Scenario Planning as a Tool in Protected Species Management and Conservation in a Changing Climate: An Atlantic Salmon Pilot

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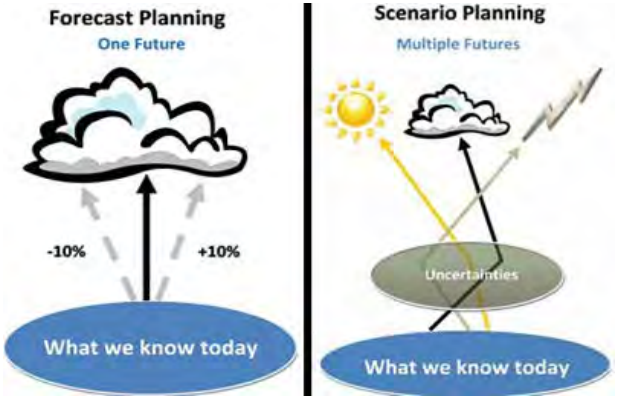
Scenario Planning

- Framework to support decisions under uncertain and uncontrollable conditions
- Explores plausible alternative conditions under different assumptions
  - ➢ Not prediction or forecast
  - ➢ Does not have to be data intensive
- Flexible and adaptable



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)*

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

3. *Combine drivers to create a scenario framework*

4. *Craft a plausible, challenging story for each scenario*

Sources: Scenario Insight and NPS 2013. Handbook for Practitioners

Benefits from 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

NMFS Climate Activities

NMFS Climate Adaptation Planning

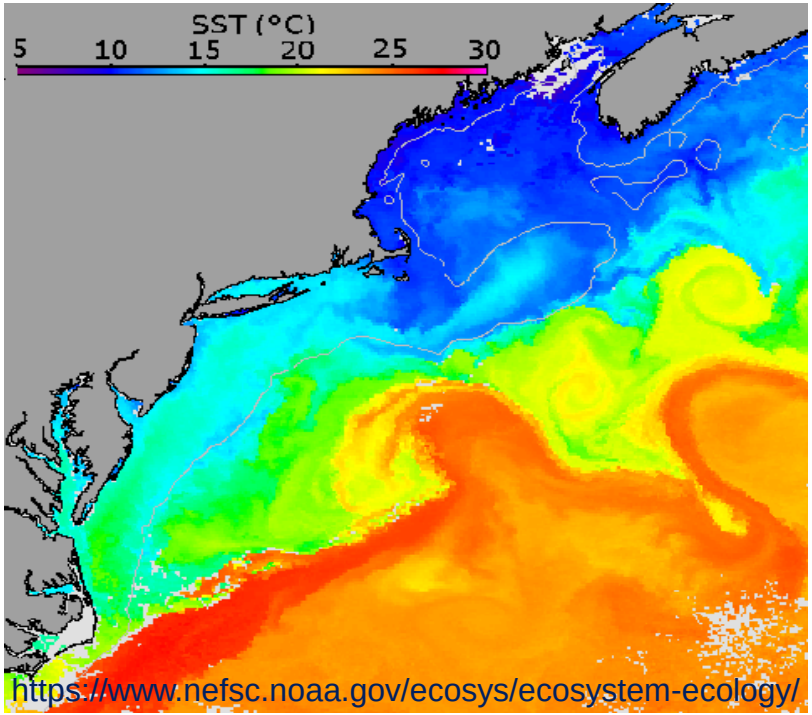
Northeast Regional Action Plan (2017-2021)

Priority

- Develop climate-related products and decision support tools to support protected species assessments and other management actions

Action

- Continue climate efforts focused on protected resources (e.g., Atlantic salmon)



https://www.nefsc.noaa.gov/ecosys/ecosystem-ecology/

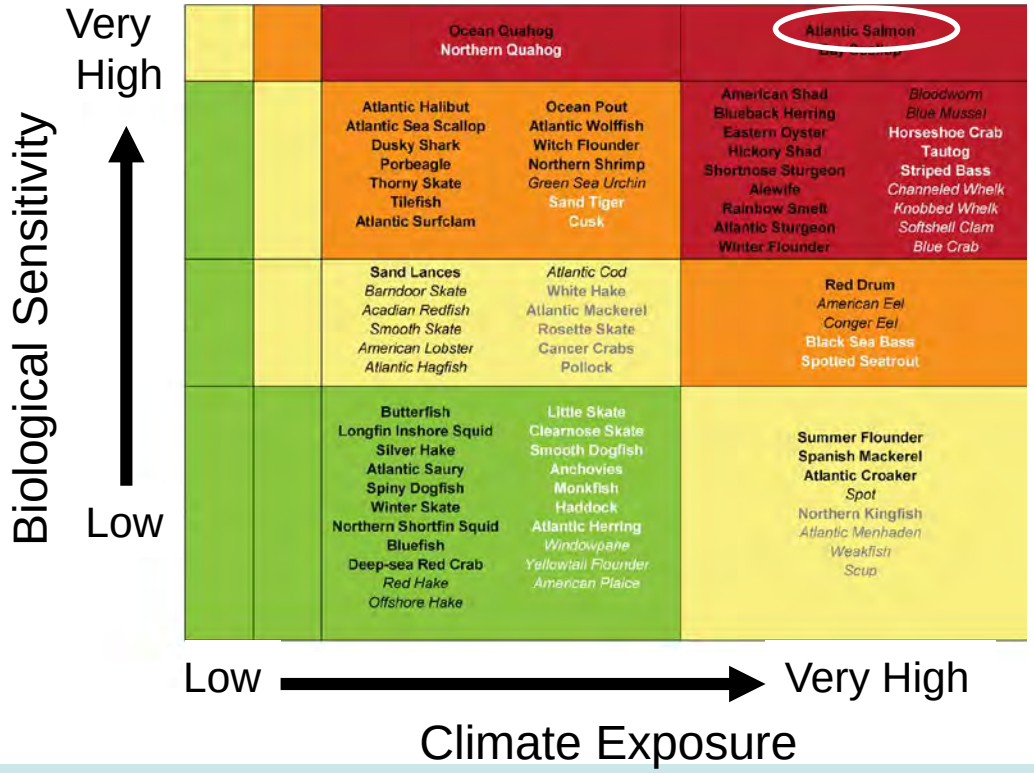
Hare et al. 2016, NOAA Technical Memorandum NMFS-NE-239

NMFS Climate Adaptation Planning

Fish & Invertebrate Vulnerability Assessment (2016)

Atlantic salmon

Overall vulnerability = very high



Hare et al. 2016

Atlantic Salmon Pilot: Key Concepts

Purpose

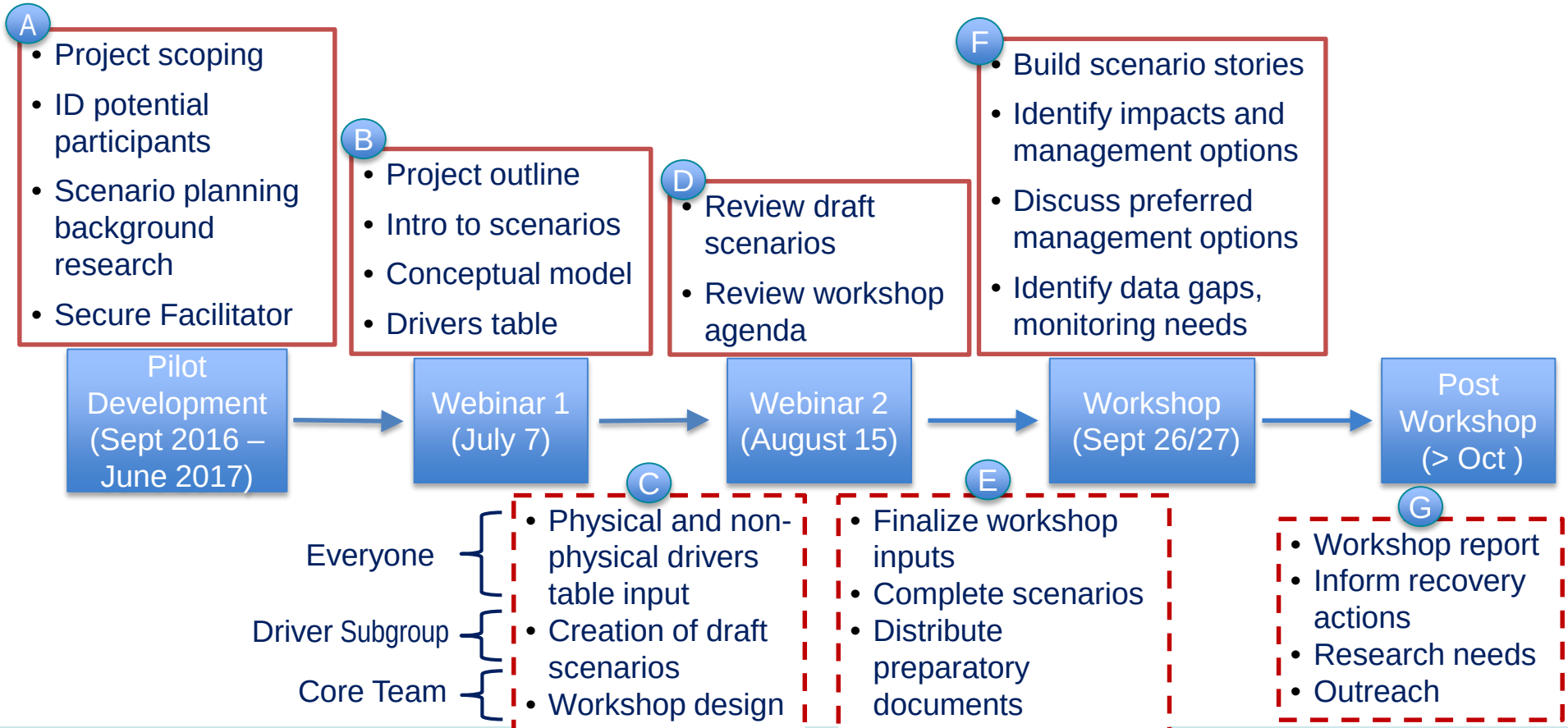
To explore what NMFS can do (e.g. feasible management actions) to improve Atlantic salmon resilience in the face of climate change in both riverine and marine environments across the species' current range.

Focal Question

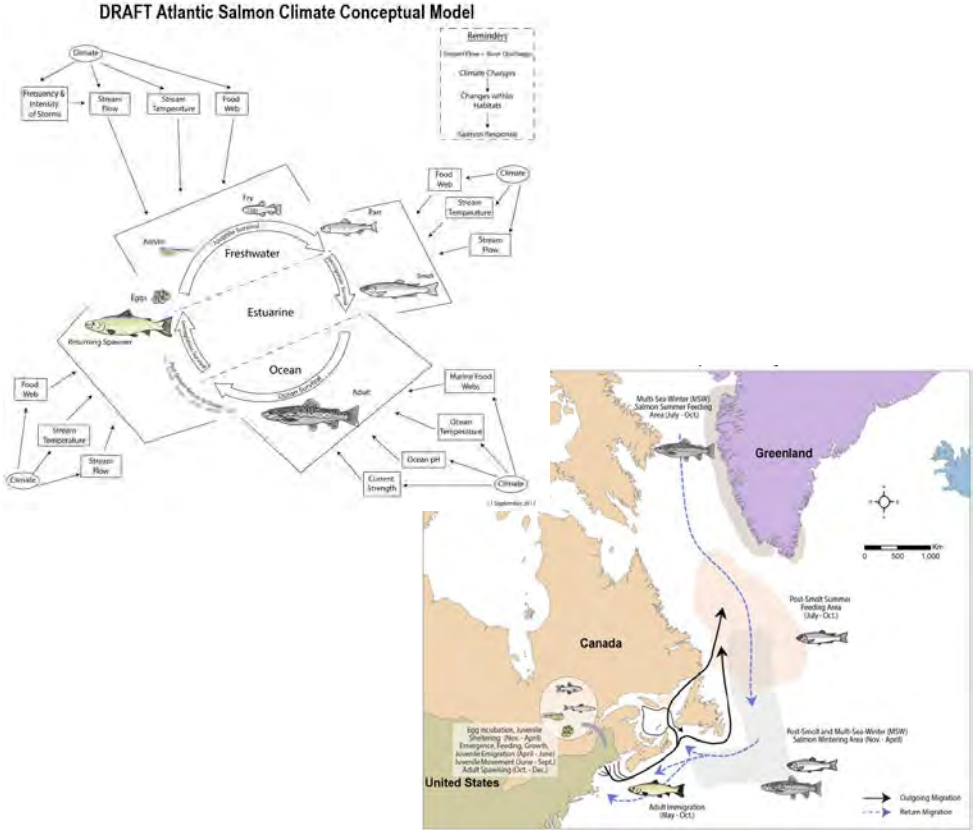
How could the effects of climate change impact the watersheds and marine ecosystems over the next 75 years?

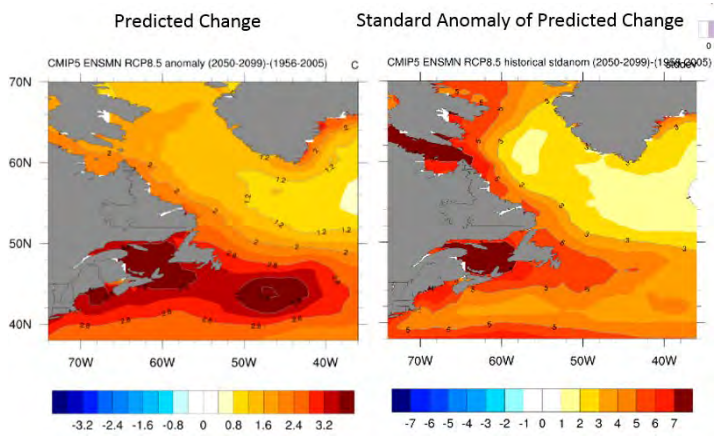

Source: NEFSC

Process Outline

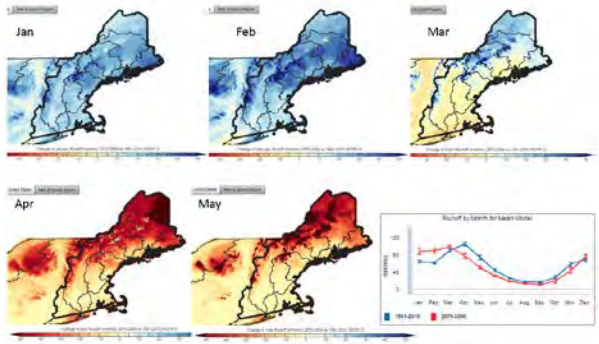


Understanding the Impact on Salmon





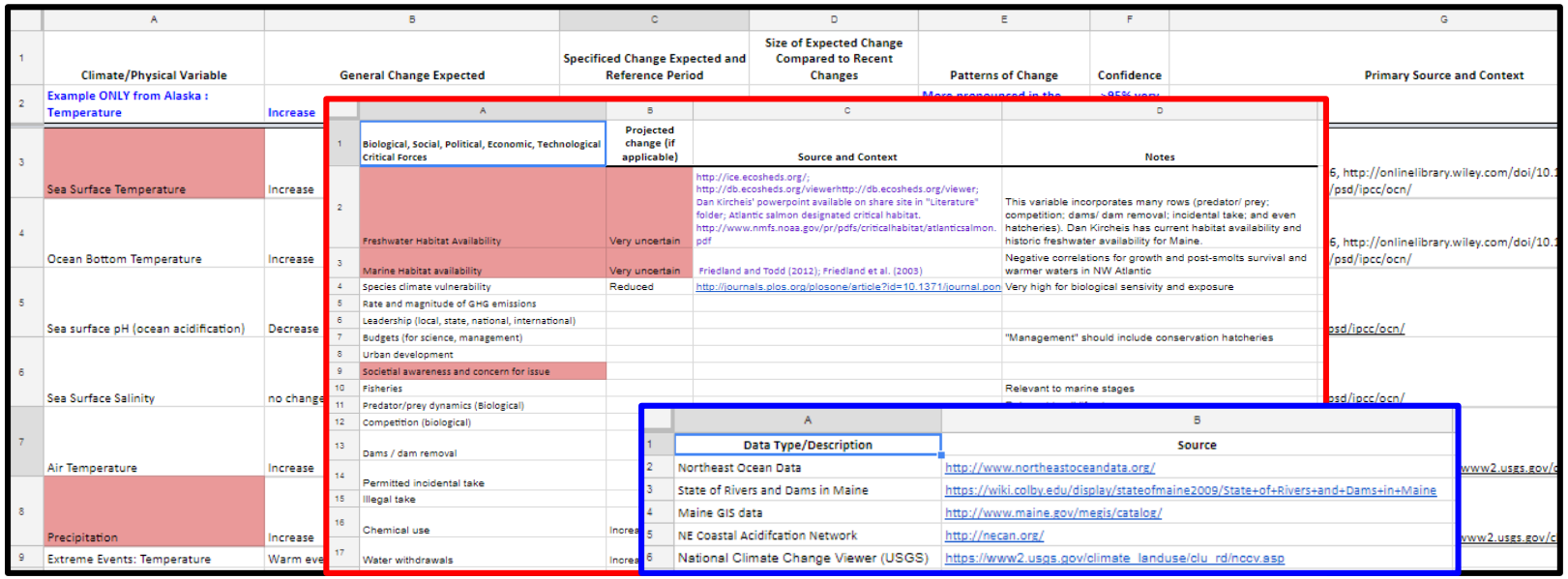
Source: NOAA Climate Change Web Portal



Source: USGS Climate Change Viewer

Driver Identification

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



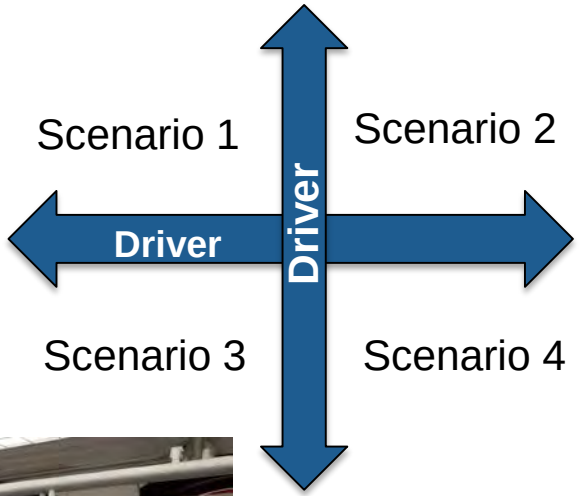
	A	B	C	D	E	F	G
1	Climate/Physical Variable	General Change Expected	Specificed Change Expected and Reference Period	Size of Expected Change Compared to Recent Changes	Patterns of Change	Confidence	Primary Source and Context
2	Example ONLY from Alaska : Temperature	Increase			More pronounced in the	>95% very	
3	Sea Surface Temperature	Increase					6, http://onlinelibrary.wiley.com/doi/10.1 /psd/ipcc/ocn/
4	Ocean Bottom Temperature	Increase					6, http://onlinelibrary.wiley.com/doi/10.1 /psd/ipcc/ocn/
5	Sea surface pH (ocean acidification)	Decrease					psd/ipcc/ocn/
6	Sea Surface Salinity	no change					psd/ipcc/ocn/
7	Air Temperature	Increase					www2.usgs.gov/c
8	Precipitation	Increase					www2.usgs.gov/c
9	Extreme Events: Temperature	Warm eve					

	A	B	C	D
1	Biological, Social, Political, Economic, Technological Critical Forces	Projected change (if applicable)	Source and Context	Notes
2	Freshwater Habitat Availability	Very uncertain	http://ice.ecosheds.org/; http://db.ecosheds.org/viewerhttp://db.ecosheds.org/viewer; Dan Kircheis' powerpoint available on share site in "Literature" folder; Atlantic salmon designated critical habitat. http://www.nmfs.noaa.gov/pr/pdfs/criticalhabitat/atlanticsalmon.pdf	This variable incorporates many rows (predator/ prey; competition; dams/ dam removal; incidental take; and even hatcheries). Dan Kircheis has current habitat availability and historic freshwater availability for Maine.
3	Marine Habitat availability	Very uncertain	Friedland and Todd (2012); Friedland et al. (2003)	Negative correlations for growth and post-smolts survival and warmer waters in NW Atlantic
4	Species climate vulnerability	Reduced	http://journals.plos.org/plosone/article?id=10.1371/journal.pon	Very high for biological sensivity and exposure
5	Rate and magnitude of GHG emissions			
6	Leadership (local, state, national, international)			
7	Budgets (for science, management)			"Management" should include conservation hatcheries
8	Urban development			
9	Societial awareness and concern for issue			
10	Fisheries			Relevant to marine stages
11	Predator/prey dynamics (Biological)			
12	Competition (biological)			
13	Dams / dam removal			
14	Permitted incidental take			
15	Illegal take			
16	Chemical use	Increa		
17	Water withdrawals	Increa		

	A	B
1	Data Type/Description	Source
2	Northeast Ocean Data	http://www.northeastoceandata.org/
3	State of Rivers and Dams in Maine	https://wiki.colby.edu/display/stateofmaine2009/State+of+Rivers+and+Dams+in+Maine
4	Maine GIS data	http://www.maine.gov/megis/catalog/
5	NE Coastal Acidifcation Network	http://necan.org/
6	National Climate Change Viewer (USGS)	https://www2.usgs.gov/climate_landuse/clu_rd/nccv.asp

Key Considerations

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



Final Matrix

High

Freshwater Accessibility

Low

Warmer, Wetter

Climatic Conditions (RCP 8.5)

Warmer, Drier

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
  - SST changes non-uniformly, with warming in the Gulf of Maine and less warming/cooling off Greenland
- Passage barriers removed / modified
- *Salmon primarily affected by marine suitability, streamflow variability and temperature*

Hanging on by a Stream

- Climatic Conditions:
  - Drier, warmer conditions prevail
  - 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 changes non-uniformly, with warming in the Gulf of Maine and less warming/cooling off Greenland
- Passage barriers removed/modified
- *Salmon primarily affected by marine suitability, streamflow variability and temperature*

Soggy but Hindered

- 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 changes non-uniformly, with warming in the Gulf of Maine and less warming/cooling off Greenland
- Most passage barriers remain
- *Salmon primarily affected by marine suitability, streamflow variability, temperature, and barriers*

Hot and Blocked

- Climatic Conditions:
  - Drier, warmer conditions prevail
  - 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 changes non-uniformly, with warming in the Gulf of Maine and less warming/cooling off Greenland
- Most passage barriers remain
- *Salmon primarily affected by marine suitability, streamflow variability, temperature, and barriers*

High

Free Flowing

Hanging on by a Stream

Warmer, Wetter

Climatic

Freshwater Accessibility

Conditions (RCP 8.5)

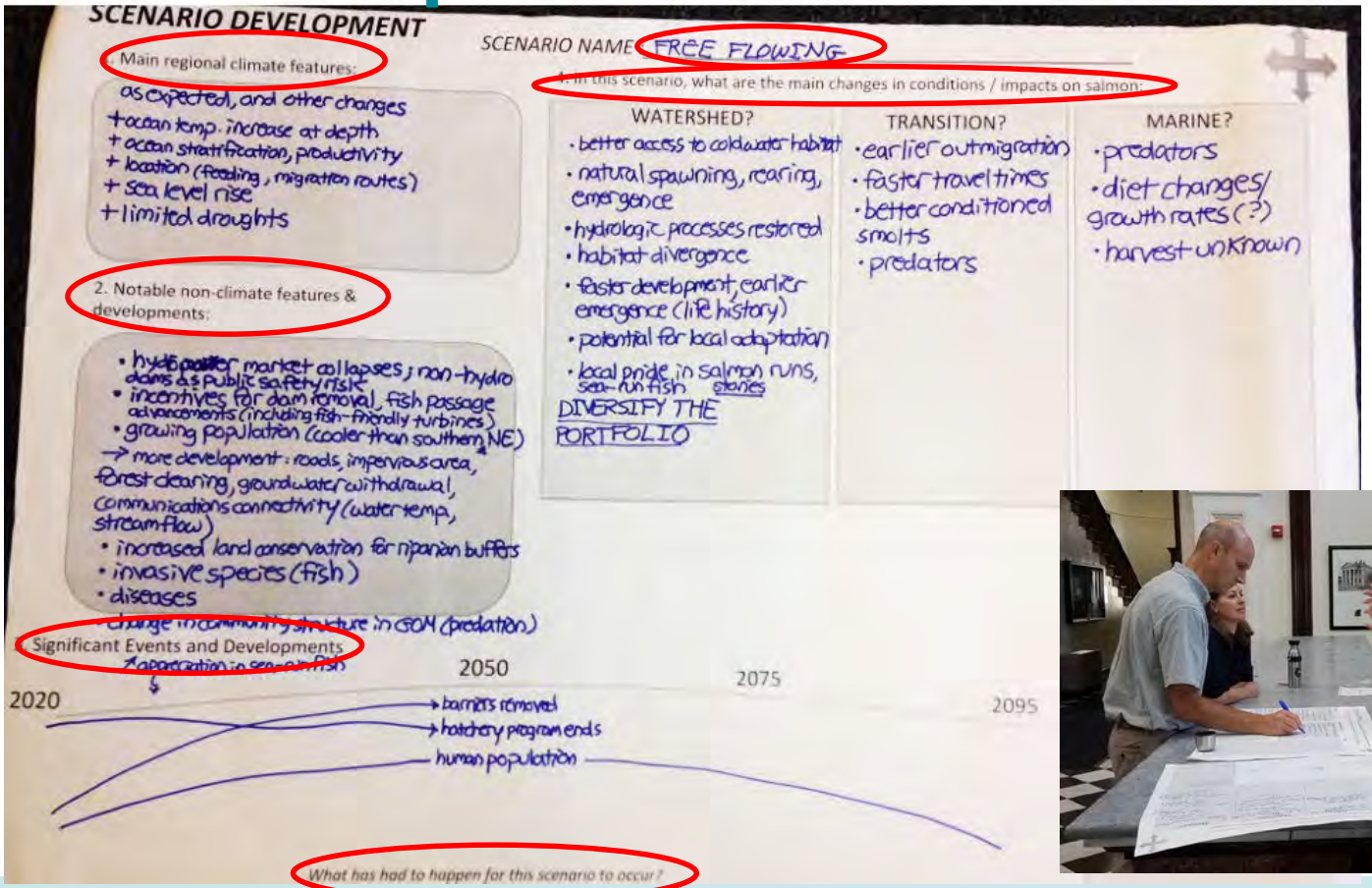
Warmer, Drier

Soggy but Hindered

Hot and Blocked

Low

Scenario Development



Generating Options

Generating Options: FREE FLOWING

If you knew this scenario was the future, what actions would you take now / within 5 years

- Connecticut lessons learned

Research

- undammed rivers as index (Canada) – lessons learned

Salmon? Climate? Social science?

- more temperature monitoring for resilience
- thermal imagery (seeps)
- further barrier assessment/ground truthing
- tracking salmon in wild (what are they telling us about habitat?)

⇒ assess and identify climate resilient habitats

- overlay stocking with habitat
- social science – other values
- increased streamflow gaging
- suitability mapping in marine environment
- changes in marine community structure/productivity

Management (Non-Dam)

E.g., stocking strategy, mixed stock fisheries, water withdrawal, etc.

- land conservation of priority habitats
- regulate/protect riparian buffers
- floodplain protection
- strategy for stocking → natural reproduction
- fishing regulations
- minimize harvest
- regulate water withdrawals
- water quality/stormwater regulations enhanced

Other

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

Dams / Other Barriers

Location of dam removal? Alternatives?

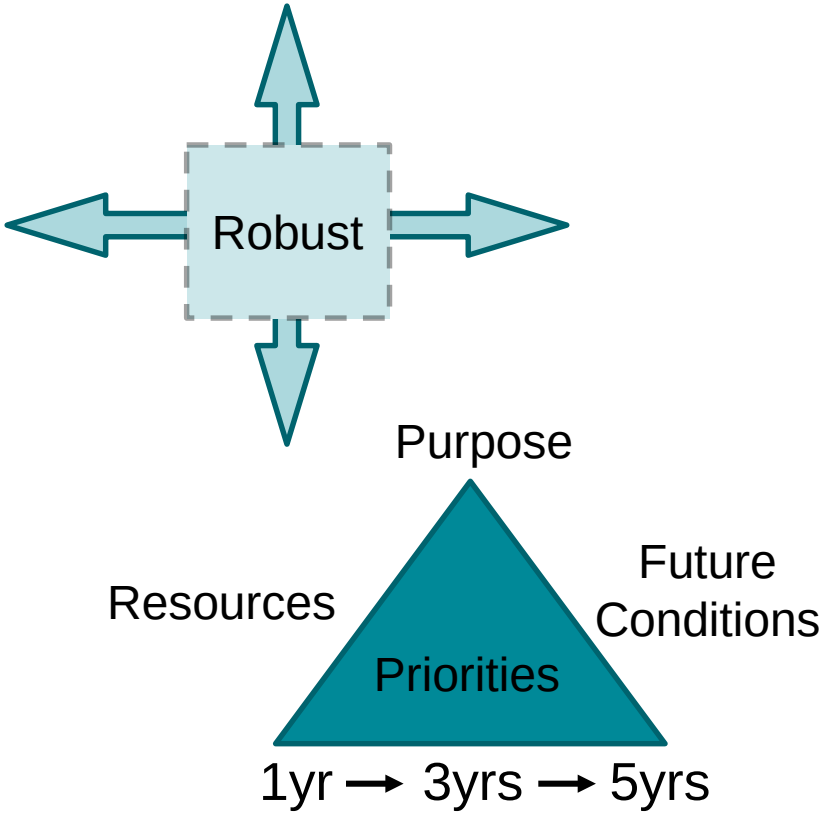
- identify priority barriers for removal/passage
- find pathways to removals (safety, liability, buyouts)
- remove high priority barriers
- improve FERC relicensing process → removals, effective fish passage
- DOT replacements (emergency, non-emergency)

Relationships / Collaboration

Other partners? Other initiatives?

- TNC (~~SHEDS~~ assessment, 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)

Assessing Options



Source: Scenario Insight, with modifications

High priority / Robust examples:

Marine and Transition:

- Conduct tagging/tracking studies of Atlantic salmon in marine environment
- Conduct multi-disciplinary North Atlantic right whale and Atlantic salmon workshop to discuss copepods/capelin

Watershed:

- Range-wide habitat analysis (e.g., map existing cold water refugia for DPS watersheds)

Outcomes

- ✓ Identify most critical and uncertain drivers for scenarios
- ✓ Create scenarios of how climate change could impact watersheds and the marine ecosystem
- ✓ Identify “robust” actions
- ✓ Identify salmon recovery needs and data gaps
- ✓ Increase coordination and collaboration for recovery efforts
- ✓ Highlight resource needs for recovery and climate change adaptation strategies

Next Steps

- ✓ Compile robust and high priority actions to inform Atlantic Salmon Recovery Plan
- ✓ Internal and external outreach
- ➢ Training to continue to increase NMFS' scenario planning capacity
- Produce Tech Memo
- Additional application(s)/case studies

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