CNL(23)104

# Atlantic Salmon Conservation and Management

*in a changing Climate*

## The U.S. approach to insert a climate focus into ongoing salmon recovery efforts

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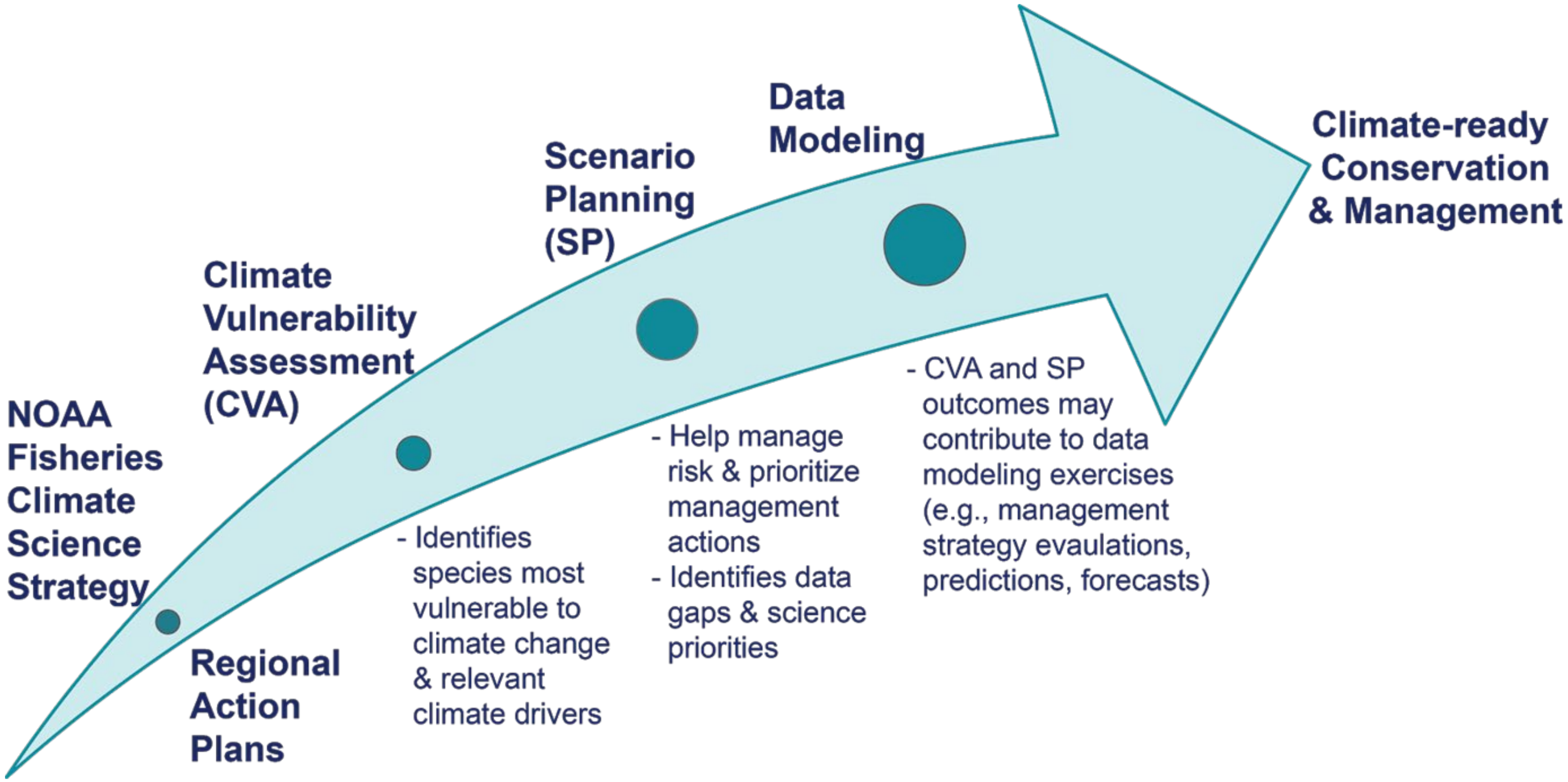
NASCO Annual Meeting
Moncton, NB, Canada
June, 2023

# Presentation Goal

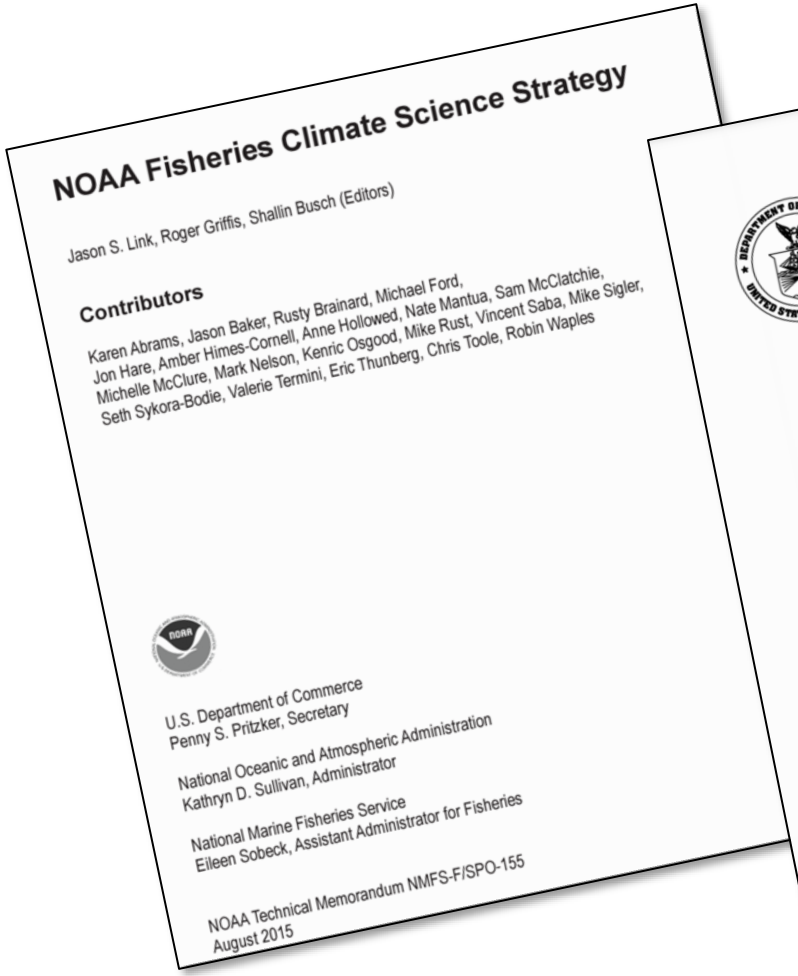
Describe a five-step approach to integrate climate planning into existing management actions to promote and enhance climate resilient populations.

# Approach




Borggaard et al. 2019

# National Climate Science Strategy and Regional Action Plans



NOAA Fisheries Climate Science Strategy

Jason S. Link, Roger Griffis, Shallin Busch (Editors)

Contributors

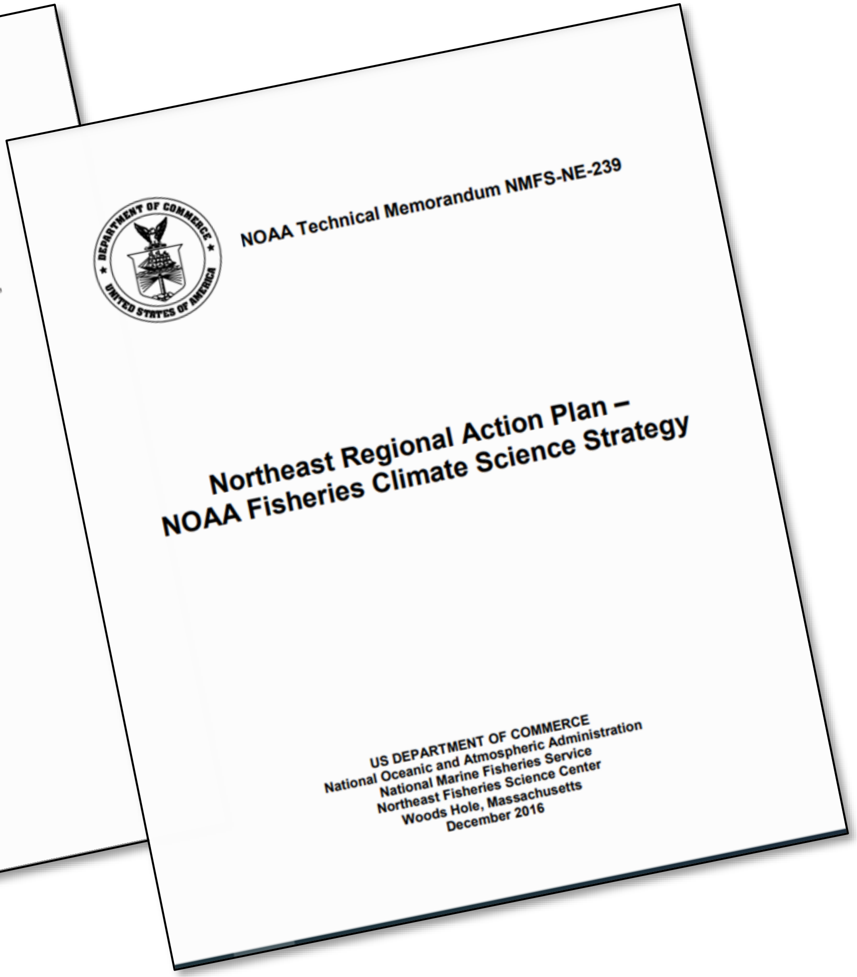
Karen Abrams, Jason Baker, Rusty Brainard, Michael Ford, Jon Hare, Amber Himes-Cornell, Anne Hollowed, Nate Mantua, Sam McClatchie, Michelle McClure, Mark Nelson, Kenric Osgood, Mike Rust, Vincent Saba, Mike Sigler, Seth Sykora-Bodie, Valerie Termini, Eric Thunberg, Chris Toole, Robin Waples

U.S. Department of Commerce
Penny S. Pritzker, Secretary

National Oceanic and Atmospheric Administration
Kathryn D. Sullivan, Administrator

National Marine Fisheries Service
Eileen Sobeck, Assistant Administrator for Fisheries

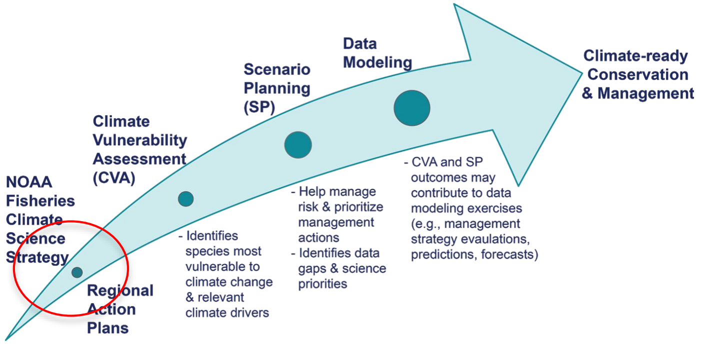
NOAA Technical Memorandum NMFS-F/SPO-155
August 2015



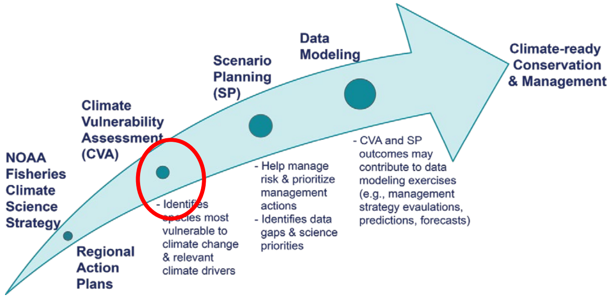
NOAA Technical Memorandum NMFS-NE-239

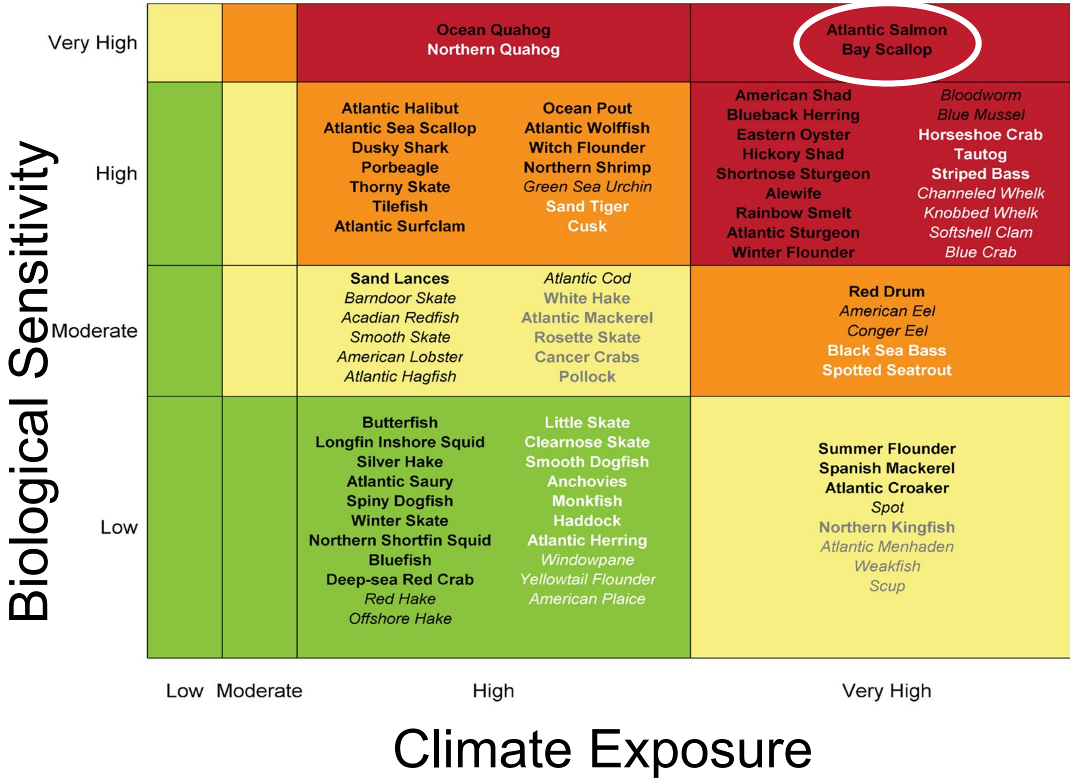
Northeast Regional Action Plan –
NOAA Fisheries Climate Science Strategy

US DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Fisheries Science Center
Woods Hole, Massachusetts
December 2016



# Climate Vulnerability Assessments (CVAs)




Hare et al. 2016

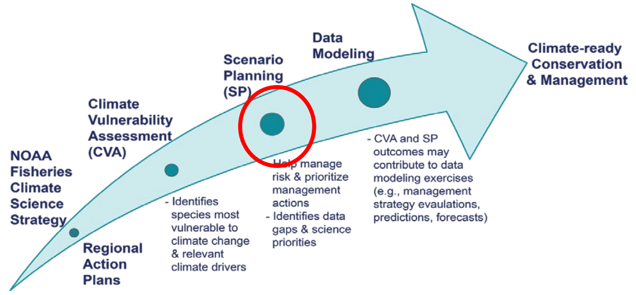
Help us understand which species are most vulnerable to climate change

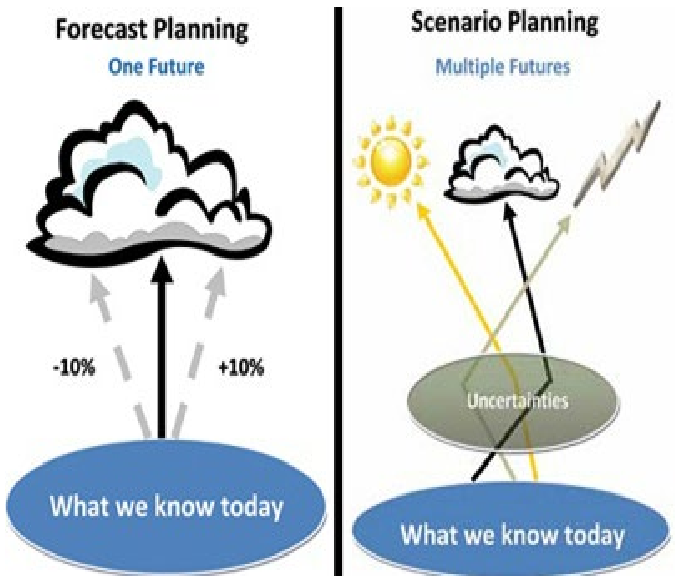
Help identify the factors that contribute to their vulnerability, including life history characteristics. Some of the factors for salmon include:

- Complex life histories across freshwater and marine environments
- narrow range of suitable habitats and prey
- relatively low fecundity among anadromous fish
- Very low abundance

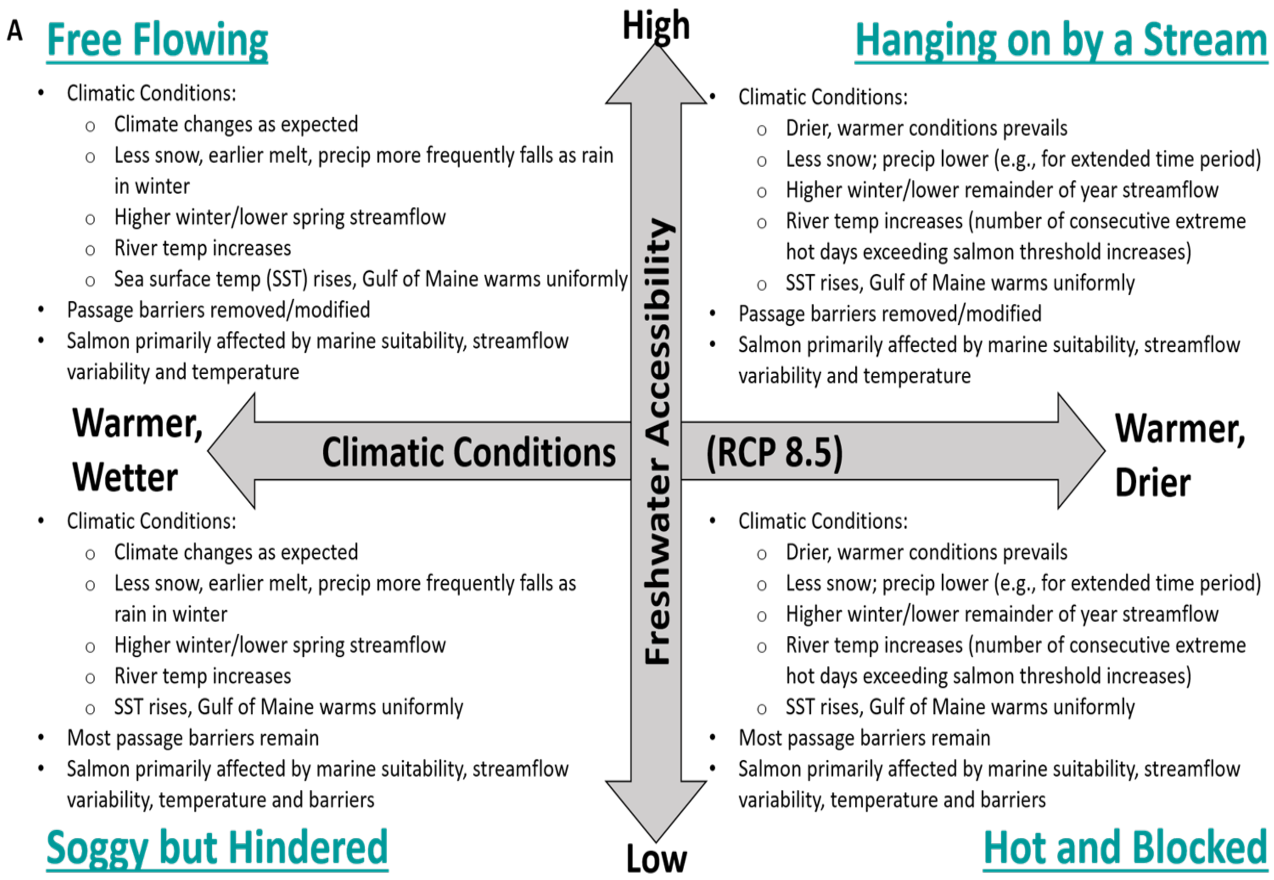
# Scenario Planning

- A structured process to:
  - explore a range of plausible future scenarios based on climate projections
  - identify common science and management actions across each scenario that can be taken proactively to mitigate the impacts of climate change




Scenario Insight; Weeks et al. 2011, Park Science




Borggaard, Dick et al. 2019

Select two independent drivers that form two intersecting axes'

Each quadrant represents a different plausible future scenario.

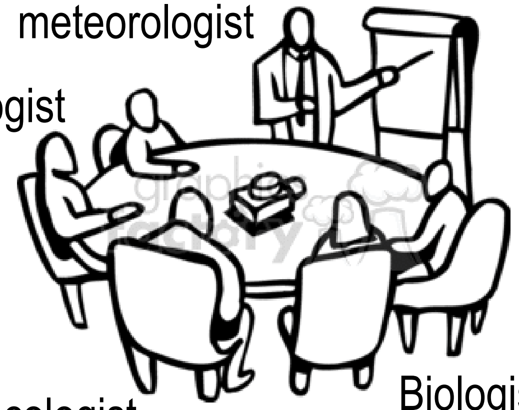
- Establishing scenario sets the stage to ask questions such as:
  - What are the risks and opportunities?
  - What should we do now to prepare?
  - How should we track changes over time?

# CVA and SP Outcomes

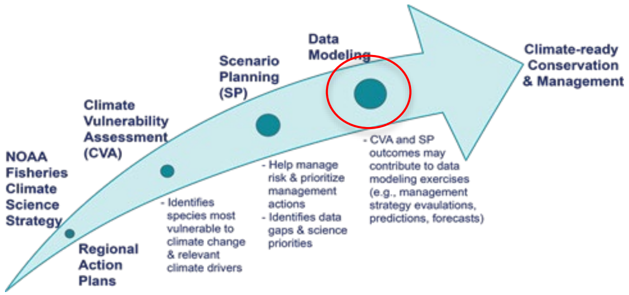
- Convergence of knowledge and ideas among the scientific and management community on the impacts of climate change on Atlantic salmon

- A short list of immediate science/modeling needs

- Mutually agreed upon actions to tackle the climate change issues pertaining to Atlantic salmon



# Science questions that emerged from Scenario Planning




What are the projected future conditions for both freshwater and marine habitats?

What are the life stage specific environmental thresholds (e.g. temperature, flow etc.)?

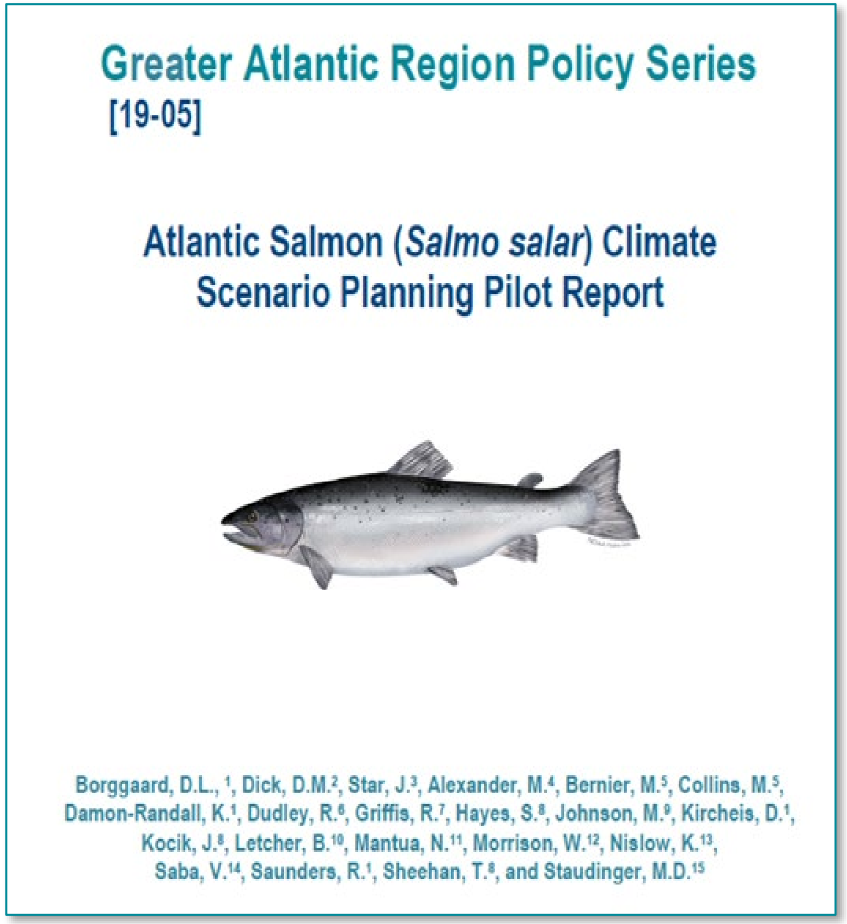
How will Atlantic salmon behavior change in response to a changing climate?

How will habitat productivity change?

Where and why are salmon dying in the ocean?

How will a changing climate further affect survival?

Are there ways to increase marine survival both in general and in light of climate change?

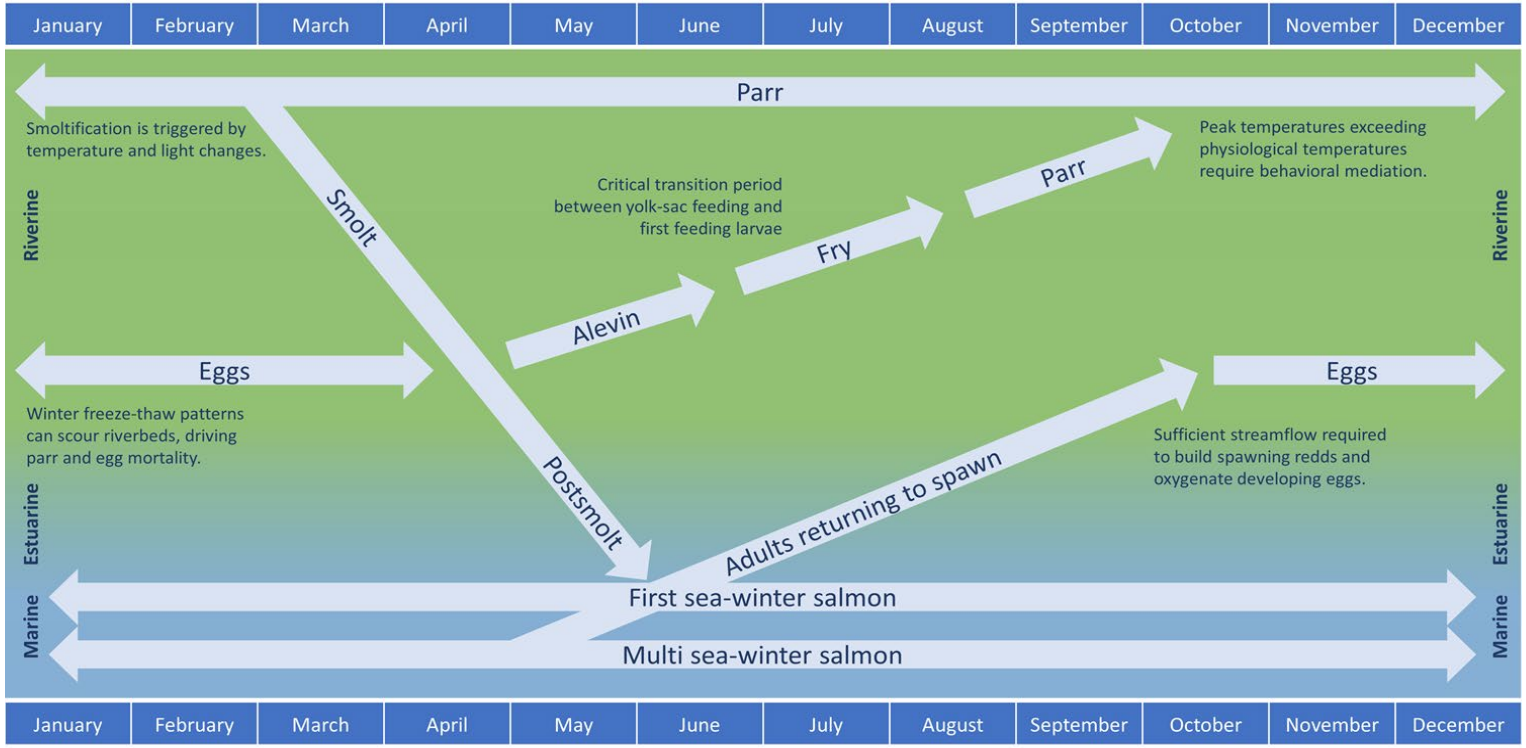


Greater Atlantic Region Policy Series
[19-05]

Atlantic Salmon (*Salmo salar*) Climate Scenario Planning Pilot Report

Borggaard, D.L., [1], Dick, D.M.[2], Star, J.[3], Alexander, M.[4], Bernier, M.[5], Collins, M.[5], Damon-Randall, K.[1], Dudley, R.[6], Griffis, R.[7], Hayes, S.[8], Johnson, M.[9], Kircheis, D.[1], Kocik, J.[8], Letcher, B.[10], Mantua, N.[11], Morrison, W.[12], Nislow, K.[13], Saba, V.[14], Saunders, R.[1], Sheehan, T.[8], and Staudinger, M.D.[15]

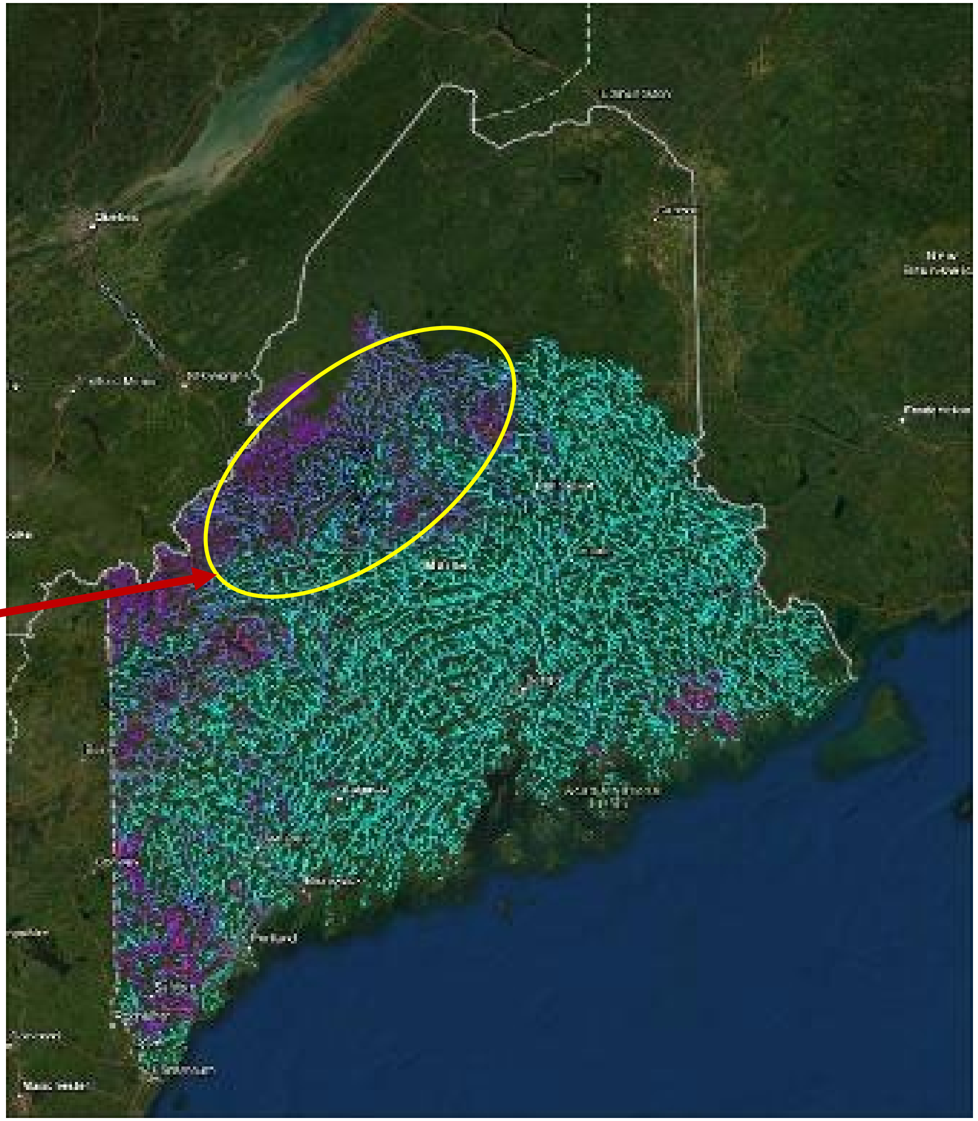
# Understanding the lifestage specific vulnerabilities to a changing climate




Henderson, EM, Mills, KE, Alexander, MA, Barajas, M, Collins, MJ, Dzaugis, M, Kircheis, D and Sheehan T.F. 2022. A synthesis of U.S. Atlantic salmon habitat requirements and implications for future suitability under a changing climate. ICES Journal of Marine Science. *in review*.

# Baseflow Modeling

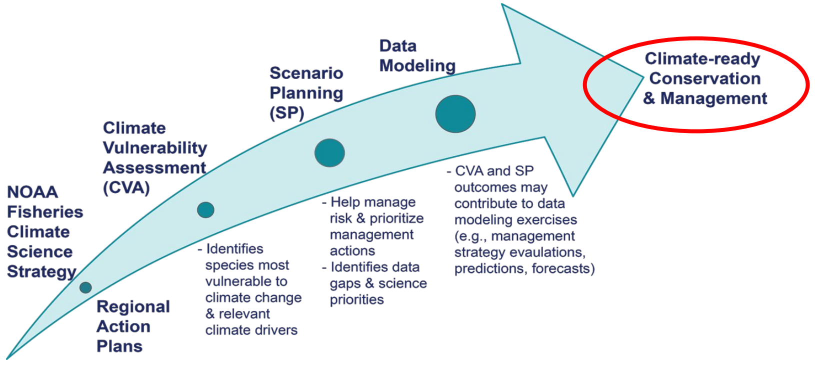
Areas in purple are areas with greatest base flow.



Lombard, P. J., Dudley, R. W., Collins, M. J., Saunders, R., & Atkinson, E. (2021). Model estimated baseflow for streams with endangered Atlantic Salmon in Maine, USA. *River Research and Applications*, *37*(9), 1254-1264.

# Understanding how delay of  salmon at hydro-electric dams impacts survival and reproduction

Rubenstein, S. R., Peterson, E., Christman, P. M., & Zydlewski, J. D. (2022). Adult Atlantic salmon (*Salmo salar*) delayed below dams rapidly deplete energy stores. *Canadian Journal of Fisheries and Aquatic Sciences*, (ja).




# "Climate Ready" conservation and management actions

# Strategic Planning

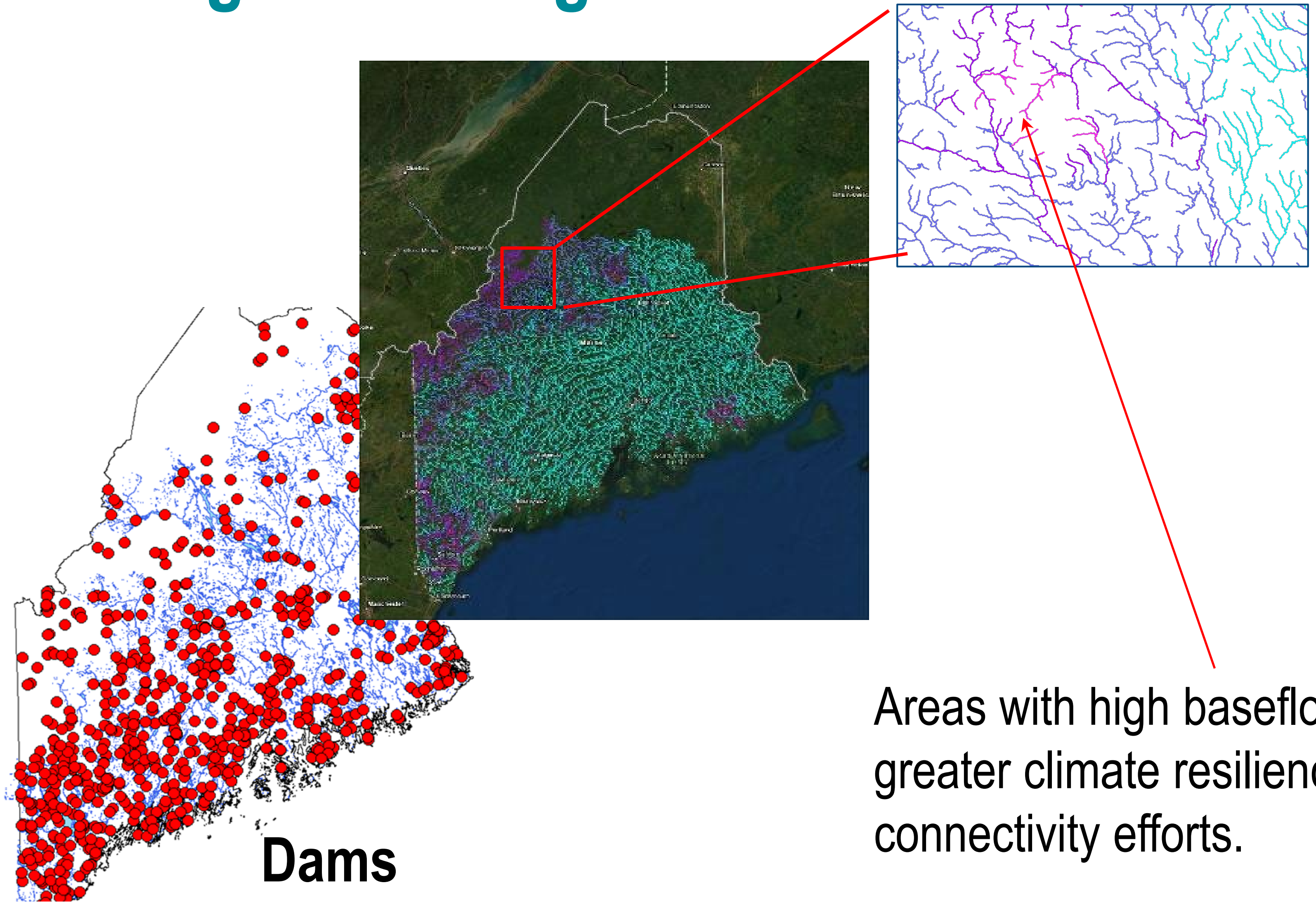



Photo Credit: Tim Swan

Areas with high baseflow are indicators of areas with greater climate resilience, enabling us to prioritize connectivity efforts.

# Regulatory Measures

- The Endangered Species Act and other policies grant us the authority to implement regulatory measures necessary to protect endangered Atlantic salmon, but only if it's well supported by science.

- The study on the impact of delays at dams added to our state of knowledge that dams exacerbate climate impacts by limiting energy reserves for gamete production and spawning, and considerably reducing the likelihood of repeat spawning

Management Action: This information has enabled us to impose passage criteria that includes a delay standard at some of our hydroelectric dams.

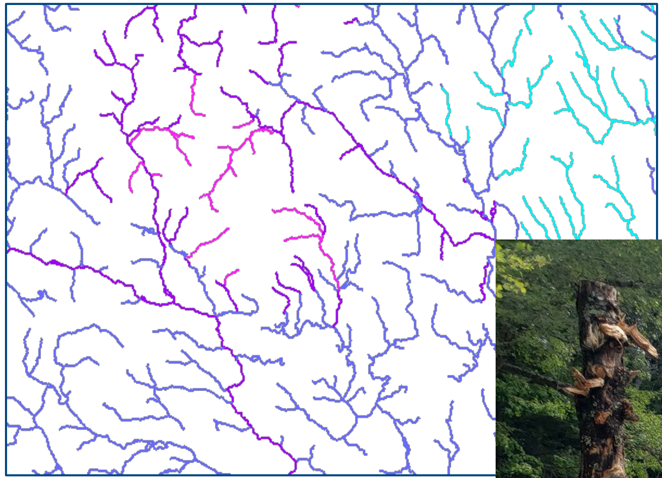
# Pro-active Conservation and Restoration

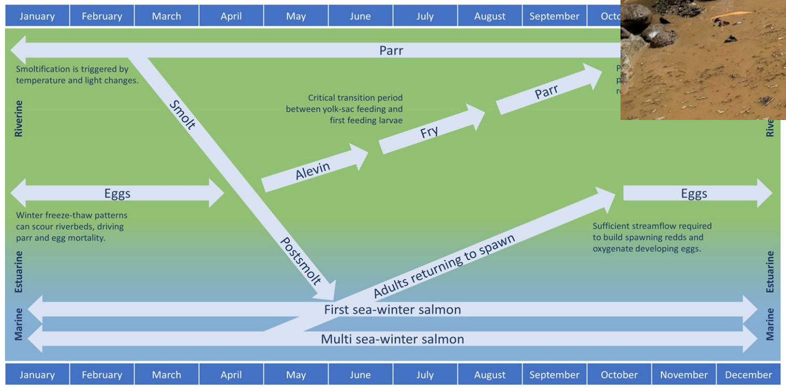

NOAA FISHERIES

Information on life history vulnerabilities and baseflow contribution can help inform:

- Where habitat restoration or habitat protection is needed

- What habitat features are needed to afford the most protection



# Summary

The CVA and SP led to a convergence of knowledge and ideas among the scientific and management community on the impacts of climate change on Atlantic salmon, and establish some mutually agreed upon actions to tackle the climate change issues pertaining to Atlantic salmon

The SP exercise helped us identify science and modeling efforts that we have been able to readily integrate into existing proactive and regulatory management actions

The information gained from the CVA and SP exercises enables us to provide better guidance to stakeholders on where and what projects will afford the greatest benefits to salmon.

# Next Steps

- Continue to refine our understanding of where climate vulnerable and climate resilient habitats are located, taking into account climate projections

- Consider Management Strategy Evaluation to compare different management strategies in light of resource constraints and identify the best, most effective management strategy to achieve our conservation and management objectives.

# Questions?