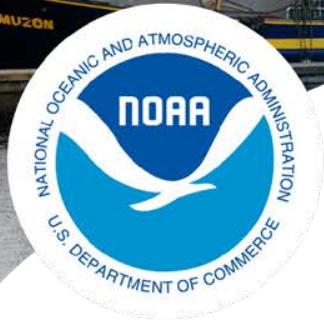
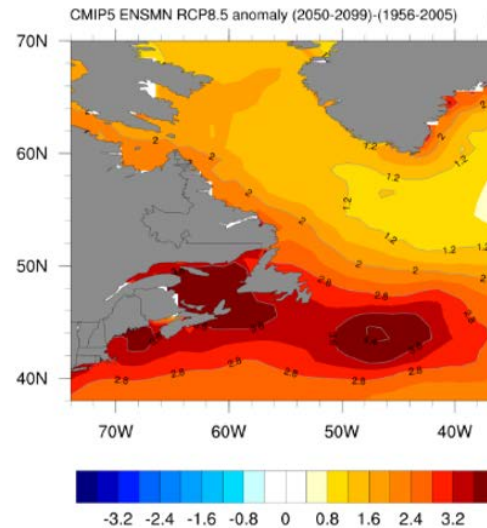


Introduction to Scenario Planning

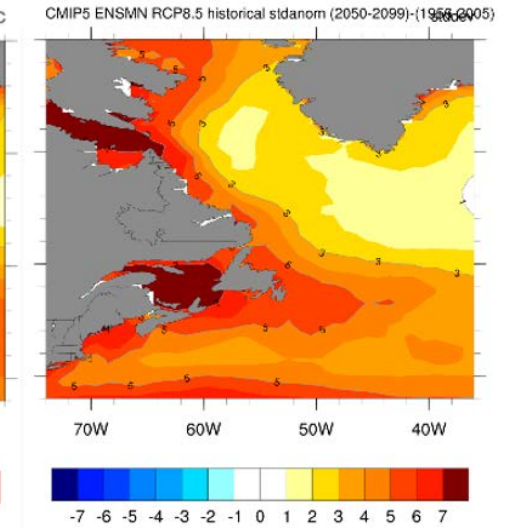


NOAA
FISHERIES

Predicted Change



Standard Anomaly of Predicted Change



Source: NOAA Climate Change Web Portal

Diane Borggaard¹ and Dori Dick²

¹ Protected Resources Division, Greater Atlantic Regional Fisheries Office, NMFS

² Ocean Associates, Inc. in support of Office of Protected Resources, NMFS

With thanks to Wendy Morrison³ for fisheries examples

³ Office of Sustainable Fisheries, NMFS

Presentation Overview

- Scenario Planning Overview
- NMFS Scenario Planning Efforts
 - Atlantic Salmon (Pilot)
 - North Atlantic Right Whale
 - Training Opportunities
 - Scenario Planning White Paper
- Other Scenario Planning Examples
 - Pacific Fisheries Management Council
 - Rhode Island



NMFS Scenario Planning Participant Views

“The Atlantic salmon climate scenario project was one of the best prioritization exercises I have ever participated in for salmon. The process that was developed enabled us to focus on all of the threats to salmon, rather than the ones that are easiest to address.”

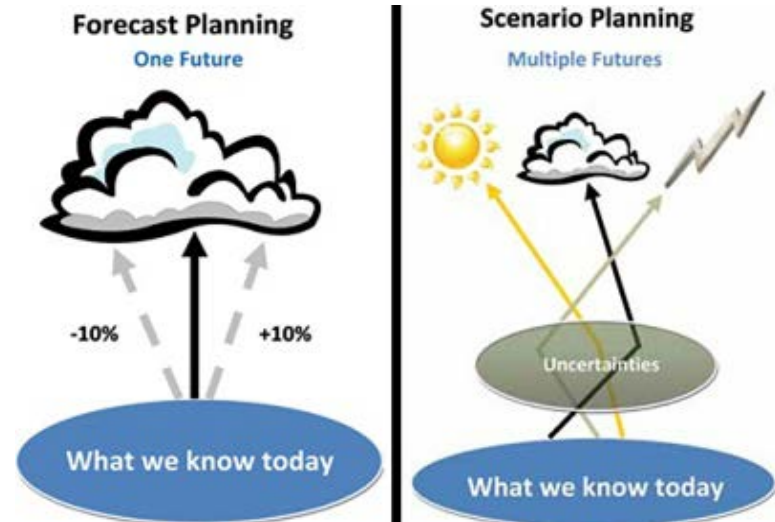
- *Kim Damon-Randall, Deputy RA, GARFO*

“The structure of the scenario planning brought together folks with diverse expertise and made tackling a “wicked” problem both manageable and intellectually stimulating. The outcome was truly a collective effort that I was pleased to be involved in.”

- *John Kocik, Protected Species Branch, NEFSC*

Scenario Planning

- Provides framework to support decisions under conditions that are uncertain and uncontrollable
- Explores plausible alternative conditions under different assumptions
 - Not prediction or forecast
 - Does not have to be data intensive
- Flexible and adaptable process
 - E.g., Adapt management now to add necessary flexibility for future



Scenario Insight; Weeks et al. 2011, Park Science

General Framework

1. Clarify the focus and goals of the investigation (scope & time horizon)



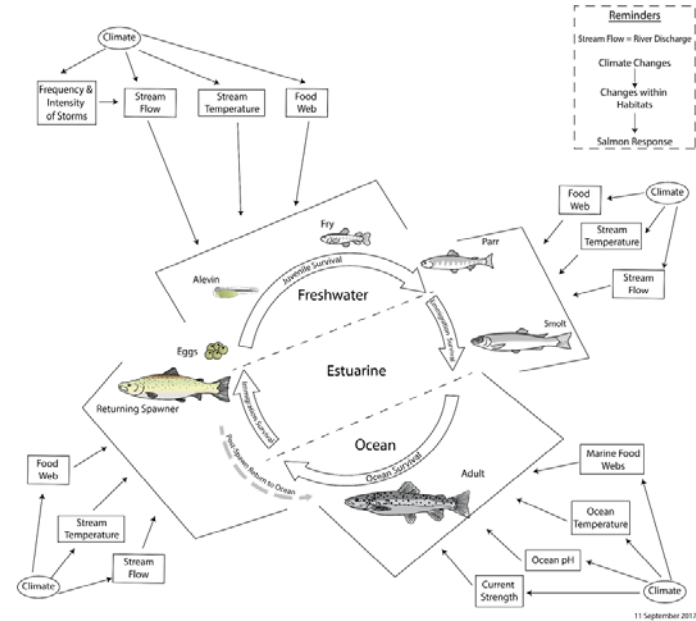
2. Research to identify factors likely to shape the future (climate drivers)

Scenario Insight; NPS 2013, Handbook for practitioners

Identifying Drivers

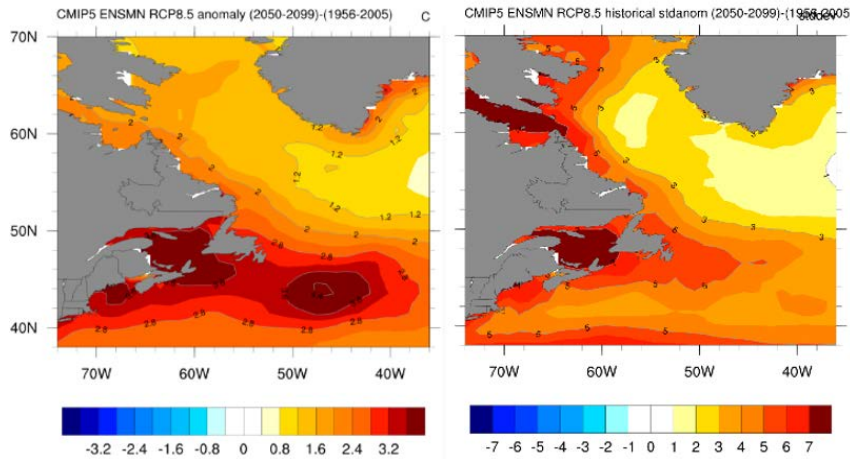
- Climate/Physical Forces
- Biological/Social/Political/Economic/Technological Forces
- Other Relevant Data Sources

DRAFT Atlantic Salmon Climate Conceptual Model

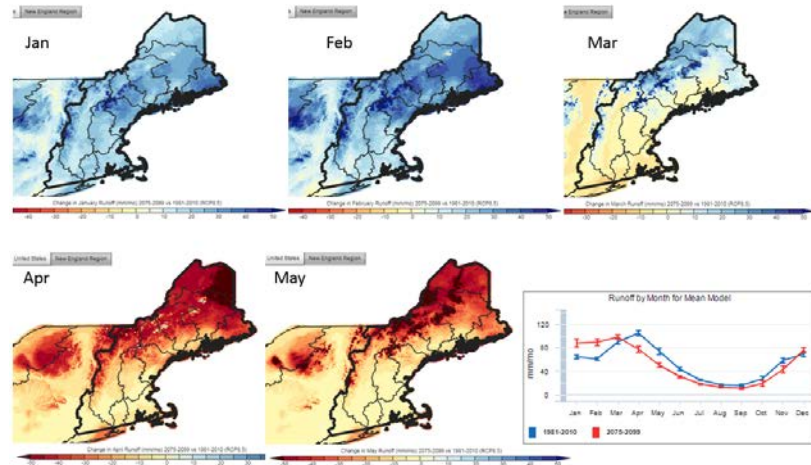


Predicted Change

Standard Anomaly of Predicted Change



Source: NOAA Climate Change Web Portal



Source: USGS Climate Change Viewer

Source: Borggaard, Dick et al. 2019

General Framework

1. Clarify the focus and goals of the investigation (scope & time horizon)



2. Research to identify factors likely to shape the future (climate drivers)

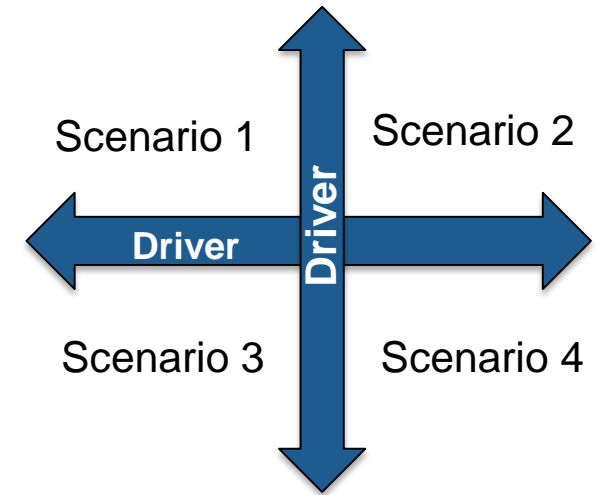
3. Combine drivers to create a scenario framework

4. Craft a plausible, challenging story for each scenario

Scenario Insight; NPS 2013, Handbook for practitioners

Scenario Framework Development

- Identify drivers that are most critical and uncertain
- Driver axes should be independent
- Each scenario should be:
 - Plausible
 - Relevant
 - Challenging
 - Divergent



General Framework

1. Clarify the focus and goals of the investigation (scope & time horizon)

2. Research to identify factors likely to shape the future (climate drivers)

3. Combine drivers to create a scenario framework



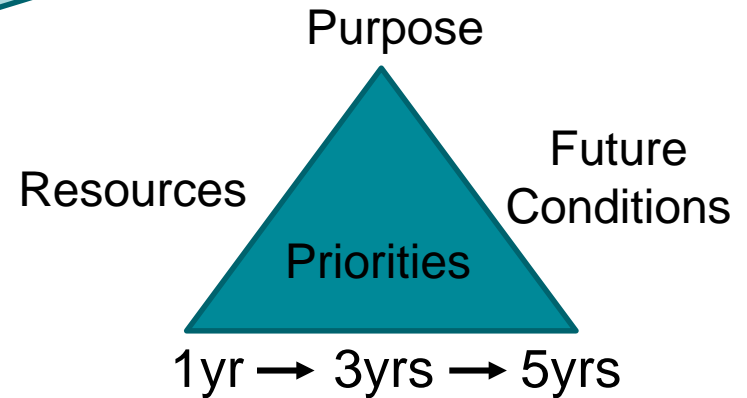
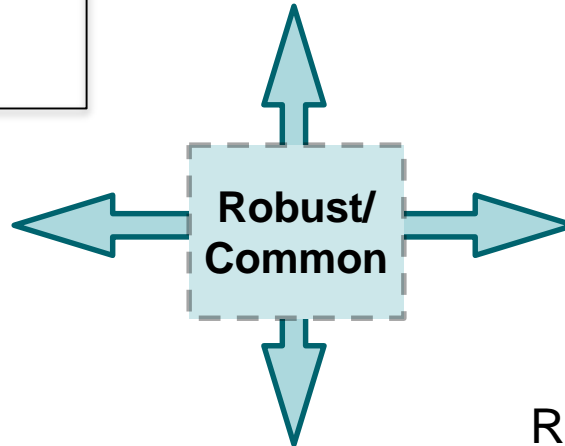
5. Use the scenarios for strategy, innovation, risk, vision-setting

4. Craft a plausible, challenging story for each scenario

Scenario Insight; NPS 2013, Handbook for practitioners

Generating and Assessing Options

Identify actions to take now to prepare for or avoid the possible future



Source: Scenario Insight, with modifications

Benefits of Scenario Planning

- 1 *Flexibility to react quickly to a changing world*
- 2 *More robust decisions and plans*
- 3 *Innovative ideas*
- 4 *Early and broad risk identification*
- 5 *Alignment towards a common vision*

Source: Scenario Insight

Challenges of Scenario Planning

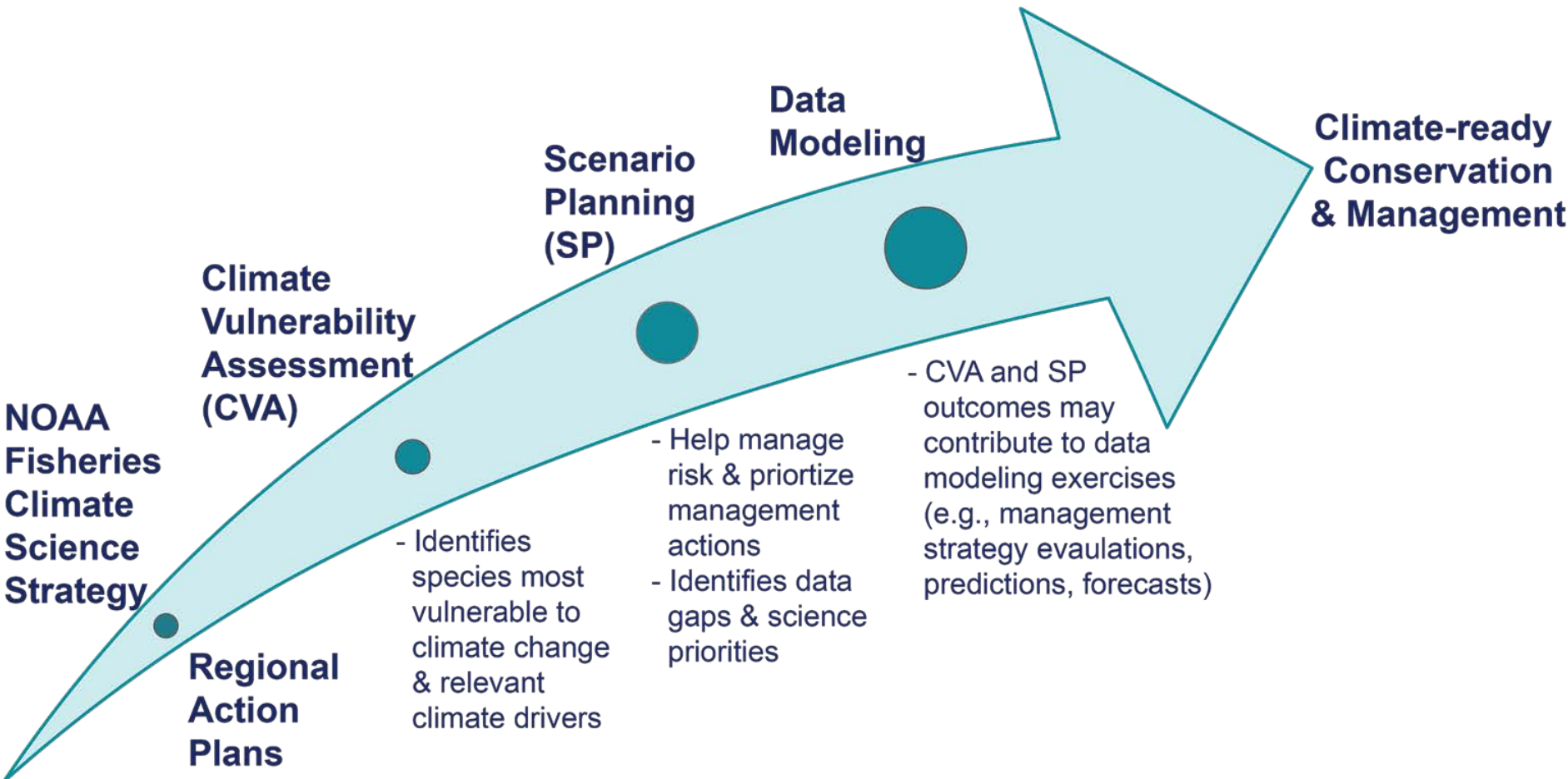
For example:

- *Out-of-the-box thinking if other issues considered higher priority or in an emergency event*
- *Limited number of scenarios*
- *Not predictive*

Scenario Planning Examples

| Key Organization(s) | Location |
|----------------------------------------------------------------|-----------------------------------------------------------------|
| National Park Service | Acadia National Park; Assateague Island National Seashore, etc. |
| NOAA Greater Farallones National Marine Sanctuary | North-Central California Coast |
| Tijuana River National Estuarine Research Reserve | Tijuana River Estuary |
| GeoAdaptive, Florida Fish and Wildlife Conservation Commission | KeysMAP: Florida Keys Marine Adaptation Planning Project |
| University of Alaska Anchorage | Salmon 2050, Kenai Peninsula, Alaska |
| Point Blue Conservation Science | San Francisco Bay Estuary |
| Rhode Island Commercial Fisheries | Rhode Island |

NMFS Climate-Ready Example Trajectory



Source: Borggaard, Dick et al. 2019

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Atlantic Salmon Scenario Planning Pilot

Purpose

To explore what NMFS can do to improve U.S. Atlantic salmon population resilience to changing conditions in riverine, estuarine, and marine habitats across its current range.

Focal Question (Initial)

How could the effects of climate change impact the watersheds and marine ecosystems over the next 75 years?



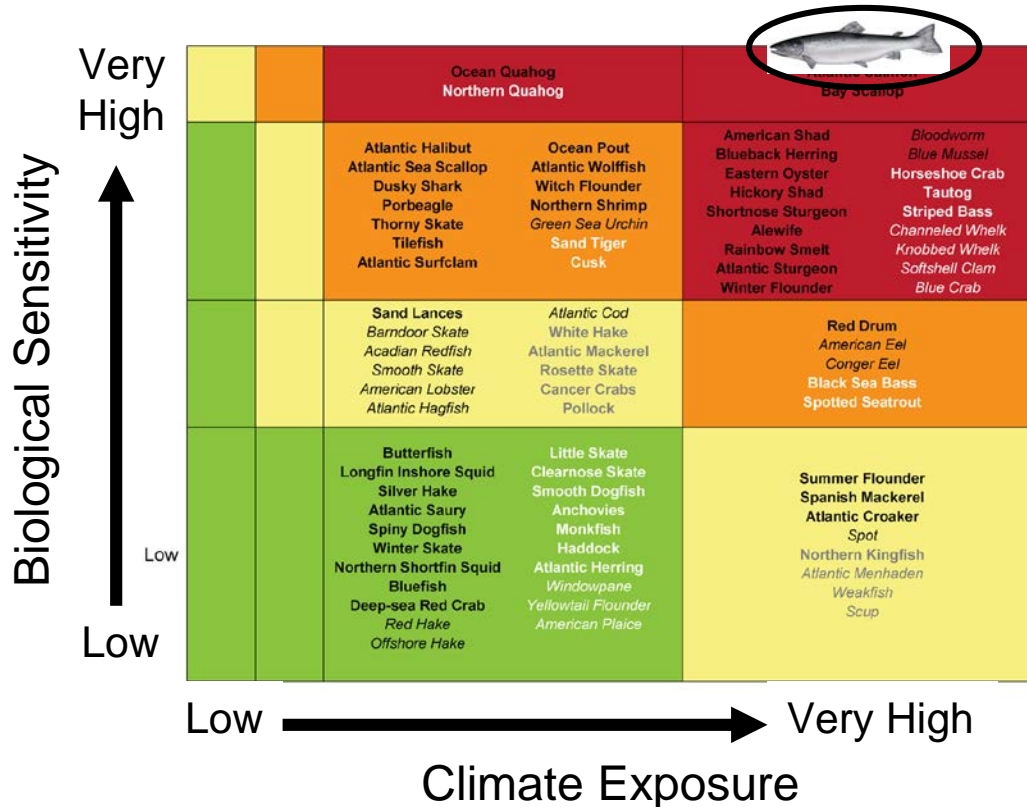
Source: Borggaard, Dick et al. 2019

NMFS Climate Adaptation Planning

Fish & Invertebrate Vulnerability Assessment (2016)

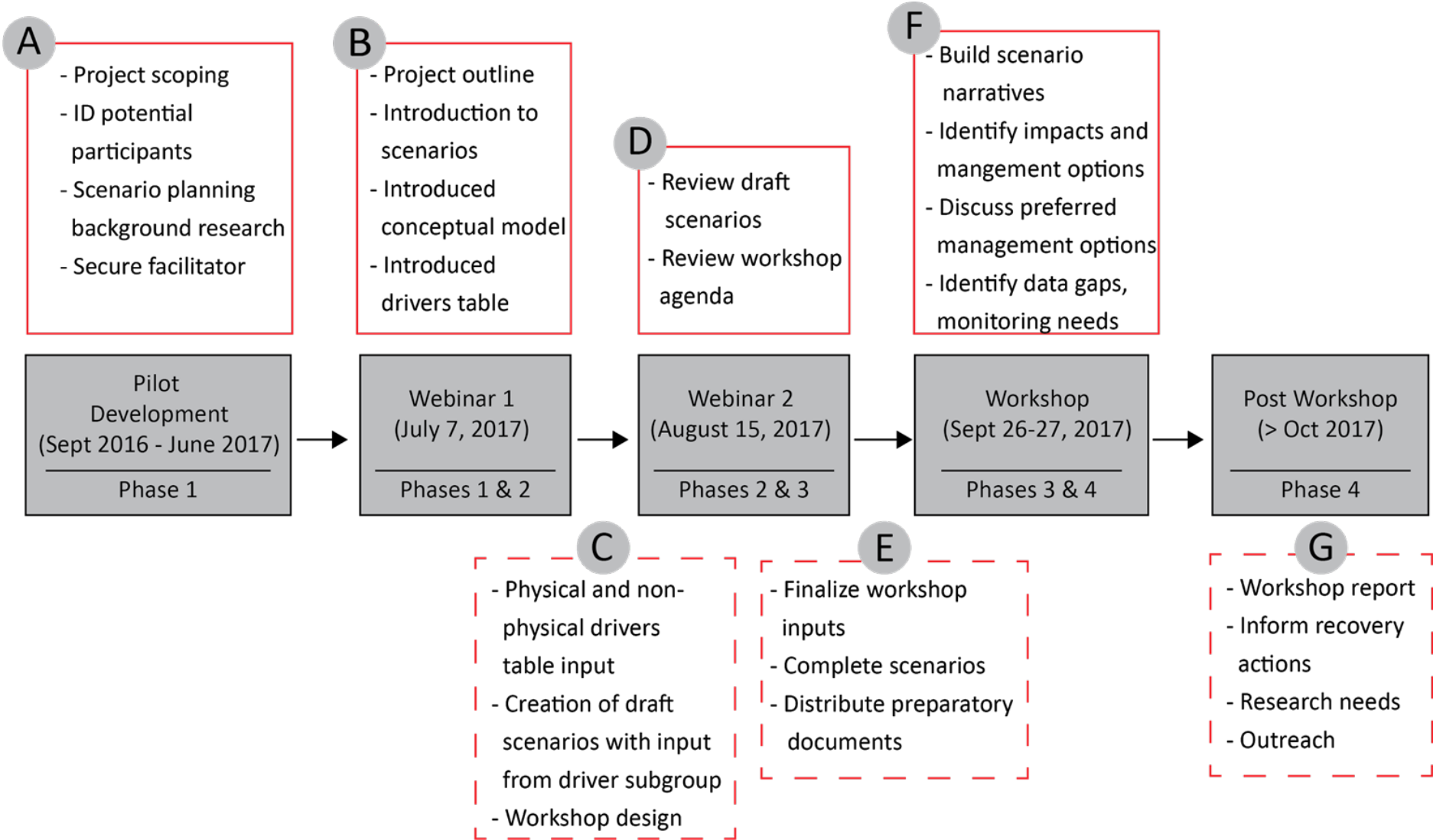
Atlantic salmon

Overall vulnerability
= very high



Hare et al. 2016

Example Process Outline (Atlantic Salmon)



Source: Borggaard, Dick et al. 2019

Driver Spreadsheets

- Climate/Physical Forces
- Biological/Social/Political/Economic/Techno Forces
- Other Relevant Data Sources

| Climate/Physical Variable | Expected General Change | Specified Change Expected and Reference Period | Patterns of change | Confidence | Primary Source and Context |
|---------------------------|-------------------------|------------------------------------------------|--------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sea surface temperature | ↑ | 2050-2099: ↑3.2 to 4°C 2060-80: ↑3 to 5°C | | | https://www.esrl.noaa.gov/psd/ipcc/ocn/ <i>Saba et al. 2016. doi.1002/2015JC011346/full</i> |

| | | Biological, social, political, economic, technological | Projected change (if applicable) | Source and context | Comments |
|--------------------------------------|---|--------------------------------------------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Precipitation | ↑ | | | | |
| Ocean bottom temperature | ↑ | Freshwater habitat availability | Very uncertain | http://ice.ecosheds.org/ ; http://db.ecosheds.org/viewerhttp://db.ecosheds.org/viewer ; Dan Kircheis' powerpoint; Atlantic salmon designated critical habitat. http://www.nmfs.noaa.gov/pr/pdfs/criticalhabitat/atlant | This variable incorporates many river dam removal; incidental take; and e current habitat availability and histo |
| Sea surface pH (ocean acidification) | ↓ | | | | |

| | | |
|--------------------------|---------|---------------------------------------|
| Sea surface salinity | No Δ to | Marine habitat availability |
| Air temperature | ↑ | Societal awareness concern for issues |
| Ice affected stream flow | ↓ | Species climate vulnerability |

| Data Type/Description | Source |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Northeast Ocean Data | http://www.northeastoceandata.org/ |
| State of Rivers and Dams in Maine | https://wiki.colby.edu/display/stateofmaine2009/State+of+Rivers+and+Dams+in |
| Maine GIS Data | http://www.maine.gov/megis/catalog/ |
| NE Coastal Acidification | http://necan.org/ |
| National Climate Change Viewer (USGS) | https://www2.usgs.gov/climate_landuse/clu_rd/nccv.asp |

Scenario Matrix Evolution (early examples)

SHRUs &/or Transition

Higher (i.e. many dams removed)

Marine

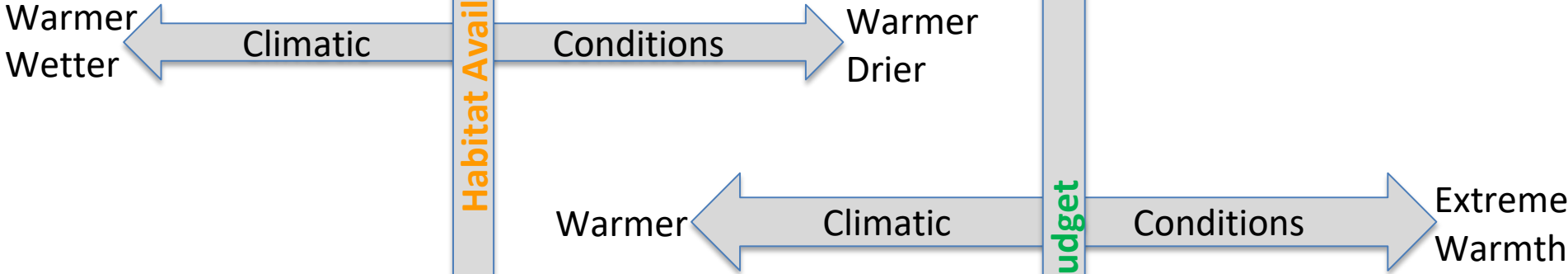
Increase \$

Habitat Availability

Budget

Lower (most dams retained)

Status Quo or Less \$



Free Flowing

- Climatic Conditions:
 - Climate changes as expected
 - Less snow, earlier melt, precip more frequently falls as rain in winter
 - Higher winter/lower spring streamflow
 - River temp increases
 - Sea surface temp (SST) rises, Gulf of Maine warms uniformly
- Passage barriers removed/modified
- Salmon primarily affected by marine suitability, streamflow variability and temperature

**Warmer,
Wetter**

Climatic Conditions

- Climatic Conditions:
 - Climate changes as expected
 - Less snow, earlier melt, precip more frequently falls as rain in winter
 - Higher winter/lower spring streamflow
 - River temp increases
 - SST rises, Gulf of Maine warms uniformly
- Most passage barriers remain
- Salmon primarily affected by marine suitability, streamflow variability, temperature and barriers

Soggy but Hindered

High

Freshwater Accessibility

Low

Hanging on by a Stream

- Climatic Conditions:
 - Drier, warmer conditions prevails
 - Less snow; precip lower (e.g., for extended time period)
 - Higher winter/lower remainder of year streamflow
 - River temp increases (number of consecutive extreme hot days exceeding salmon threshold increases)
 - SST rises, Gulf of Maine warms uniformly
- Passage barriers removed/modified
- Salmon primarily affected by marine suitability, streamflow variability and temperature

(RCP 8.5)

**Warmer,
Drier**

- Climatic Conditions:
 - Drier, warmer conditions prevails
 - Less snow; precip lower (e.g., for extended time period)
 - Higher winter/lower remainder of year streamflow
 - River temp increases (number of consecutive extreme hot days exceeding salmon threshold increases)
 - SST rises, Gulf of Maine warms uniformly
- Most passage barriers remain
- Salmon primarily affected by marine suitability, streamflow variability, temperature and barriers

Hot and Blocked

Source: Borggaard, Dick et al. 2019



Free Flowing



High

Hanging on by a Stream



Freshwater Accessibility

Warmer, Wetter

Climatic

Conditions (RCP 8.5)

Warmer, Drier



Low



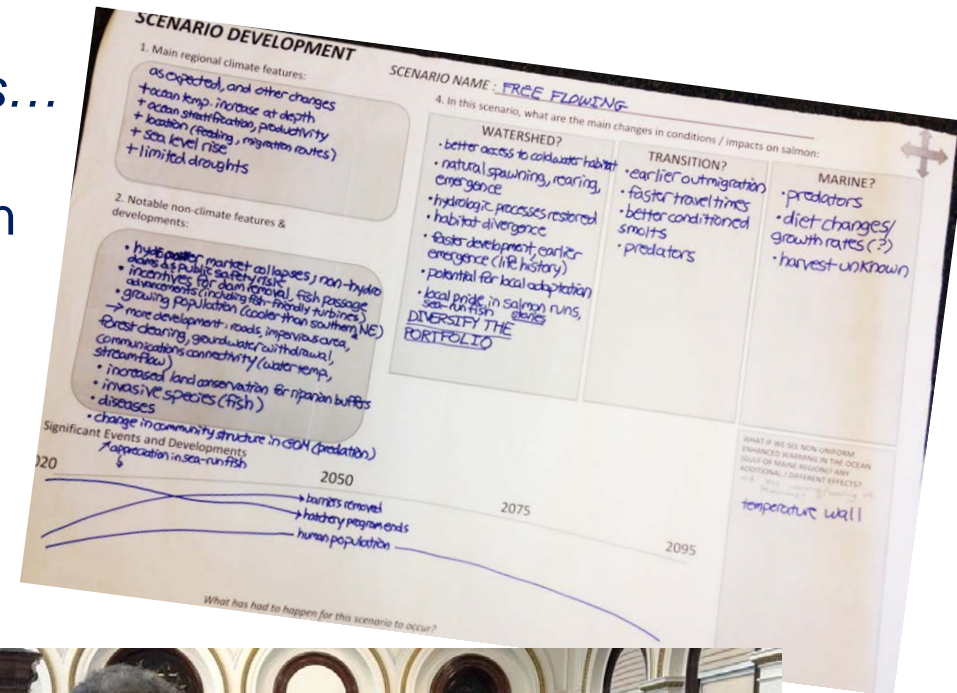
Soggy but Hindered

Hot and Blocked

Scenario Development

Breakout Groups: *Given the scenarios...*

- What do the plausible futures mean for salmon?



Source: Borggaard, Dick et al. 2019

Generating Options

Breakout Groups: *Given the scenarios...*

- Assuming a scenario is a plausible future, what actions would you take to address them?



Generating Options: FREE FLOWING
 If you knew this scenario was the future, what actions would you take now / within 5 years

Research

- Salmon? Climate? Social science?
- more temperature monitoring for resilience
- thermal imagery (seeps)
- Further barrier assessment/ground truthing
- tracking salmon in owl (what are they telling us about habitat?)
- assess and identify climate resilient habitats
- overlay stocking with habitat
- social science - other values
- increased streamflow gauging
- small stream/fitness
- connectivity

Dams / Other Barriers

- Location of dam removal? Alternatives?
- identify priority barriers for removal/passage
- find pathways to removals (safety, liability, buyouts)
- remove high priority barriers
- improve FERC relicensing process
- removals, effective fish passage
- DOT replacements (emergency, non-emergency)

Management (Non-Dam)

- E.g., stocking strategy, mixed stock fisheries, water withdrawal, etc.
- land conservation of priority habitats
- floodplain protection
- strategy for stocking → natural reproduction
- fishing regulations
- minimize harvest
- regulate water withdrawals
- water quality/streamwater regulations

Enhanced Relationships / Collaboration

- Other partners? Other initiatives?
- TNC (GHES), barriers, land conservation
- SHEDS
- improve state-Federal relations, Federal-Federal (FERC)
- collaborate utilities
- DOT
- recreational community (fishing)
- environmental orgs
- Canada (research, exchange info temperature, tracking, climate)

Other

- integration with land use planning
- Final conservation role models
- stakeholders/success stories
- targeted communications campaign (data stories, infographics)



Source: Borggaard, Dick et al. 2019

Outcomes

High priority examples:

- Conduct range-wide habitat analysis (e.g., map existing cold water refugia for DPS watersheds)*
- Evaluate migration behavior and survival assessment
- Conduct tagging/tracking studies in marine environment to understand how changing climate might affect survival



* = funded post-pilot workshop

Source: Borggaard, Dick et al. 2019

Recovery Plan

| F3.0 | Identify, maintain, protect and restore priority freshwater habitats for Atlantic salmon | | | | | | | | |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|------------|-----------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|
| F3.1 | Establish and implement a water temperature monitoring protocol in all SHRUs to support efforts to identify climate vulnerable and climate resilient habitats | A | 1 | 1 | Baseline | — | — | — | USFWS, Maine DMR, NMFS, NGO's |
| F3.2 | Inventory and prioritize freshwater habitats that provide the best opportunity for salmon recovery, including climate resilient habitats, in all SHRUs | A | 1 | 1 | Baseline | — | — | — | Maine DMR, USFWS |
| F3.3 | Protect and maintain freshwater and riparian habitats according to prioritization in all SHRUs | A | 1 | 2 | Calculated | \$ 5,000,000.00 | \$ 25,000,000.00 | Estimate's assumes \$5 million annual investment of roughly 45,000 acres/year that would provide some conservation benefit to salmon. This figure is <u>estimated</u> based on land acquisition efforts for the purpose of conservation made by the Lands for Maine's future program. This figure does not directly factor in restoration of freshwater | Lands For Maine's Future, Maine DMR, USFWS, NMFS, NGOs, |

Source: USFWS and NMFS, 2019

North Atlantic Right Whale

Purpose

To explore future conditions for right whales throughout their range and develop possible options to address those conditions to improve recovery.

Focal Question

What will affect/influence the recovery of right whales throughout their range over the next 60 years?



Source: NMFS, in prep.

Assessing Scenarios and Options

WORKSHEET Scenario Deepening

Scenario Name Here _____

1. Main regional climate features


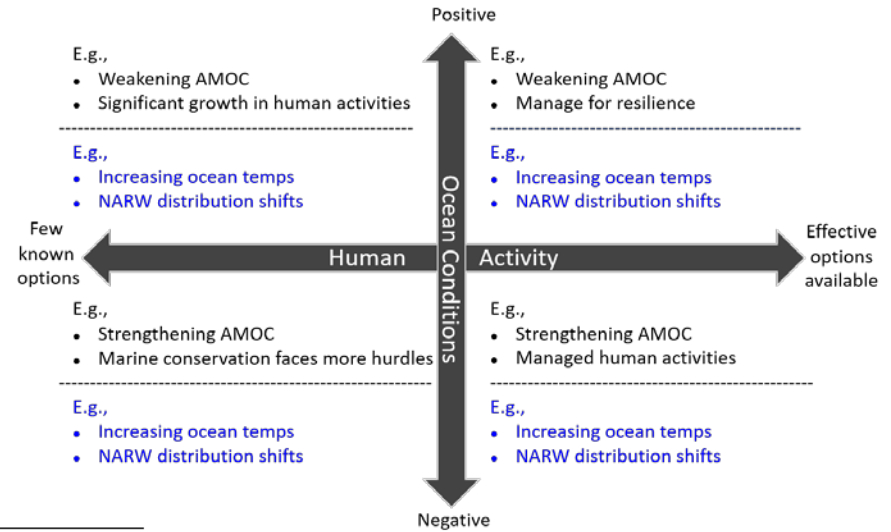
2. Notable non-climate features & developments

3. Significant Events and Developments

4. In this scenario, what are the main changes in conditions / impacts on right whales?

| | | |
|----------|----------|----------|
| REGION 1 | REGION 2 | REGION 3 |
|----------|----------|----------|

2020 2030 2050 2075

WORKSHEET Generating Options

Scenario Name Here _____

What indicators would you look at to _____

If you knew this scenario was the future, what actions would you take now / within 5 years to prepare for / achieve / avoid this?

| | | |
|---------------------------|----------------------------------------------------------------------|--------------------------------------|
| SCIENCE / RESEARCH | MANAGEMENT - VESSELS | RELATIONSHIPS / COLLABORATION |
| | | |
| | MANAGEMENT - OTHER (e.g., AQUACULTURE, WIND ENERGY, NOISE) | OTHER |
| | | |



Source: NMFS, in prep.

Atlantic Salmon & Right Whale Highlights

- Identified most critical and uncertain drivers
- Created plausible future scenarios of climate impacts to the species/ ecosystem
- Identified and prioritized actions across one or more futures
- Increased collaboration with partners to address an area of common concern
- Identified resource needs for recovery, data gaps, and climate change adaptation strategies
- Provided opportunity for participants to extract themselves from a “triage” approach to recovery, and insert themselves into advanced planning

Source: Borggaard, Dick et al. 2019; NMFS, in prep.

Thanks to:

Salmon Pilot: Federal Experts from NOAA (NMFS and ESRL), USFWS, USGS, USFS including:

Dan Kircheis
Mike Alexander
Matt Bernier
Matt Collins
Julie Crocker
Kim Damon-Randall
Rob Dudley
Jon Hare
Sean Hayes
Mike Johnson
John Kocik
Wendy Morrison

Ben Letcher
Nate Mantua
Keith Nislow
Vince Saba
Rory Saunders
Tim Sheehan
Michelle Staudinger
Jed Wright
Joe Zydlewski
Roger Griffis



Right Whale Exercise: Federal Experts from NOAA (NMFS and ESRL), MMC, NOS including:

Mike Asaro
Diane Borggaard
Colleen Coogan
David Morin
Peter Burns
Kevin Madley
Julie Crocker
Sean Hayes
Peter Corkeron/Allison Henry
Henry Milliken
Harvey Walsh

Vince Saba
Lance Garrison
John Quinlan
Laura Engleby/Jessica Powell
Barb Zoodsma
Shannon Bettridge
Teri Rowles
Jacqueline Pearson-Meyer
Donna Wieting

Lynne Barre
Dave Wiley/Ben Haskell
Becky Shortland
Mike Alexander
Quay Dortch
Frances M.D. Gulland
Peter Thomas
Michael Runge
Michelle Staudinger



Facilitator and Trainer: Jonathan Star (Scenario Insight)

Support from: Offices of Protected Resources and Science and Technology

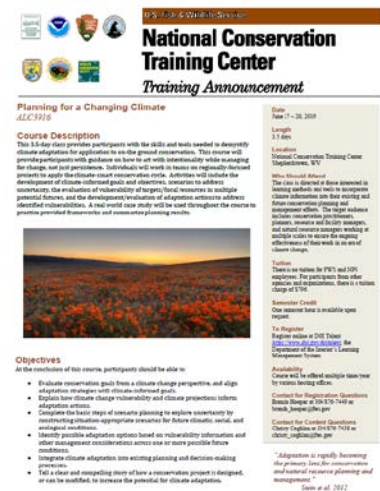
NMFS Scenario Planning Trainings

GARFO Training (2018)

- Overview of principles and hands-on exercises

Planning for a Changing Climate (2019-2023)

- Target: protected resource managers and scientists, others engaged in endangered species and marine resource conservation planning
- Climate smart principles, driver identification, vulnerability assessments, scenario planning
- Offered at U.S. FWS National Conservation Training Center and in a region annually



U.S. Fish & Wildlife Service
National Conservation Training Center
Training Announcement

Planning for a Changing Climate
ALC3916

Course Description
This 3.5-day class provides participants with the skills and tools needed to develop climate adaptation for application to the general conservation. This course will provide participants with guidance on how to set with intentionality while managing for change, and not protection. Individuals will work in teams on regionally-focused projects to apply the climate smart conservation cycle. Activities will include the development of climate-related goals and objectives, scenarios to address uncertainty, the evaluation of vulnerability of target/focal resources to multiple potential futures, and the development/revision of adaptation actions to address identified vulnerabilities. A real world case study will be used throughout the course to provide practical framework and scenario planning results.

Objectives
At the conclusion of this course, participants should be able to:

- Evaluate conservation goals from a climate change perspective, and align adaptation strategies with climate-related goals.
- Explain how climate change vulnerability and climate projections inform adaptation actions.
- Complete the basic steps of scenario planning to explore uncertainty for monitoring situations appropriate scenarios for future climatic, social, and management conditions.
- Identify possible adaptation options based on vulnerability information and their management considerations across one or more possible future conditions.
- Integrate climate adaptation into existing planning and decision-making processes.
- Tell a clear and compelling story of how a conservation plan is designed, or can be modified, to increase the potential for climate adaptation.

Availability
Course will be offered multiple times over by various learning efforts.

Contact for Registration Questions
Brandi Shupe at 800-875-7463 or brandi_shupe@fws.gov

Contact for Content Questions
Cristina Rodriguez at 202-718-7418 or cristina_rodriguez@fws.gov

"Adaptation is equally becoming the primary focus for conservation and natural resource planning and management."
Gunn et al. 2022

Scenario Planning White Paper

- Office of Sustainable Fisheries is working on a white paper that introduces scenario planning and summarizes 5-6 examples
- Coming ~Spring 2020



Slide: Courtesy of Wendy Morrison, NMFS F/SF

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PFMC Climate & Communities Initiative

- PFMC is initiating a scenario planning exercise on the topic of shifting stock availability.
- Expected outcome = “the definition of tools, products, and processes necessary to react to potential future ecosystem states.”



<https://www.pcouncil.org/ecosystem-based-management/fishery-ecosystem-plan-initiatives/climate-and-communities-initiative/>

Slide: Courtesy of Wendy Morrison, NMFS F/SF
Project Contact: Christopher Kit Dahl, PFMC

PFMC Climate & Communities Initiative- General Timeline

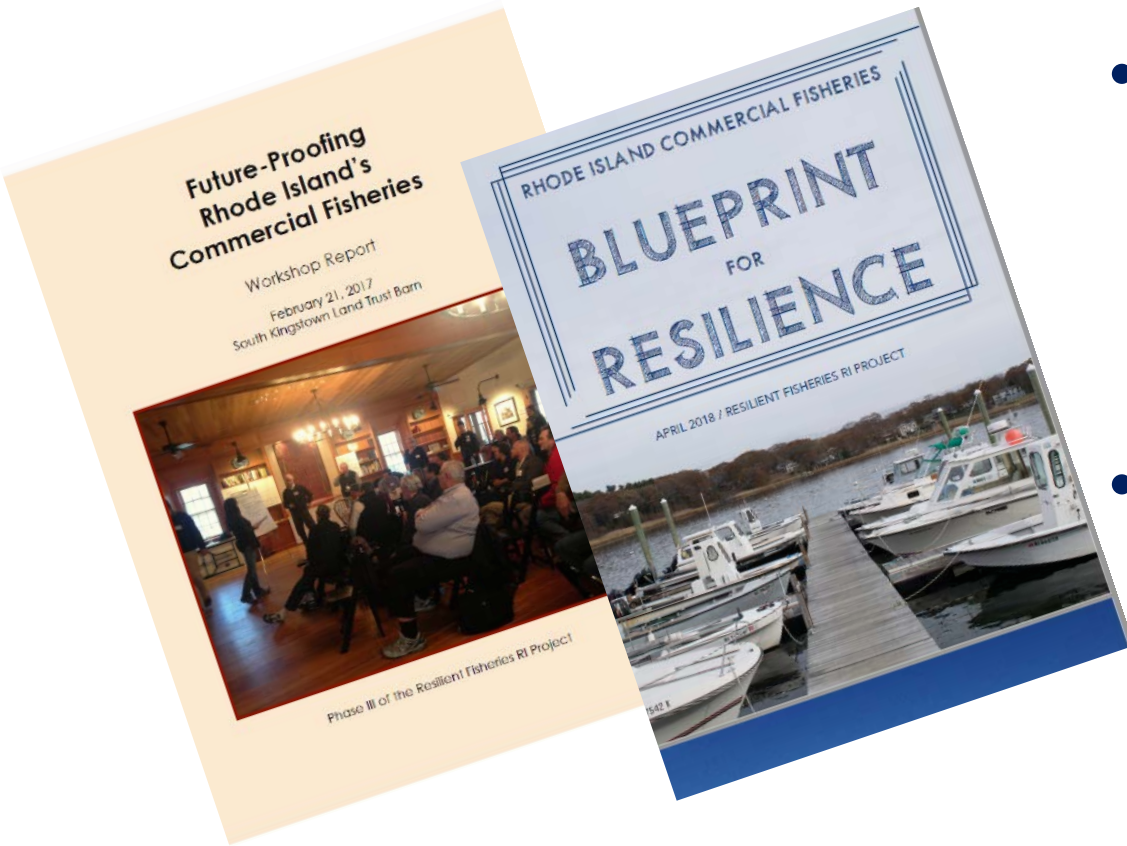
| Timeframe | Activity |
|----------------|-----------------------------------------------------------------------------------|
| Early 2018 | Science & management background documents & webinars |
| Late 2018 | Council adds scenario planning to initiative |
| Summer 2019 | Interview ~15 expert stakeholders |
| September 2019 | Report to Council on plans |
| January 2020 | Workshop to create scenarios |
| March 2020 | Report to Council on progress |
| Spring 2020 | Refine scenario descriptions |
| Fall 2020 | Investigate management implications; assess whether management changes are needed |

<https://www.pcouncil.org/ecosystem-based-management/fishery-ecosystem-plan-initiatives/climate-and-communities-initiative/>

Slide: Courtesy of Wendy Morrison, NMFS F/SF
Project Contact: Christopher Kit Dahl, PFMC

Resilient Fisheries Rhode Island

- SK funded project
- Aimed to create conversation among commercial fishing community about climate change
- Process included interviews with fishermen, webinars on climate issues and workshop to plan for the future



<http://resilientfisheriesri.org/>

Slide: Courtesy of Wendy Morrison, NMFS F/SF

Resilient Fisheries Rhode Island



- Based on concerns heard in interviews, facilitators created four future scenarios with environmental and socio-political details.
- During the workshop fishermen were divided into four groups (1 group for each scenario) to:
 - Discuss how fishing would change under their scenario
 - Brainstorm proposed strategies
 - Rate proposed strategies from other groups as to how well it would work in their scenario
 - Identify win-win strategies

<http://resilientfisheriesri.org/>

Slide: Courtesy of Wendy Morrison, NMFS F/SF

Resilient Fisheries Rhode Island

Results: 7 Goals and 32 tactics under the following strategy areas:

- Public relations (4)
- Civic engagement (4)
- The next generation (6)
- Innovative seafood marketing (4)
- Working waters and coastlines (4)
- Healthy habitats (4)
- Adaptive science & management (6)



<http://resilientfisheriesri.org/>

Slide: Courtesy of Wendy Morrison, NMFS F/SF



NEFSC NOAA permit 775-1875

Questions?



https://nature.ca/notebooks/english/atsalmon_p2.htm

Contact Info:

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Dori Dick: dori.dick@noaa.gov