



**NOAA**  
**FISHERIES**

Office of  
Science and  
Technology

# Marine Ecosystems and Climate Program

## Ecosystem Science Review

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July 2016

[www.st.nmfs.noaa.gov/ecosystems/climate](http://www.st.nmfs.noaa.gov/ecosystems/climate)

# Outline

1. Who we are
2. What we do
3. Strengths and Challenges
4. Future Directions

# Who we are:

**Who:** National program launched in 2004.

**Goal:** Increase the production, delivery and use of climate-related information to fulfill NMFS mandates.

**Drivers:** NMFS mandates & priorities  
Administration policies & directives

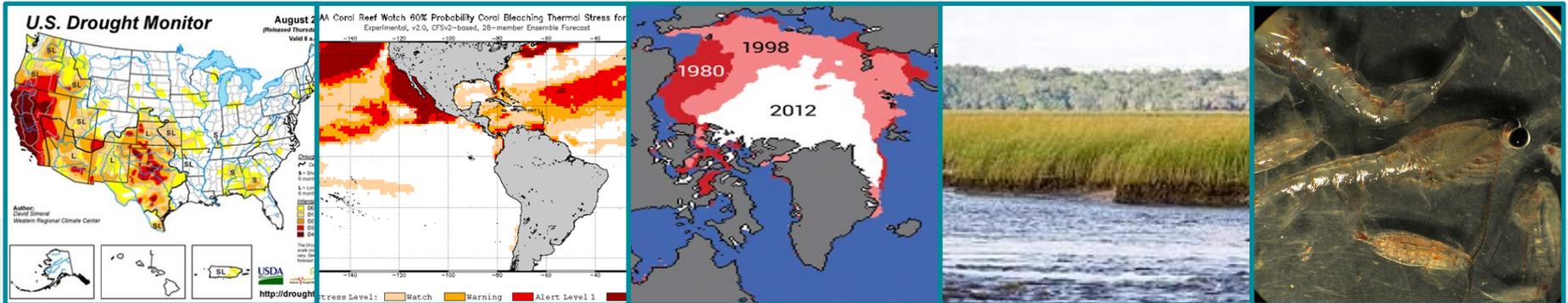
*National Ocean Policy*

*National Adaptation Strategies*

*Executive Orders (Climate Adaptation)*

Growing demand for information

# Growing Challenges for Effective Management



Droughts

Warming Oceans

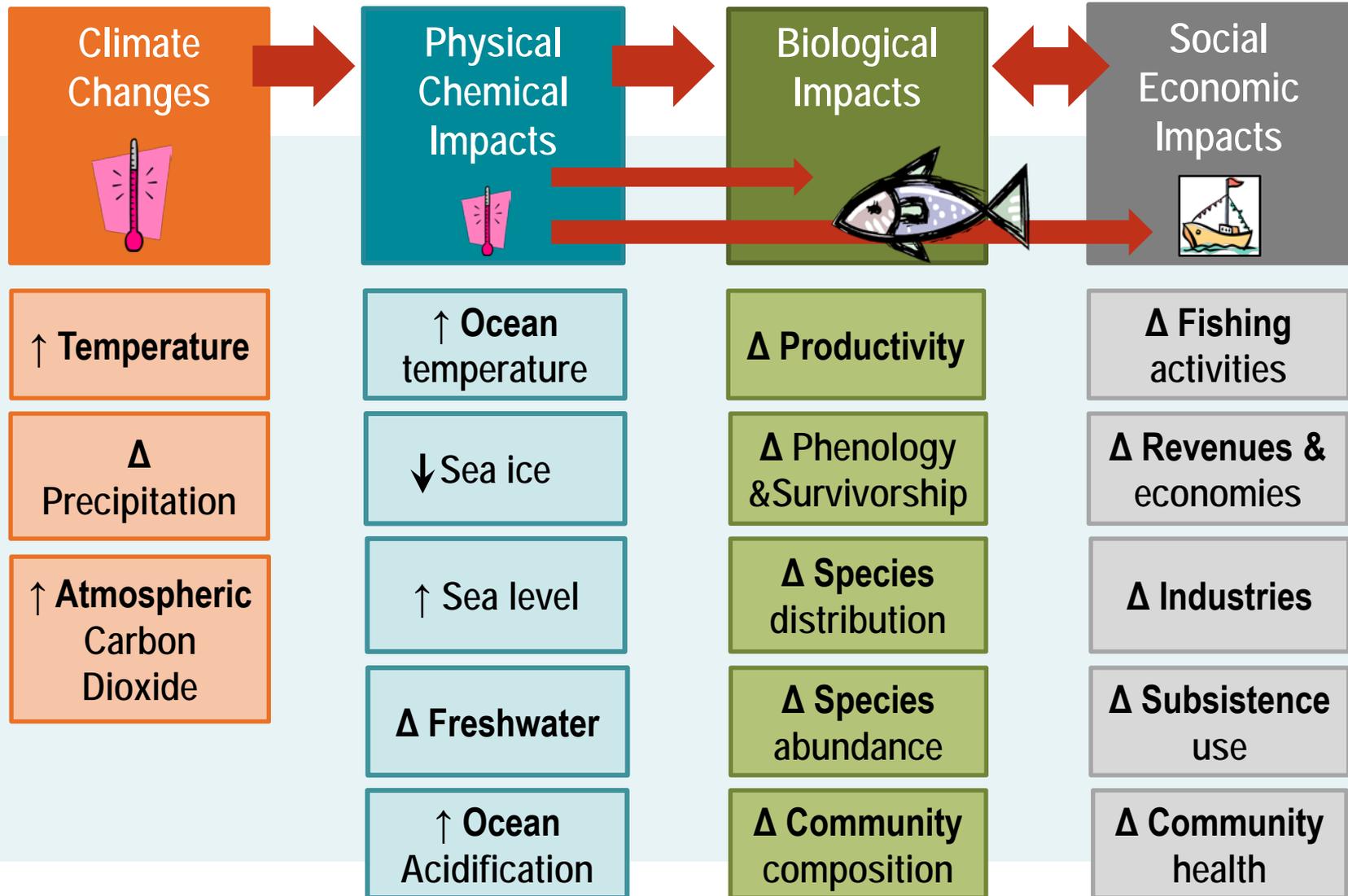
Loss of Sea Ice

Rising Seas

Ocean Acidification

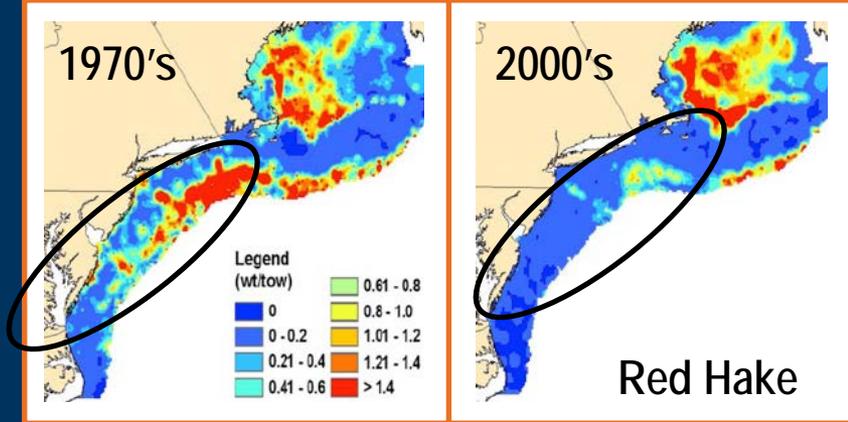


# The Impacts Are Expected to Increase

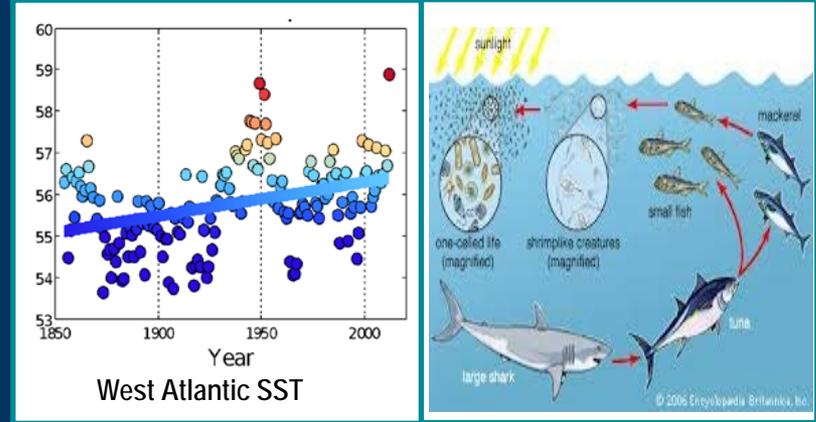


# Growing Demands for Information

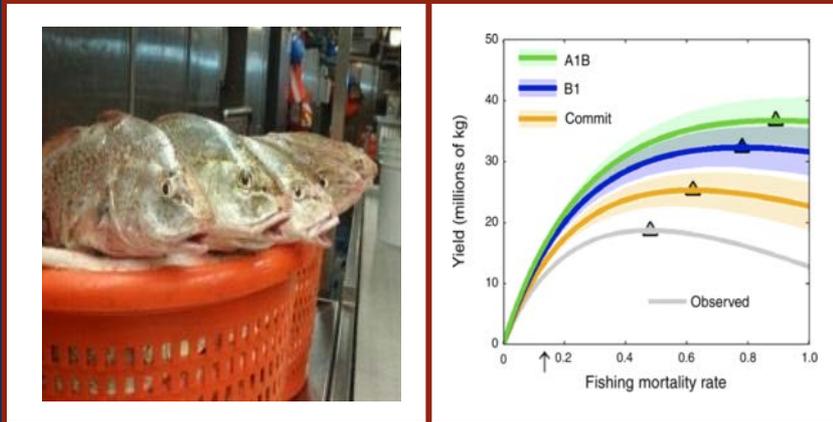
## WHAT IS CHANGING?



## WHY IS IT CHANGING?



## HOW WILL IT CHANGE?



## HOW TO RESPOND?

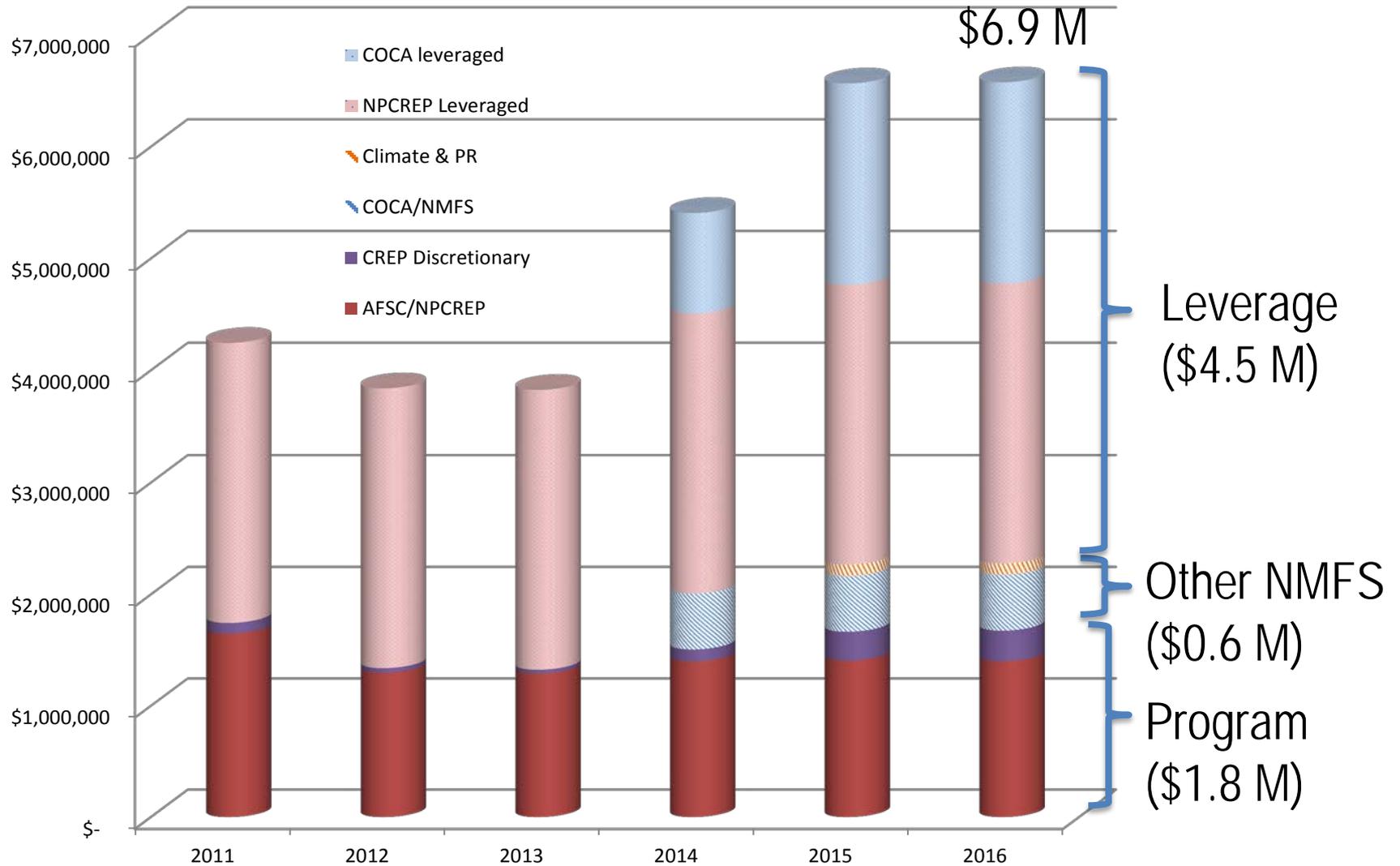


# Who we are:

- Structure: NMFS Climate Network
  - Science Centers
  - Regional Offices
  - Headquarters Offices
- Staff: 1 FTE & fellows (2 FTE 2016)
- Actions: Lead and support science (funding)
- Funding: \$1.4 M/yr (2004) - \$2.4 M/yr (2016)
- Partners: NMFS, NOAA Offices, externals



# Funding and Leverage



Year

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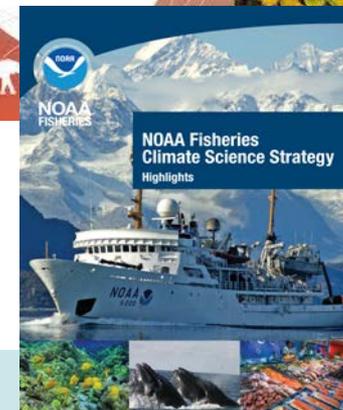
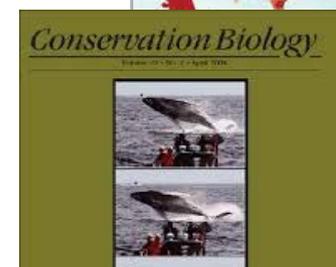
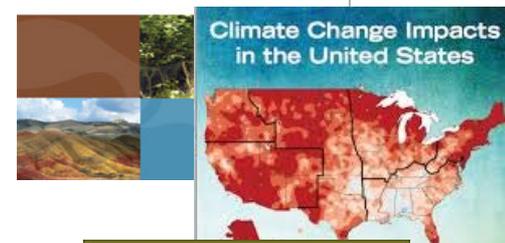
# What we do (Part 1)

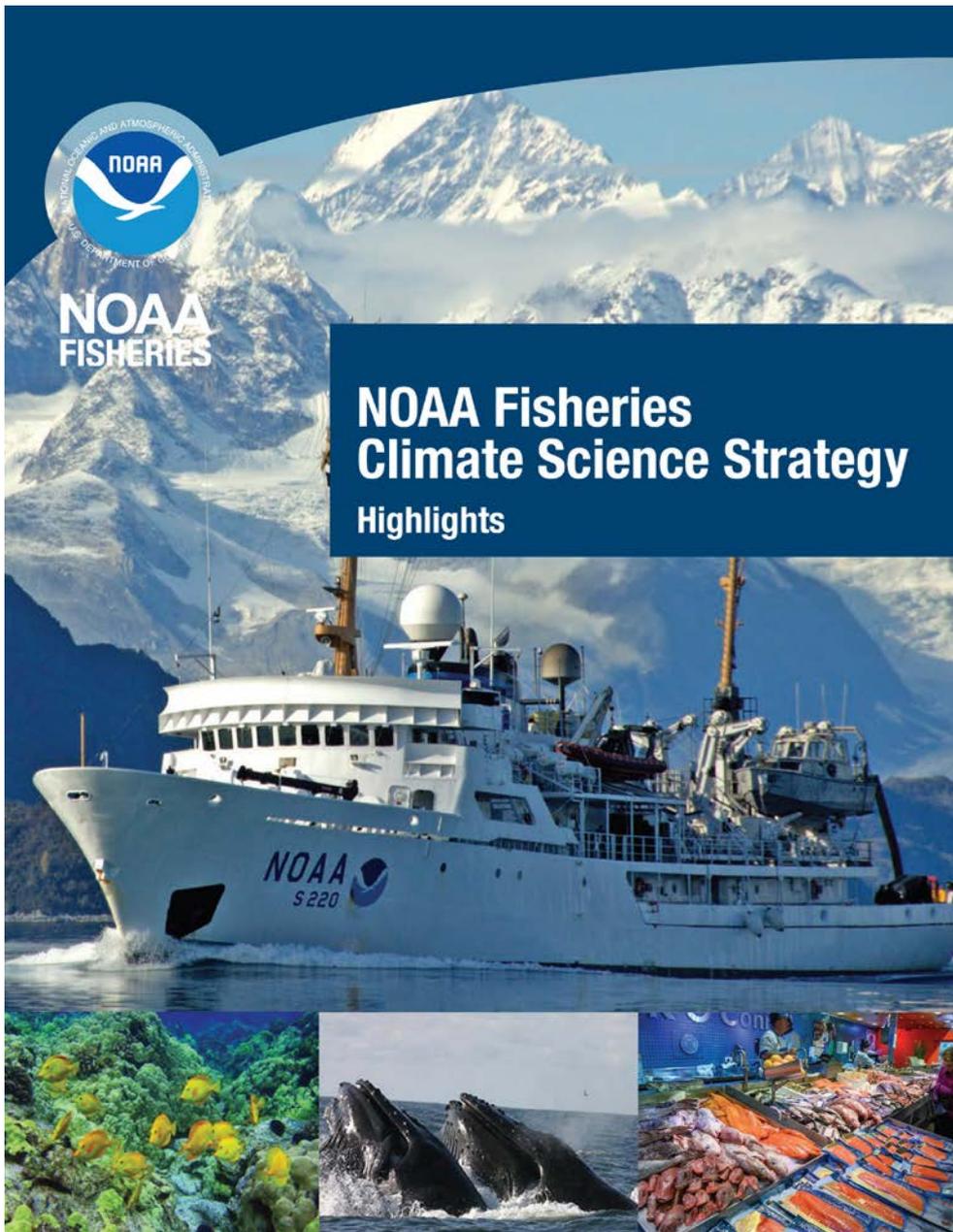
## Leading Science (10% funding)

- National Fish Wildlife and Plants Climate Adaptation Strategy (2013)
- US National Climate Assessment (2014)
- NMFS ESA and Climate Initiative (2014)
- Workshops and Symposia (2012-16)
- NMFS Climate Science Strategy (2015)
- Regional Action Plans (2016)



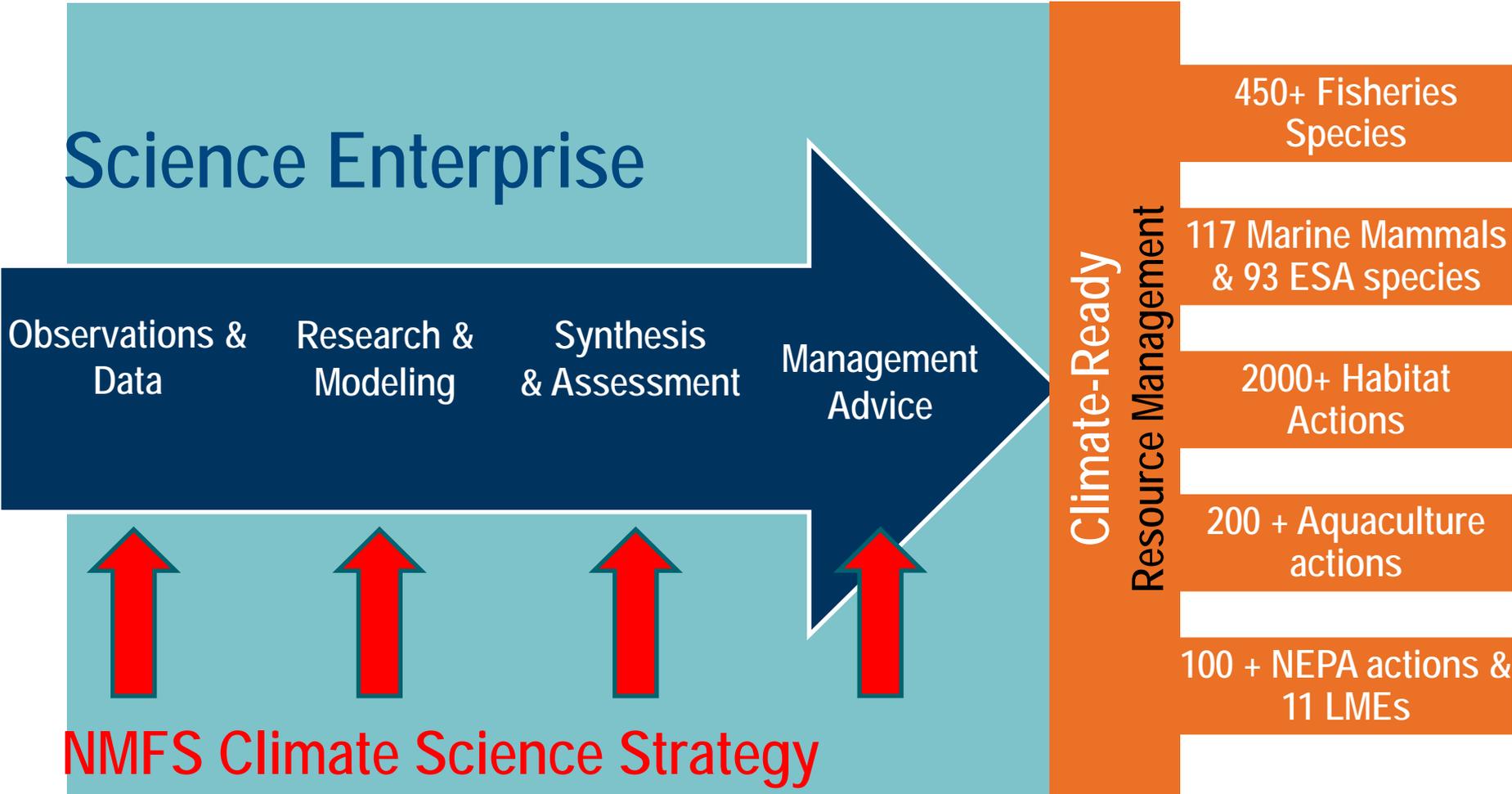
NATIONAL fish, wildlife & plants  
CLIMATE ADAPTATION STRATEGY



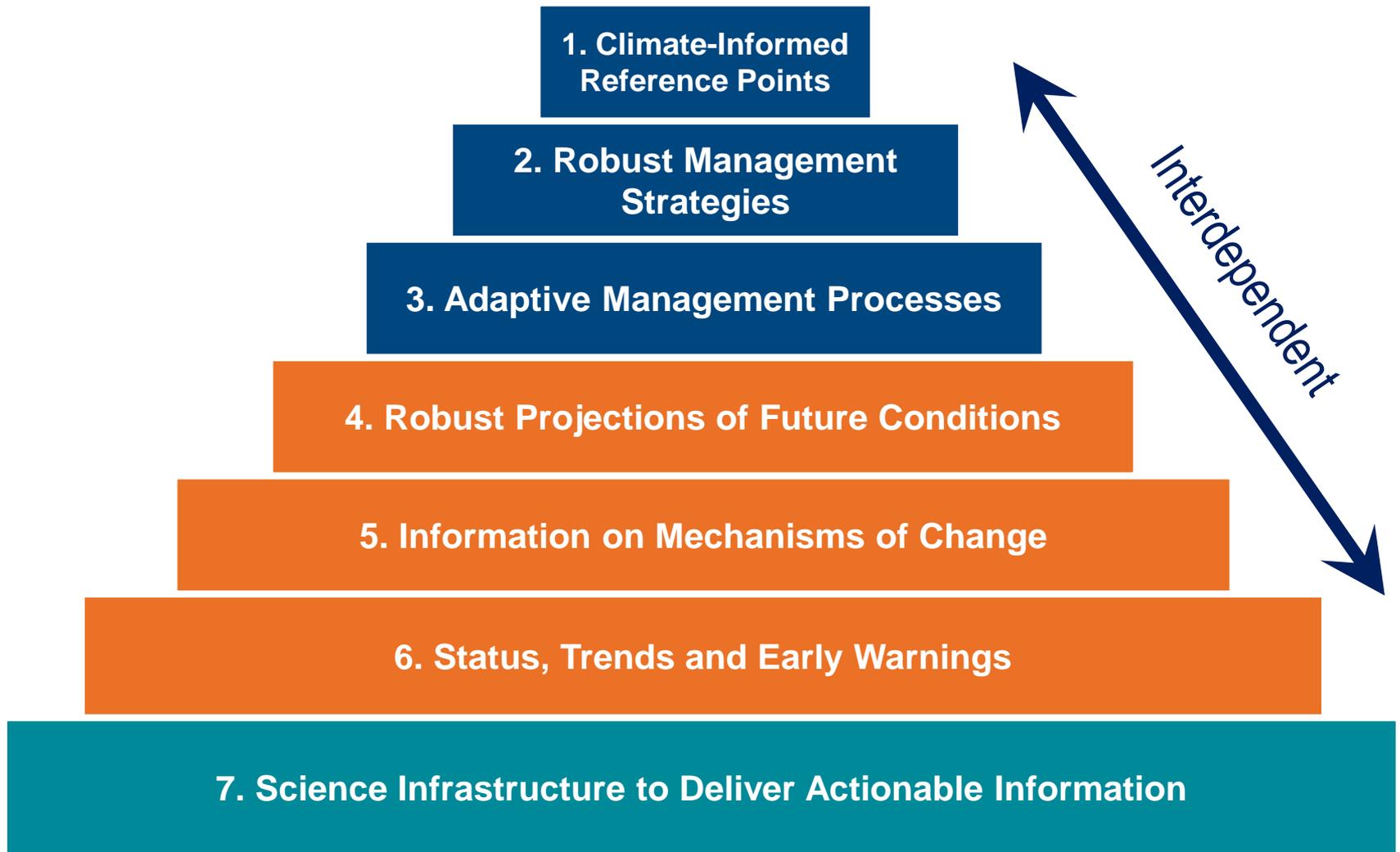


**Goal:**  
**Increase the  
production,  
delivery and use  
of climate-related  
information  
In fulfilling  
NOAA Fisheries  
mandates**

# Strategy designed to meet growing information needs for climate-smart decisions:



# NOAA Fisheries Climate Science Strategy

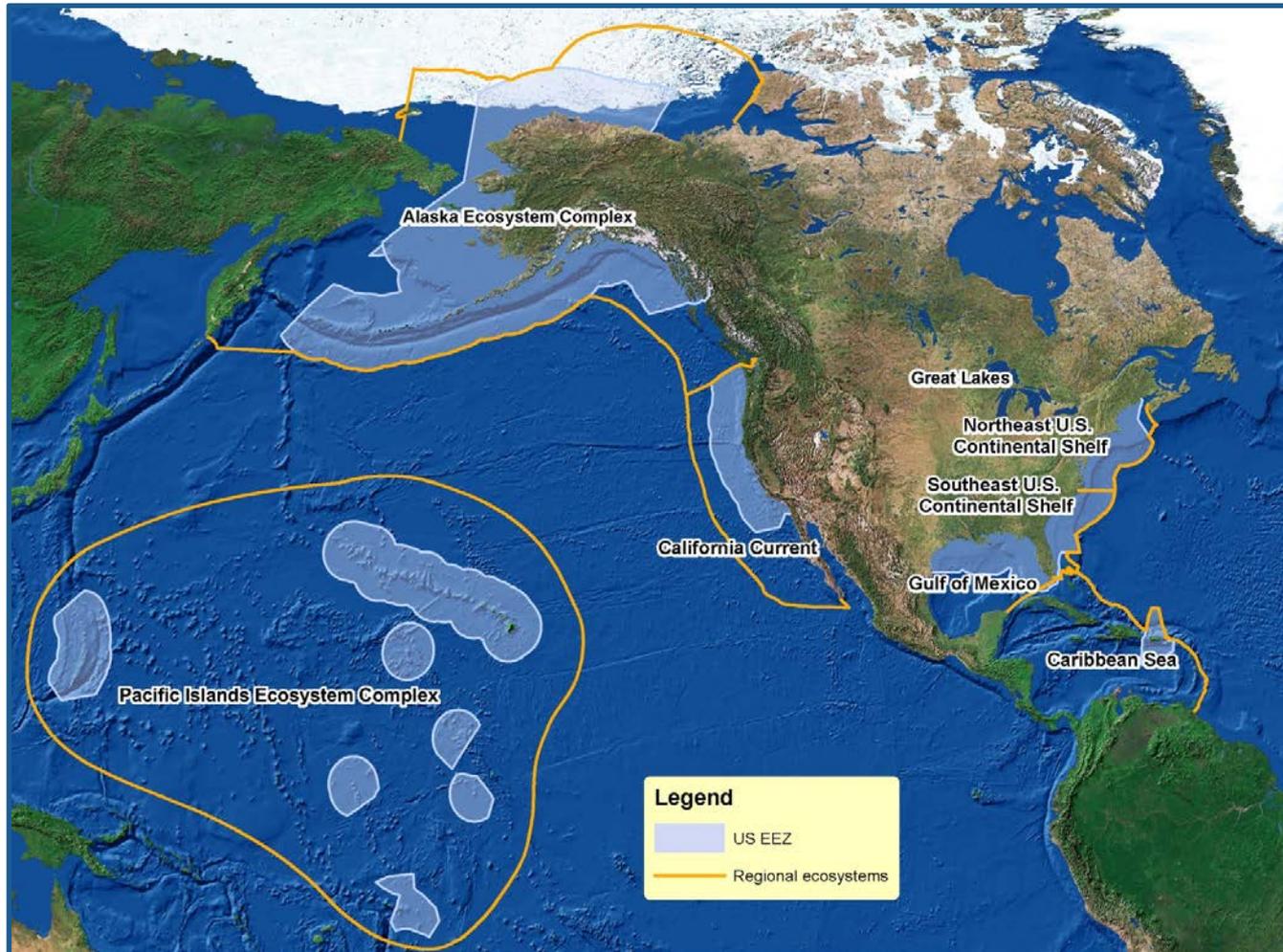


# Expected Results

- *Better tracking* of ecosystem changes that provide early warnings of climate-related changes.
- *Increased understanding* of what's vulnerable and the mechanisms of change.
- *Near and long term forecasts* of ocean and resource conditions.
- *Climate sensitive* resource assessments and
  - biological reference points.
- *Robust management scenarios.*
- *Reduced impacts and increased resilience.*

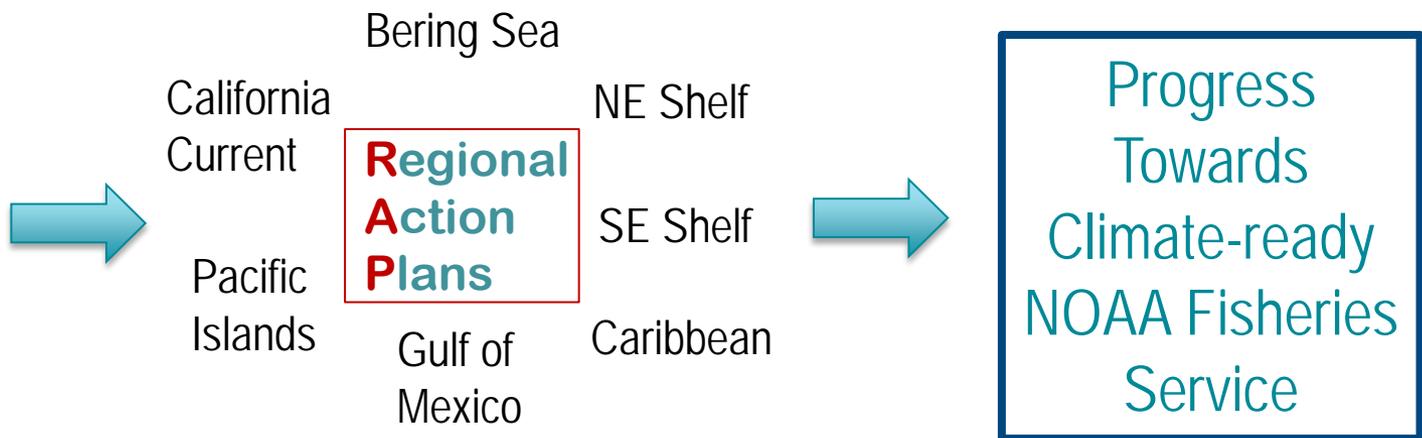
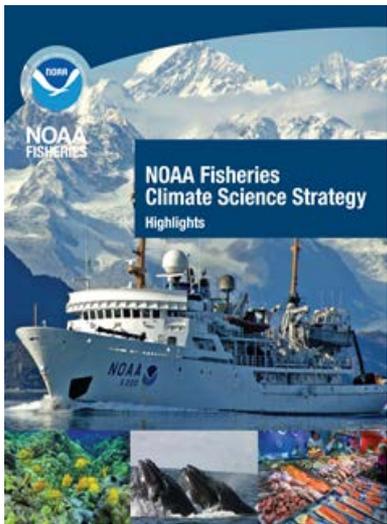


# Regional Action Plans Underway to Guide Strategy Implementation



# Regional Action Plans

- Develop with key partners such as FMCouncils, States etc.
- Customize implementation of the NCSS in each region.
- Inform future agency planning and budgeting.
- Build and expand partnerships and leverage resources.



- Seeking input now thru summer 2016.
- Finalize all regional plans by October 1, 2016.

# What we do (Part 2)

## Supporting Science (90% funding)

- North Pacific Climate Regimes and Ecosystem Productivity Program
- Climate Vulnerability Assessments
- Climate and Fisheries Research Program (NMFS-OAR)
- OCEANADAPT (fish stock distribution tracker)
- Climate and Protected Species Tools



# North Pacific Climate Regimes and Ecosystem Productivity Program (NPCREP)



# NPCREP – Designed to be Initial Phase of Nation-wide Program



# NPCREP Timeline

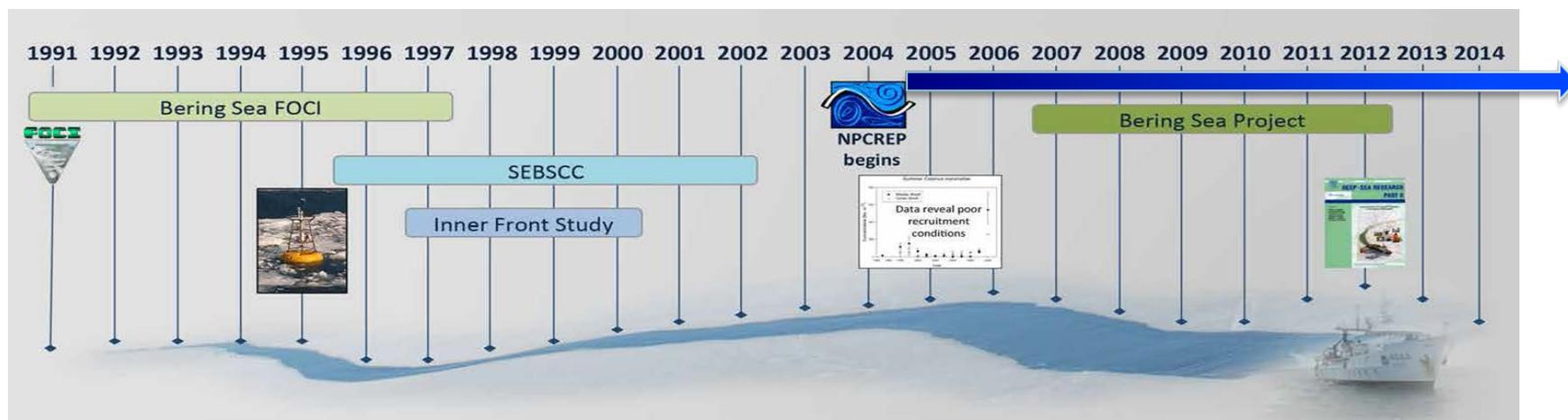


## 1990s

- *Increasing concern* for climate effects on fisheries and ecosystems.
- *Interest in improved forecasts* to improve management.
- *Existing efforts* to build on.

## 2000s

- *ST led NMFS requests* for new funding.
- *New funding in 2004* allows launch of NPCREP.



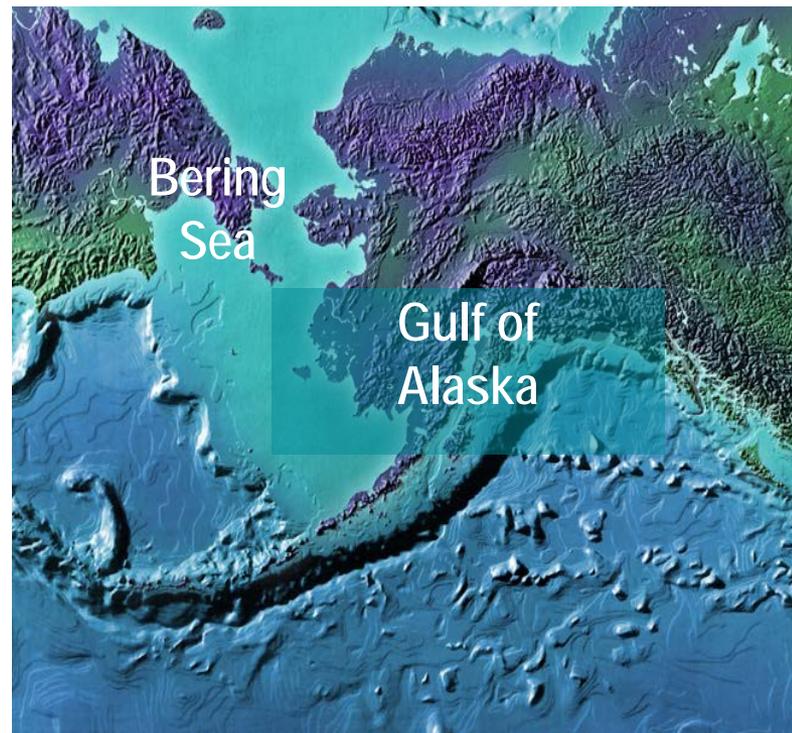


# NPCREP Mission:

## Understand climate impacts and ecosystem responses

### GOALS:

- *Prevent collapse* of commercial fisheries and sustain optimum yields
- *Protect species* and reduce economic impacts of natural climate fluctuations
- *Develop indices* of climate and ecosystem status
- *Forecast* extreme events



# NPCREP Structure



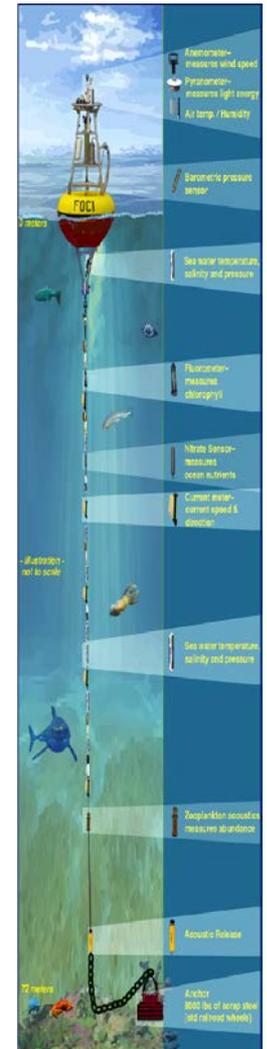
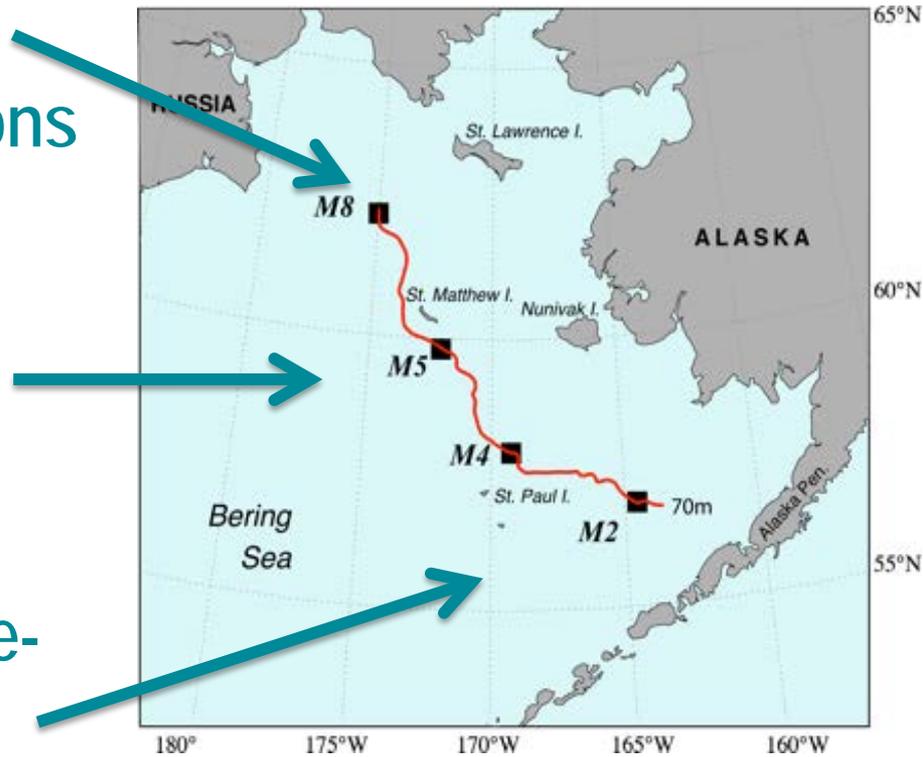
- Joint NMFS-OAR Program
- Managed by AFSC and PMEL:
  - Planning and execution of annual operations
  - Partnerships and leverage
- Supported by ST:
  - Program planning and evaluation
  - Budget initiatives
  - Promotion & Communications

# NPCREP Activities

1. Tracking Climate and Ocean Conditions

2. Ecosystem surveys & process research

3. Modeling Climate-related Impacts



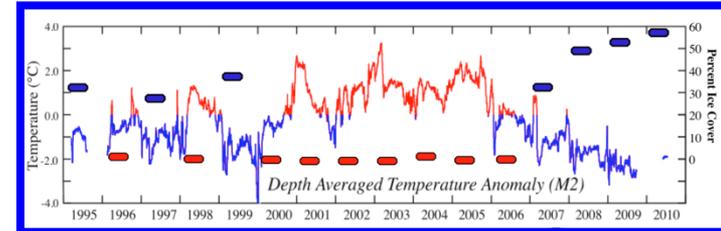
# BERING SEA POLLOCK

Quota reduced from 1.6 to 0.8 million tons



Council adopts SSC recommendation to reduce pollock harvest

5



Science and Statistical Committee (SSC) receives warning and recommends harvest reductions

4



2005 temperature and zooplankton data show unfavorable ocean conditions for recruitment

1



Help?



NMFS warnings of poor environmental conditions reported in assessments

3

Stock assessment model reveals low/declining recruitment

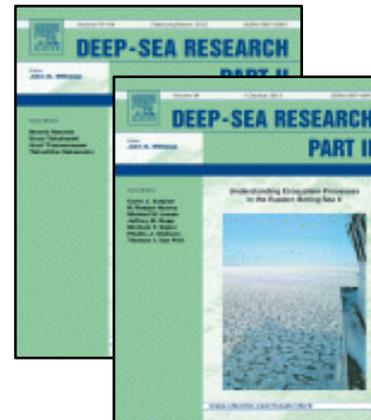
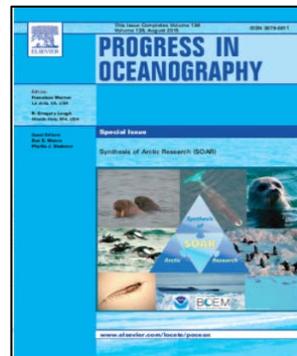
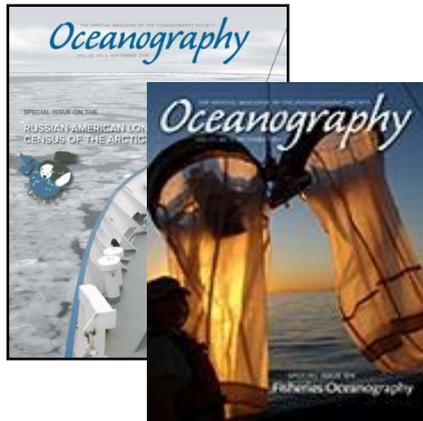
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# Products and Results

- Over 400 publications
- Vital observing system
- Foundation for ecosystem assessments
- Trusted source of information
- Used for decision making by NPFMC and industry
- *Model for other regions*



# Fish Stock Climate Vulnerability Assessments



# Fish Stock Climate Vulnerability Assessments



## Species Vulnerability

**Cross NOAA  
Collaboration  
critical**

### Sensitivity

- Habitat Specificity
- Prey Specificity
- Sensitivity to Ocean Acidification
- Sensitivity to Temperature
- Stock Size/Status
- Other Stressors
- Adult Mobility
- Spawning Cycle
- Complexity in Reproductive Strategy
- Early Life History Survival and Settlement Requirements
- Population Growth Rate
- Dispersal of Early Life Stages

### Exposure

- Sea surface temperature\*
- Air temperature\*
- Salinity\*
- Ocean acidification (pH)\*
- Precipitation\*
- Currents\*\*
- Sea level rise\*\*

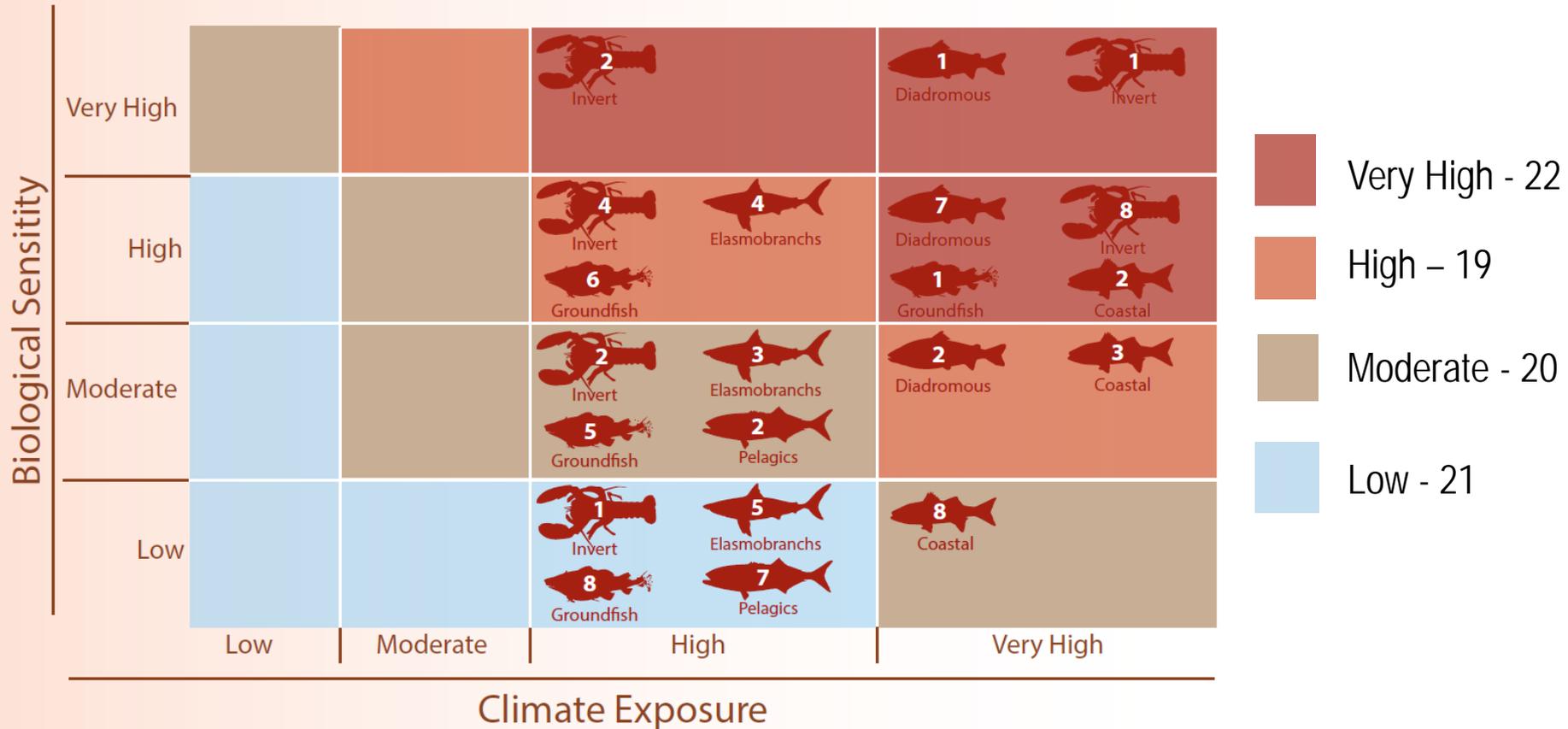
*\*modelled results (mean & variance)*

*\*\*written description only*

# What Are the Results?



## Relative Vulnerability

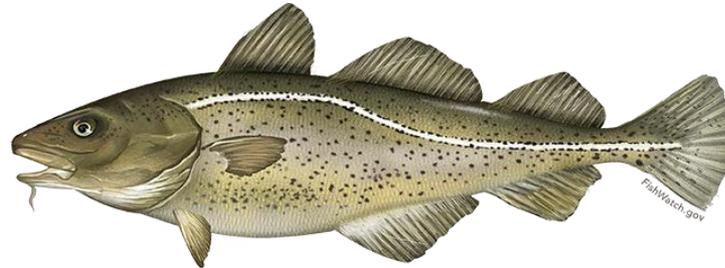


82 fish and invertebrate species from Northeast U.S. Shelf Ecosystem



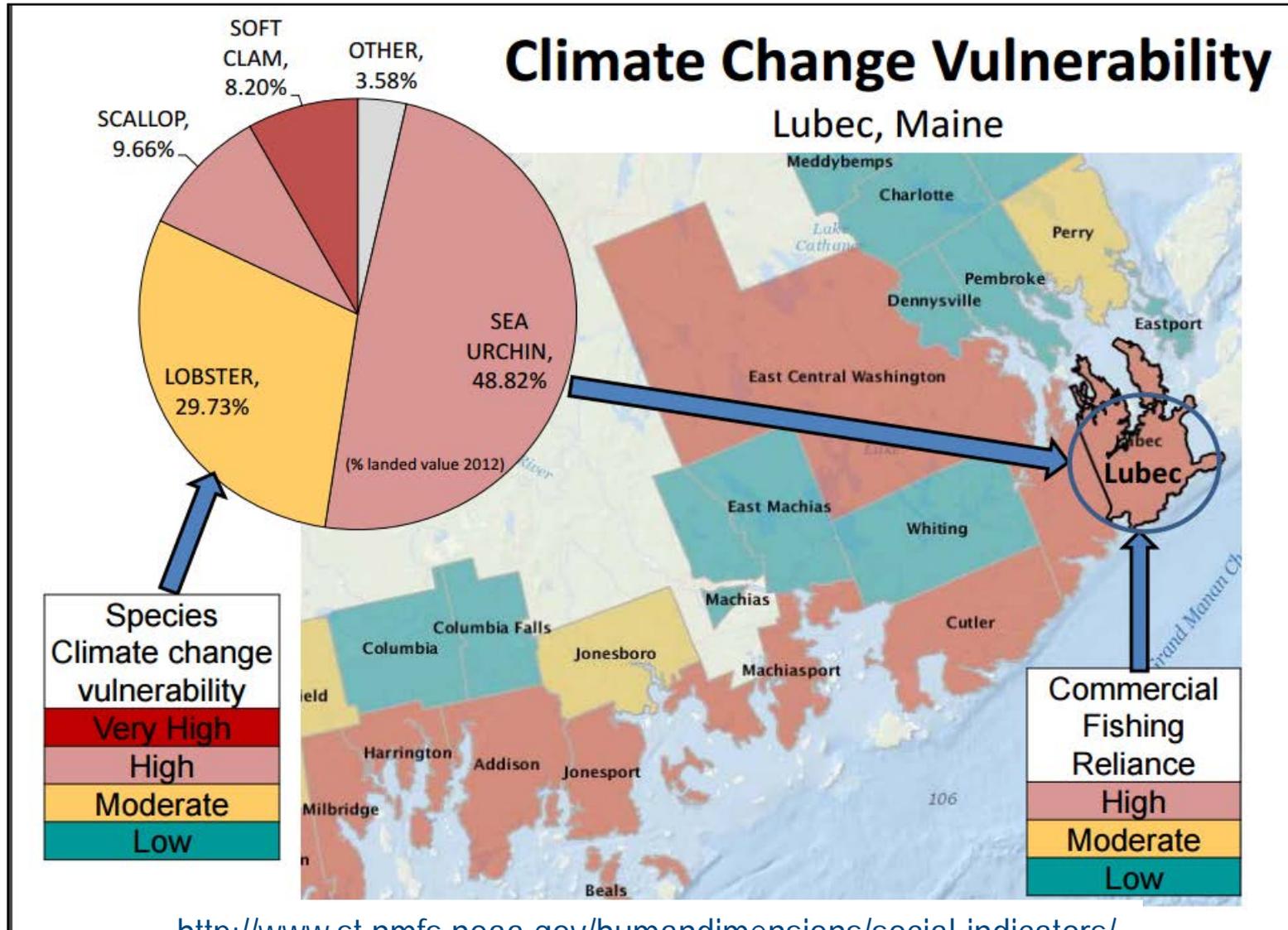
# Example of Species Specific Results

Atlantic Cod:



1. Overall Vulnerability to changes in productivity: **Moderate**
2. Propensity for changes in distribution: **High**
3. Overall Directional Change Score: **Negative**
4. Species Narrative: **2-3 pages summarizing results and current understanding of climate effects on Atlantic Cod**

# Multiple Indicators of Fishing Community Vulnerability



<http://www.st.nmfs.noaa.gov/humandimensions/social-indicators/>

# Next Steps



## 1. Expand Fish Stock Climate Vulnerability Assessments

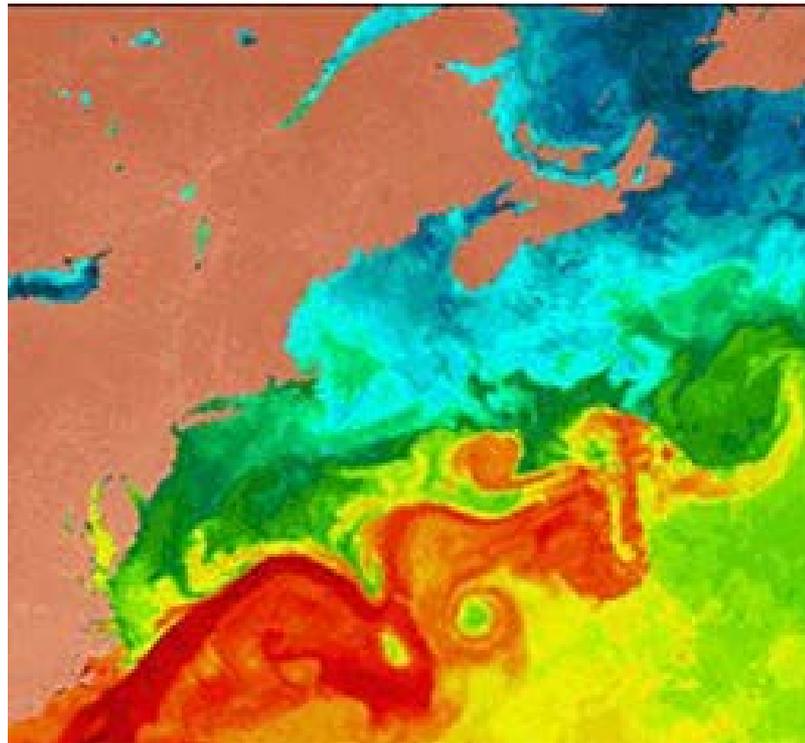
2016 - West Coast, Bering Sea

2017 – Pacific Islands, Southeast

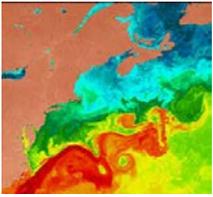
## 2. Expand Fishing Community Vulnerability Assessments



# NMFS-OAR Climate and Fisheries Research Program

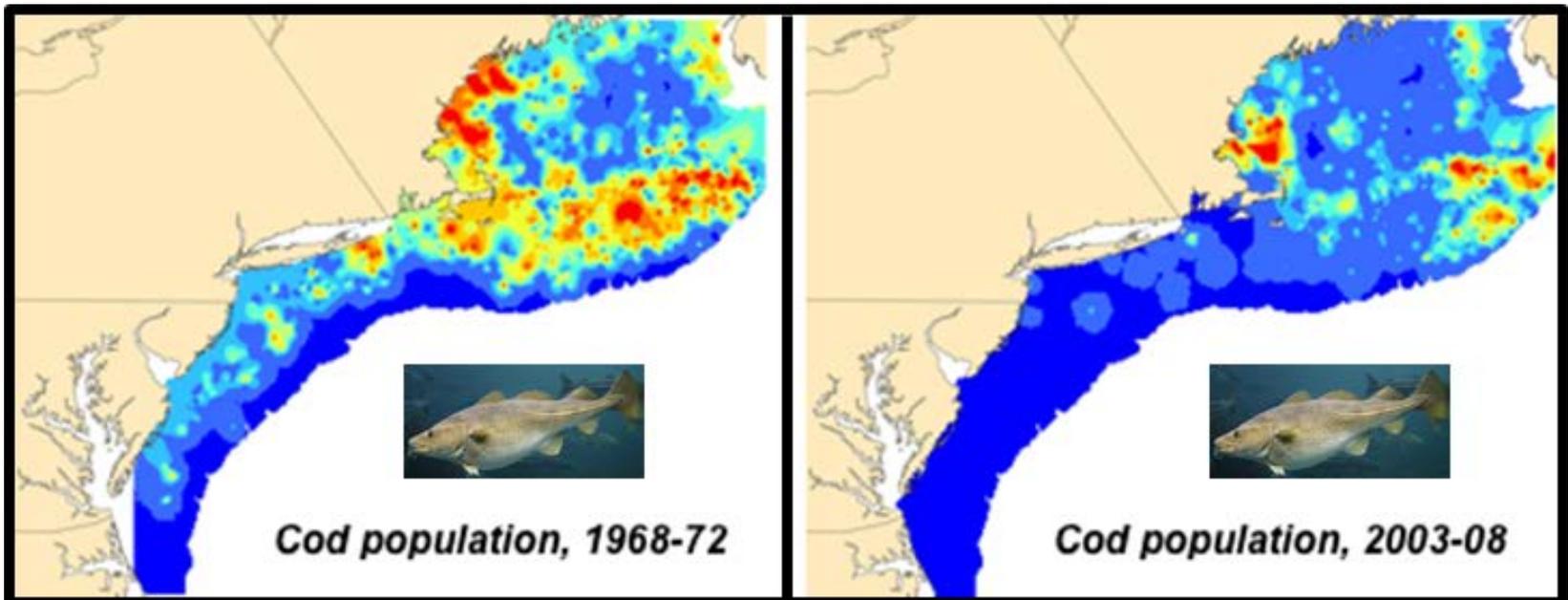


# Climate and Fisheries Research Program



- Established in 2014
- Joint OAR-NMFS Program
- External competitive research
- Understand climate impacts on fish stocks, fisheries and fishing communities
- FY15-17: 7 Northeast projects (\$5 M)
- FY17-19: Call for proposals (\$6.6 M)
- Coordination with FATE etc

# OCEANADAPT: Tracking Changes in the distribution of US fish stocks

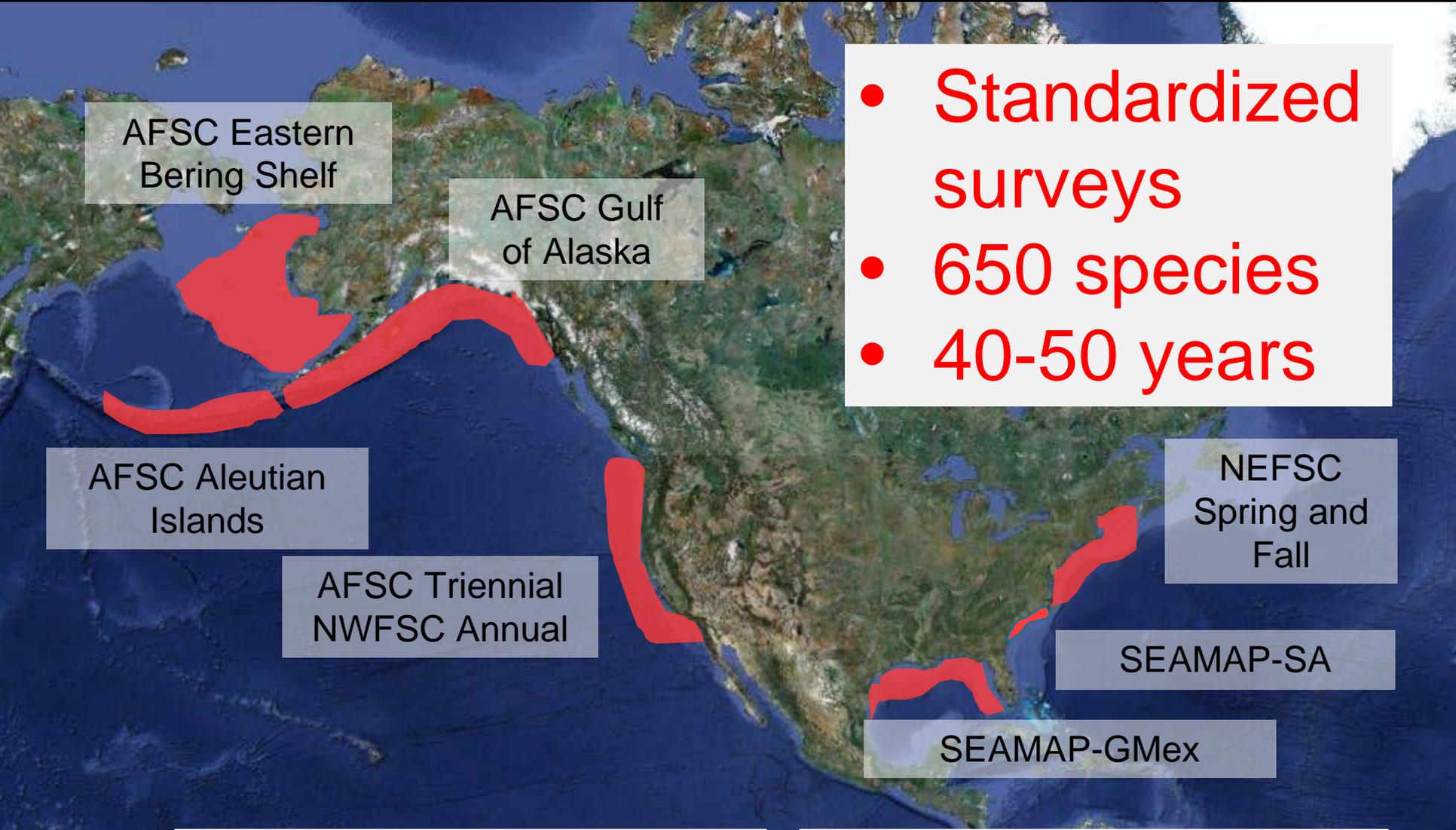


# OCEANADAPT

Web-based tool to:

- Increase awareness
- Increase access to data
- Increase understanding
- Improve responses

# Data From Regional Bottom Trawl Surveys



- Standardized surveys
- 650 species
- 40-50 years



# OceanAdapt

HOME

NATIONAL DATA

REGIONAL DATA

DOWNLOAD DATA

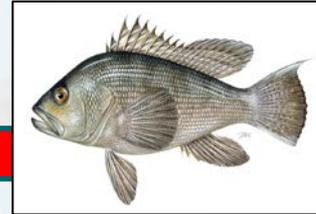
ABOUT

These graphs allow you to explore data on the distribution of marine animals in the U.S. For an individual species, the lines show the average latitude and depth through time for the center of its distribution. If all species in a region are selected, the lines show the average change across those species' distributions as compared to the initial year.

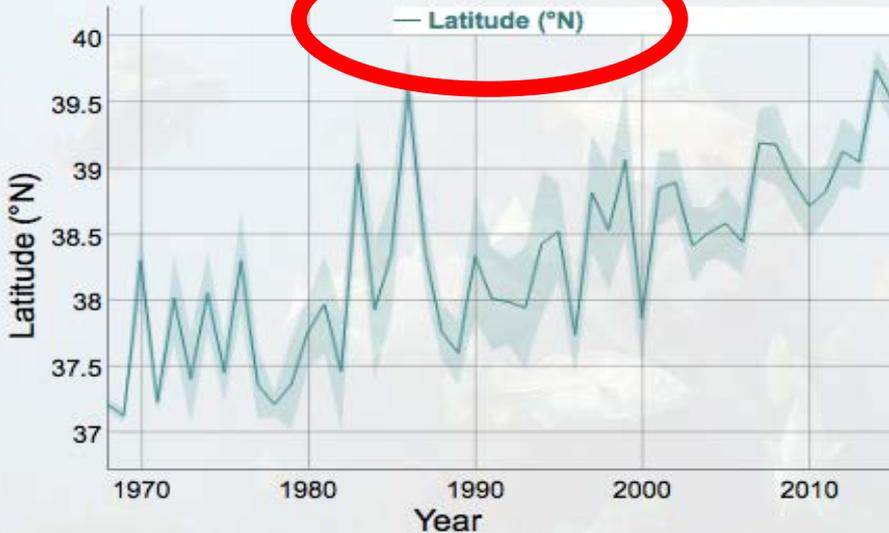
SELECT A REGION:

SHOW:  COMMON SPECIES NAME  SCIENTIFIC SPECIES NAME

SELECT A SPECIES (OPTIONAL):



VIEWS: **BOTH** | CHANGE IN LATITUDE | CHANGE IN DEPTH



Click and drag to zoom. Double click to zoom out.

DOWNLOAD LATITUDE & DEPTH DATA

DIRECT LINK TO GRAPH IN NEW TAB



# OCEANADAPT

## Next Steps:

- Annual updates
- Add SE region
- Add Animations
- Show Applications
- Add Projected shifts

# Climate and Protected Species Tools



# Climate and Protected Resources Tools

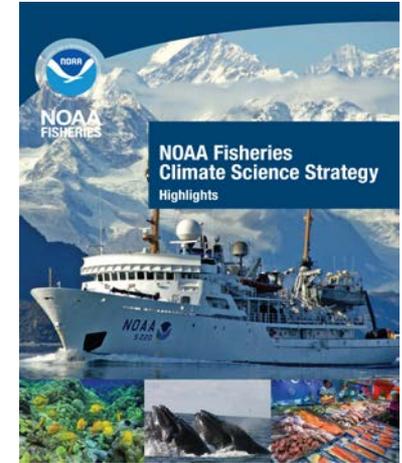


- ST & PR Director's Climate Initiative (2014)
- Tools to incorporate climate information into ESA activities.
- Projects (@ \$150 K/yr):
  - ESA Section 7 Climate Toolkit
  - Fish Passage Guidance (Climate Update)
  - PR Climate Vulnerability Assessment

# What we do - Summary

## Leading Science (10% funding)

- Shaped national adaptation strategies
- Shaped US National Climate Assessment
- Shaped NMFS science and policy priorities



## Supporting Science (90% funding)

- Advanced climate-ready fisheries in the Bering Sea
- Advanced Fish Stock Climate Vulnerability Assessments
- Launched NMFS-OAR Climate and Fisheries Research Program
- Delivered strategic science and tools (OCEANADAPT, Protected Species Tools)



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# Strengths

- Increased focus on climate and ocean science
- Elevated priority within NMFS, NOAA
- Built partnerships
- Leveraged resources
- Delivered priority science and tools
- Products valued and used

# Challenges & Opportunities

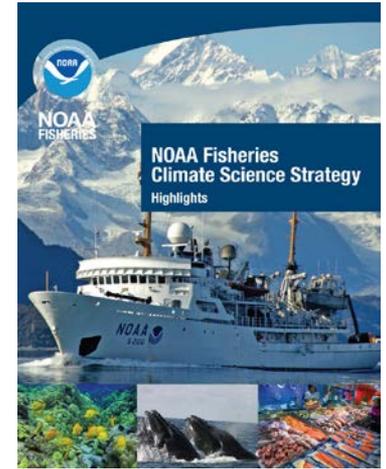
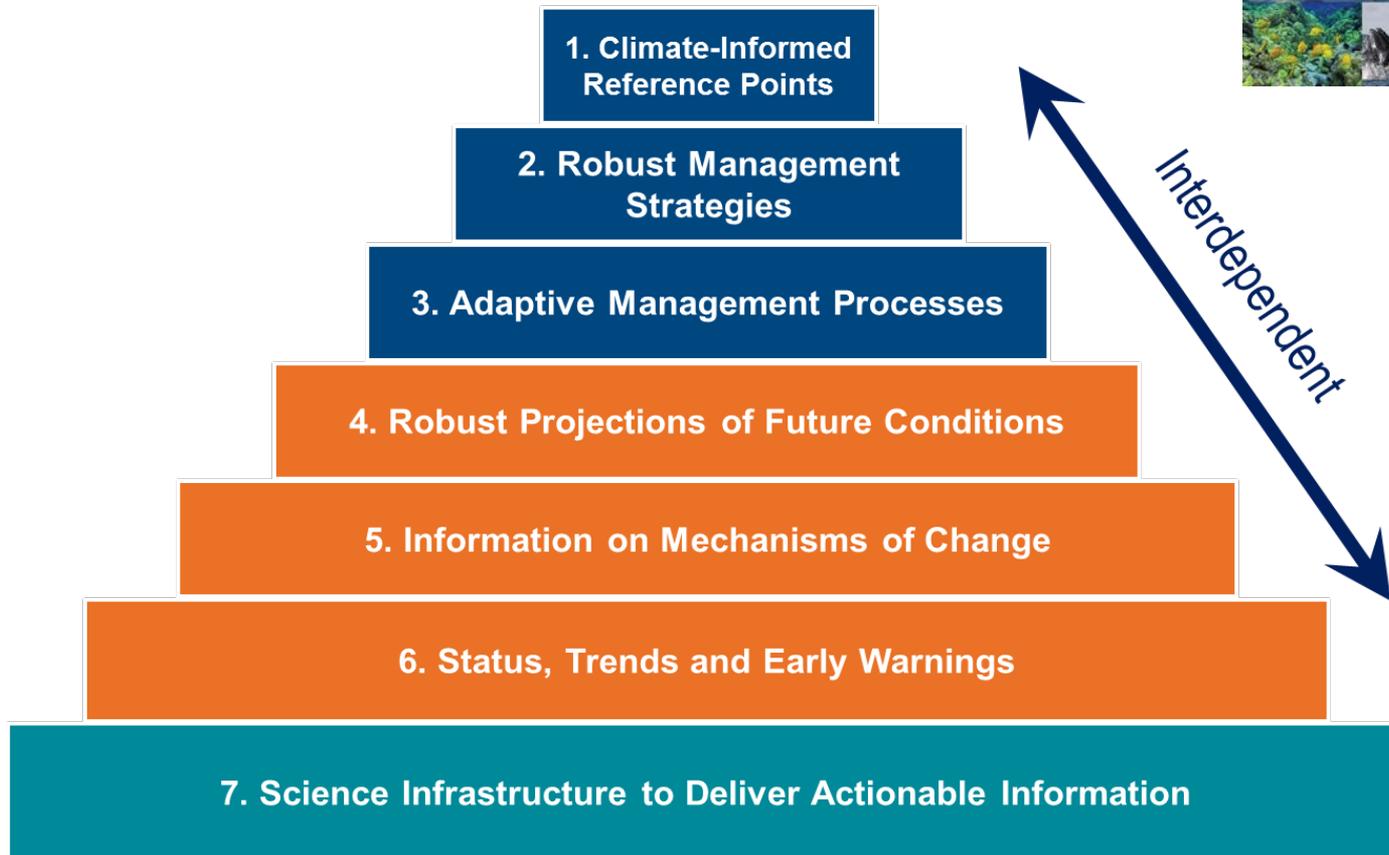
- Increasing demands for science & tools
  - Few new resources
  - Barriers to use of climate information in management
  - Coordination and leverage with other programs
- 
- Increasing demands for science & tools
  - Strong leadership support for action
  - NCSS Regional Action Plans to guide actions
  - Opportunities for collaboration (NMFS, NOAA, fed, state and academic partners)
  - Increasing focus on climate and oceans (IPCC, NCA)

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# Future Directions

## *Support implementation of NCSS Regional Action Plans*



# ToR 1: Goals, Objectives & Structure?

## Goal:

Increase the production, delivery and use of climate-related information to fulfill NMFS mandates.

## Objectives:

Lead and support climate-related science

## Structure:

NMFS, NOAA and inter-agency networks

## ToR 2: Effective Integration and Collaboration?

ST Programs:	<i>Joint project with FATE, EASA</i>
HQ Programs:	<i>ST-SF Vuln Assessments</i>
Science Centers:	<i>Priorities and Projects (NCSS)</i>
Regional Offices:	<i>Priorities and Projects</i>
NOAA Offices:	<i>Co-lead Research Program</i>
Other Agencies:	<i>Co-lead NFWPCA Strategy</i>
International:	<i>Co-lead Symposia (SOTM)</i>
Non-govt:	<i>OCEANADAPT etc</i>

## ToR 3 and 4: Addressing NMFS Needs and Priorities?

- Active input from NMFS leadership
- Active engagement of NMFS Centers, Offices and partners on directions and strategies
- Input on nation-wide and regional priorities
- Facilitate internal and external partnerships
- Promote collaboration
- Leverage resources

# ToR 5: Effective Communication?

Increased public information on NMFS climate-related activities

- Launched climate web sites for ST and NMFS
- Promote announcements of NMFS climate-related science



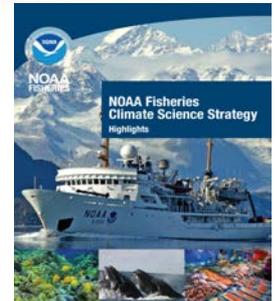
Increased internal NMFS communications

- NMFS Climate network for information exchange



Effective engagement with partners and the public

- Broad engagement in NMFS Climate Science Strategy
- Broad engagement in Regional Action Plans



Promote NMFS climate-related science internally and externally

- NOAA Climate Adaptation Team
- Interagency fora
- Congressional briefings



Thank You

[www.st.nmfs.noaa.gov/ecosystems/climate](http://www.st.nmfs.noaa.gov/ecosystems/climate)