365, USA

Elizabeth A. Daly
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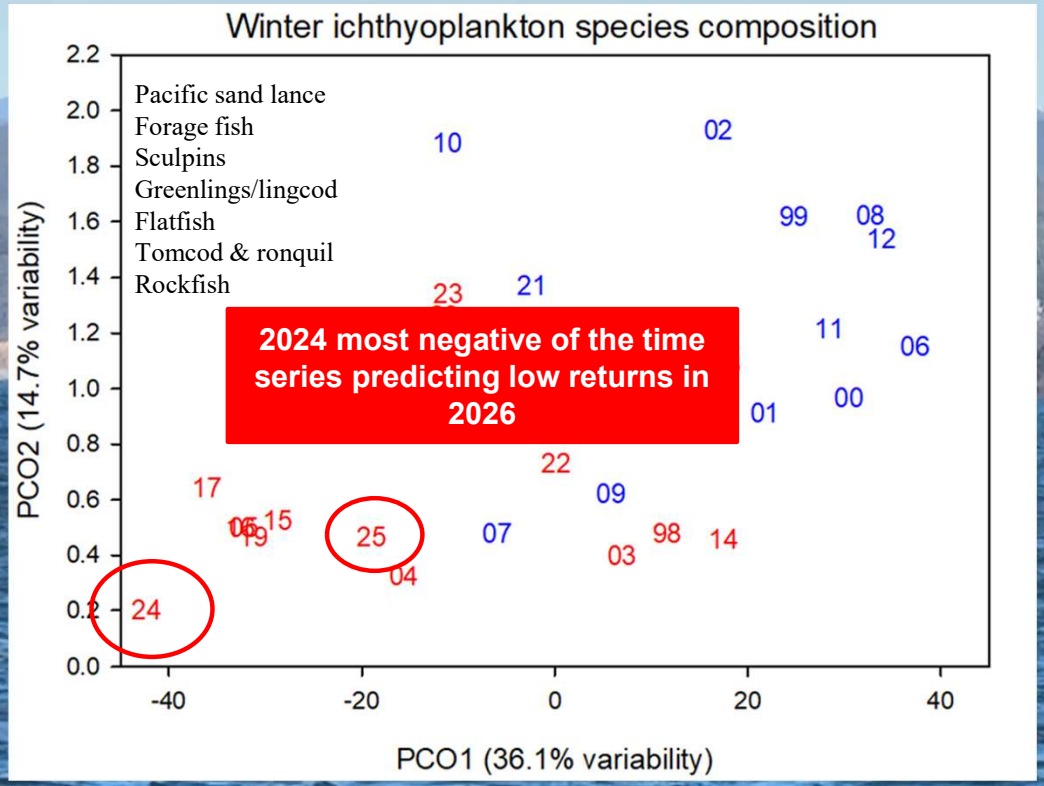
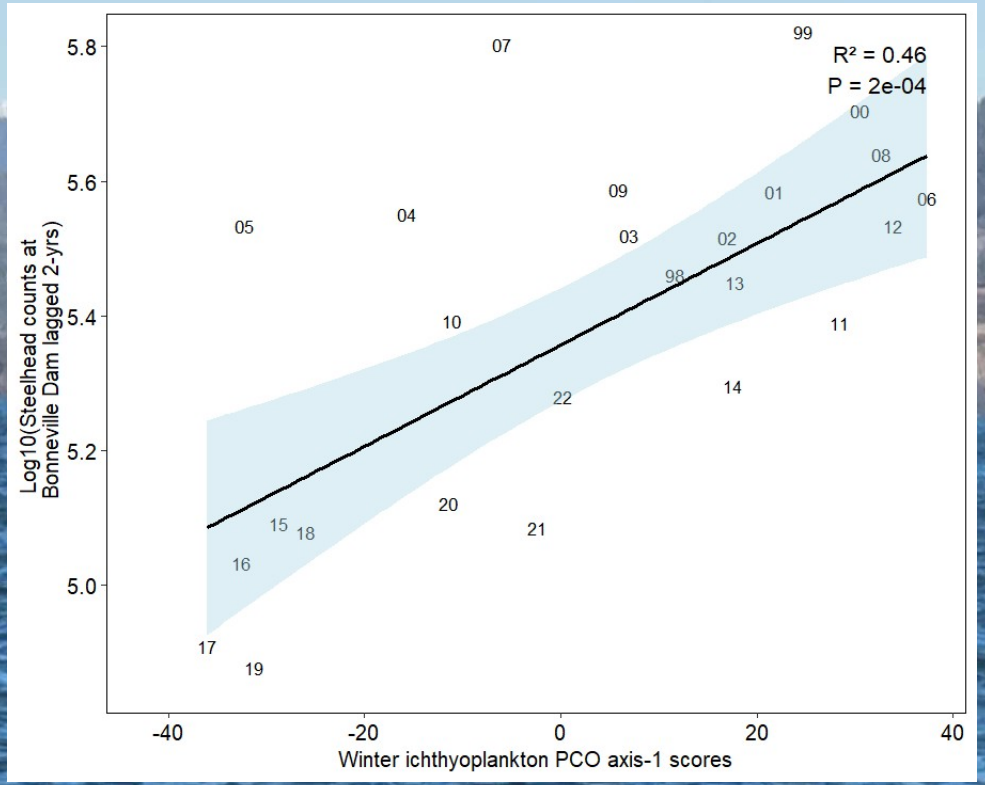
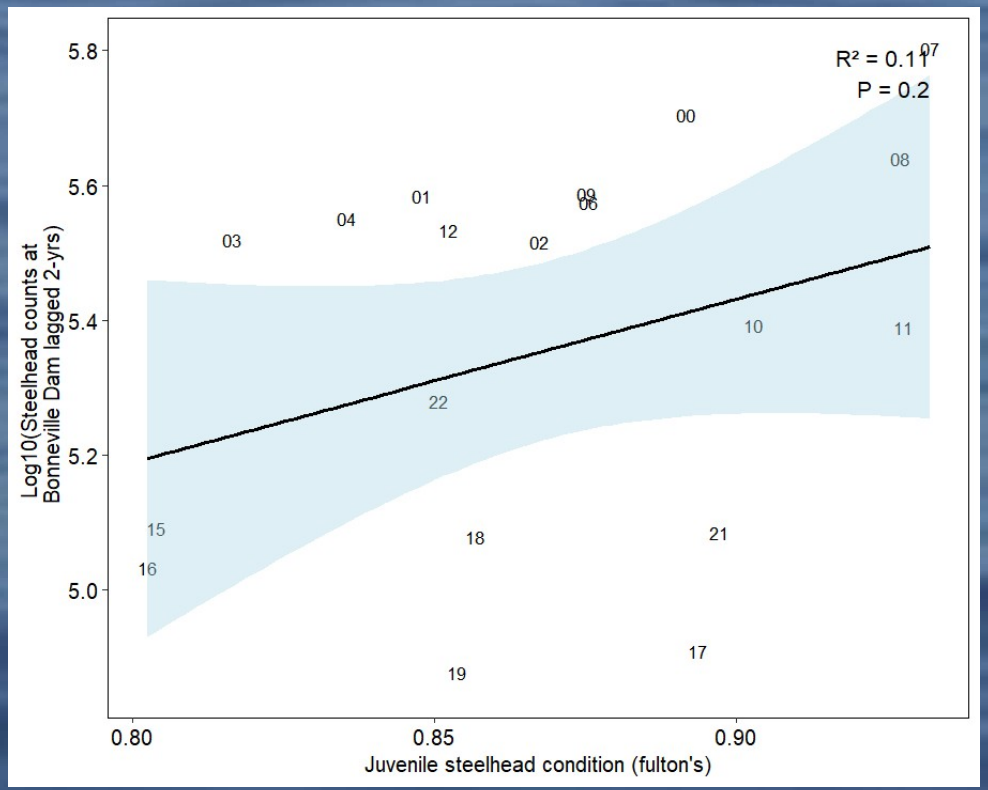
Richard D. Brodeur
National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center, Hatfield Marine Science Center, Newport, Oregon 97365, USA

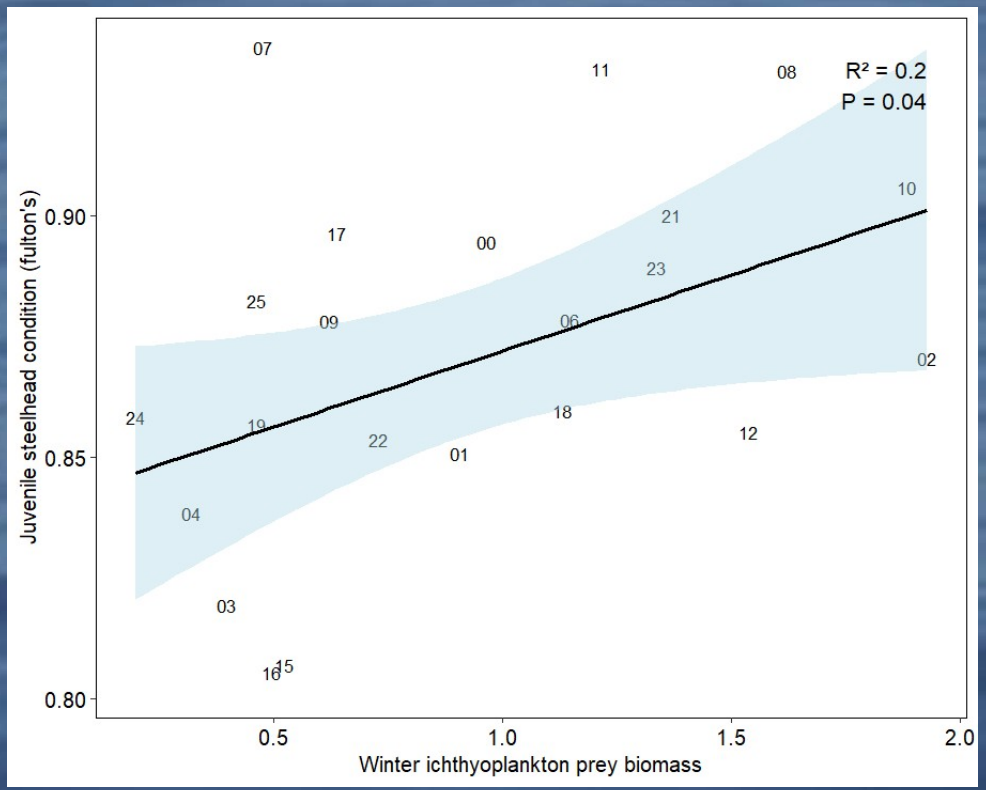
Fish prey community changes with ocean conditions and is correlated with spawner returns 2-yrs later



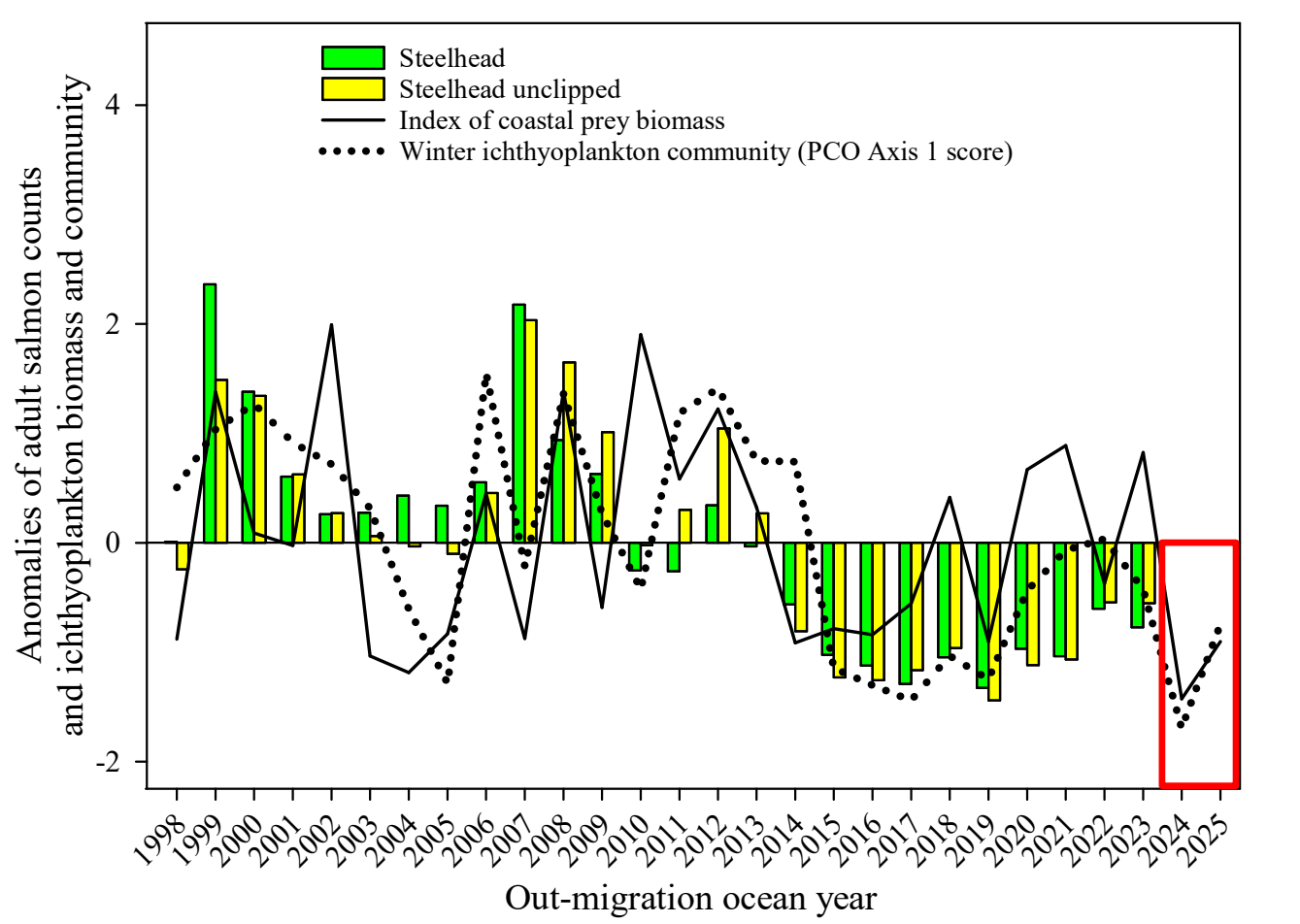


Thin is not in

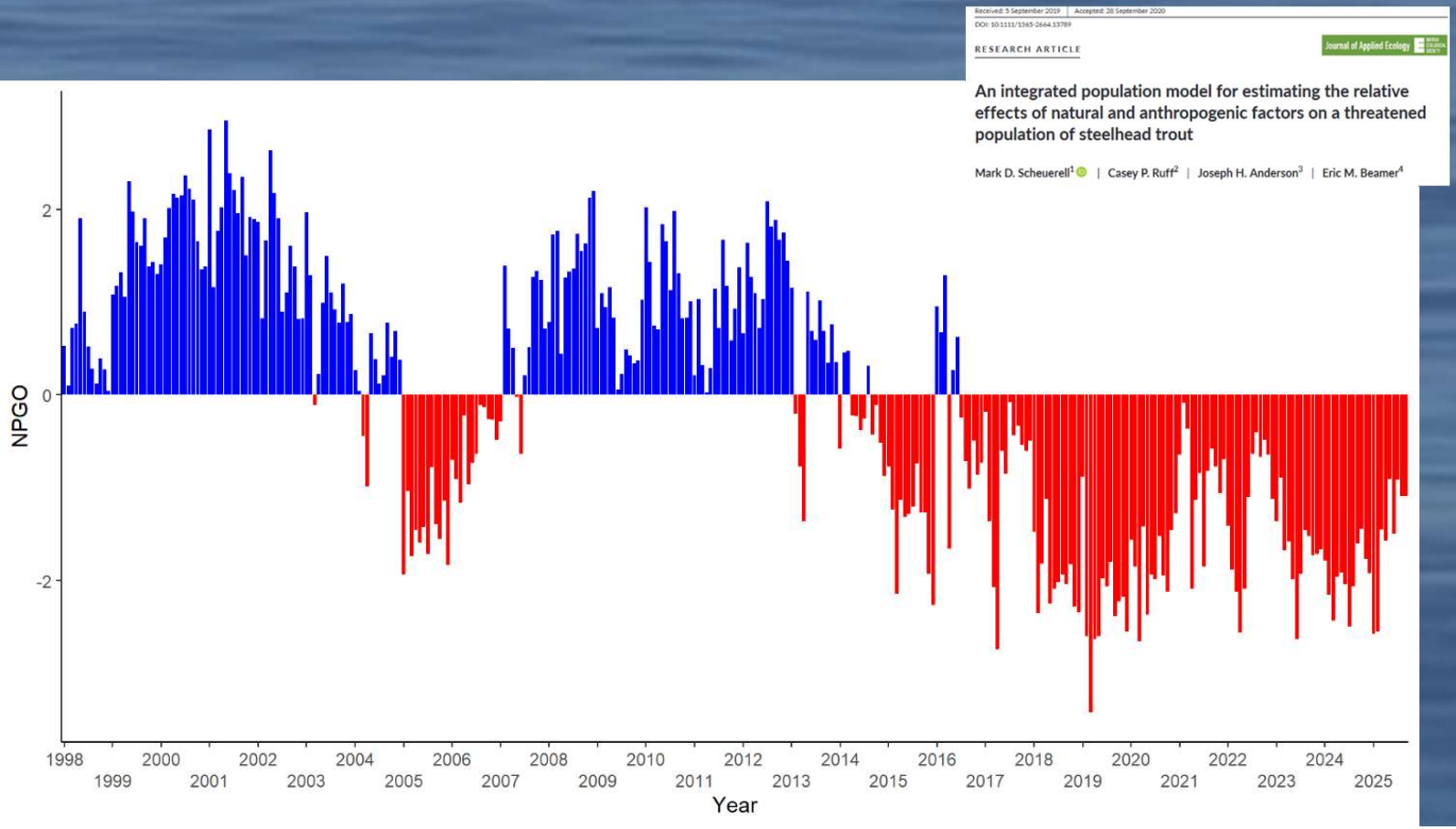




Fewer fish return to spawn when ocean age-0 steelhead out-migrate into poor food conditions



Beyond Simple Temperature: The NPGO and the strength of ocean mixing which feeds the ecosystem



Received: 5 September 2019 | Accepted: 28 September 2020
DOI: 10.1111/1365-2664.13789

RESEARCH ARTICLE

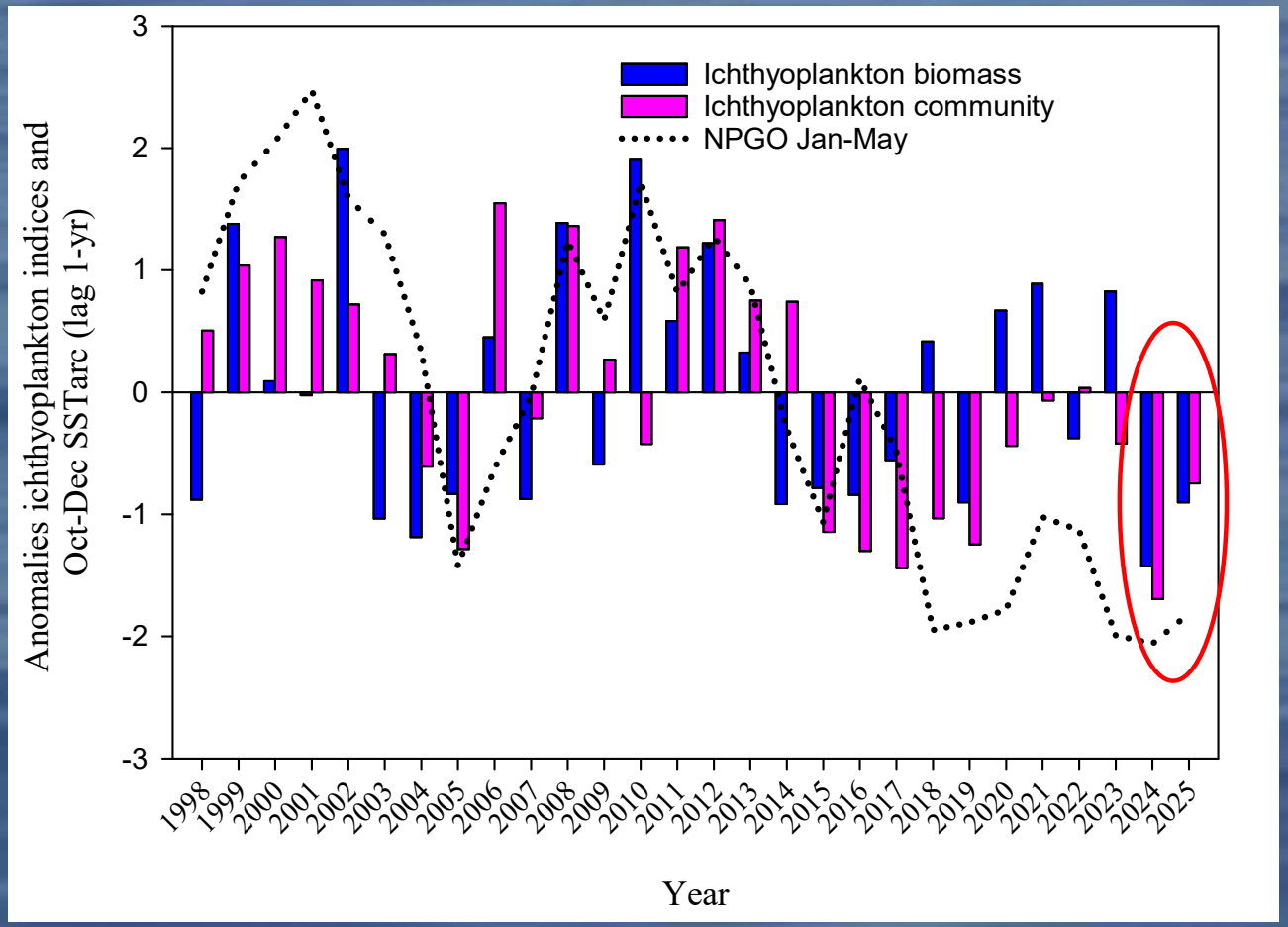
Journal of Applied Ecology

An integrated population model for estimating the relative effects of natural and anthropogenic factors on a threatened population of steelhead trout

Mark D. Scheuerell[1] | Casey P. Ruff[2] | Joseph H. Anderson[3] | Eric M. Beamer[4]

Positive correlation between NPGO and age-0 marine survival

2024-2025 winter NPGO has been negative, as well as the winter ichthyoplankton indices



In Summary:

- Ocean conditions during the time of outmigration, and through the first summer, have been increasingly warm since late 2013 concurrent with low returns of spawner steelhead

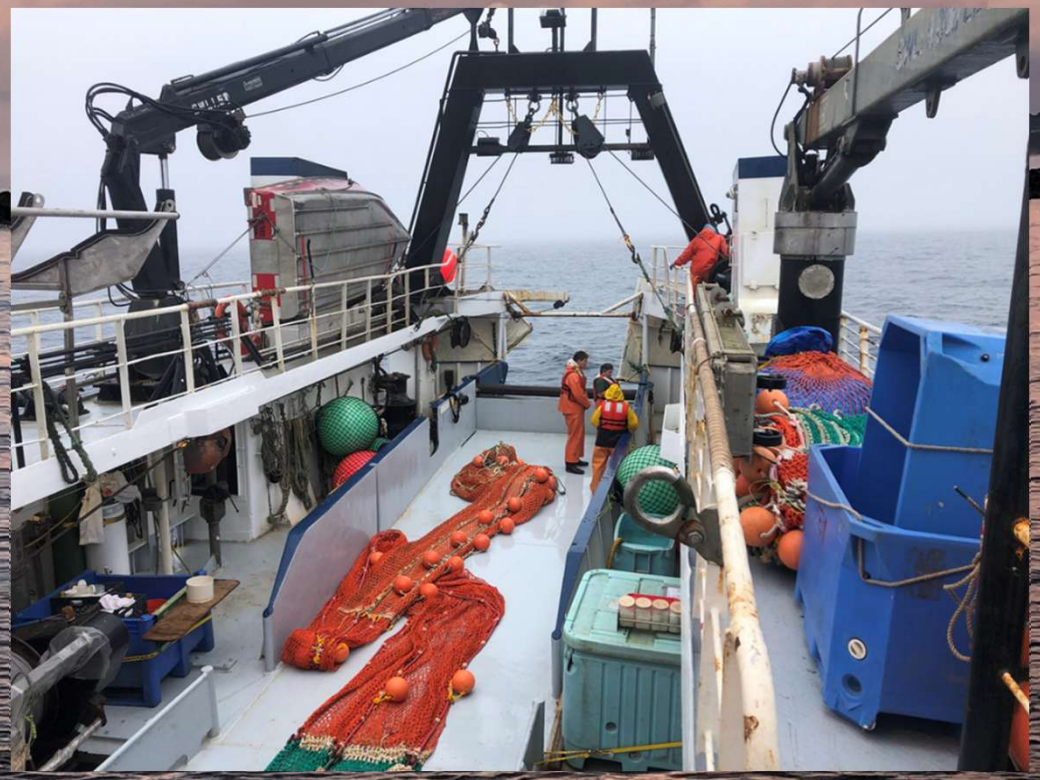
- Ocean age-0 steelhead prey fields, body condition, and diet composition shows significant changes between cold and warm ocean conditions

- 2024 & 2025 marked significant declines in both the biomass and the composition of key marine fish larvae (ichthyoplankton) that feed ocean age-0 steelhead

"We're havin' a heat wave
Tropical heat wave
The temperature's risin'
It isn't surprising"

Rogers and Hammerstein

Thanks to all the supporters of and participants in the JSOES and NHL surveys, and also those that help process and analyze samples in the laboratory



BONNEVILLE POWER ADMINISTRATION

OSU Oregon State University Hatfield Marine Science Center

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce