Execution Focus Area

Sustaining Marine Resources in a Changing Climate

Ned Cyr, Roger Griffis (NMFS)
Krisa Arzayus (NESDIS)

The Challenge 1: Impacts and Risk

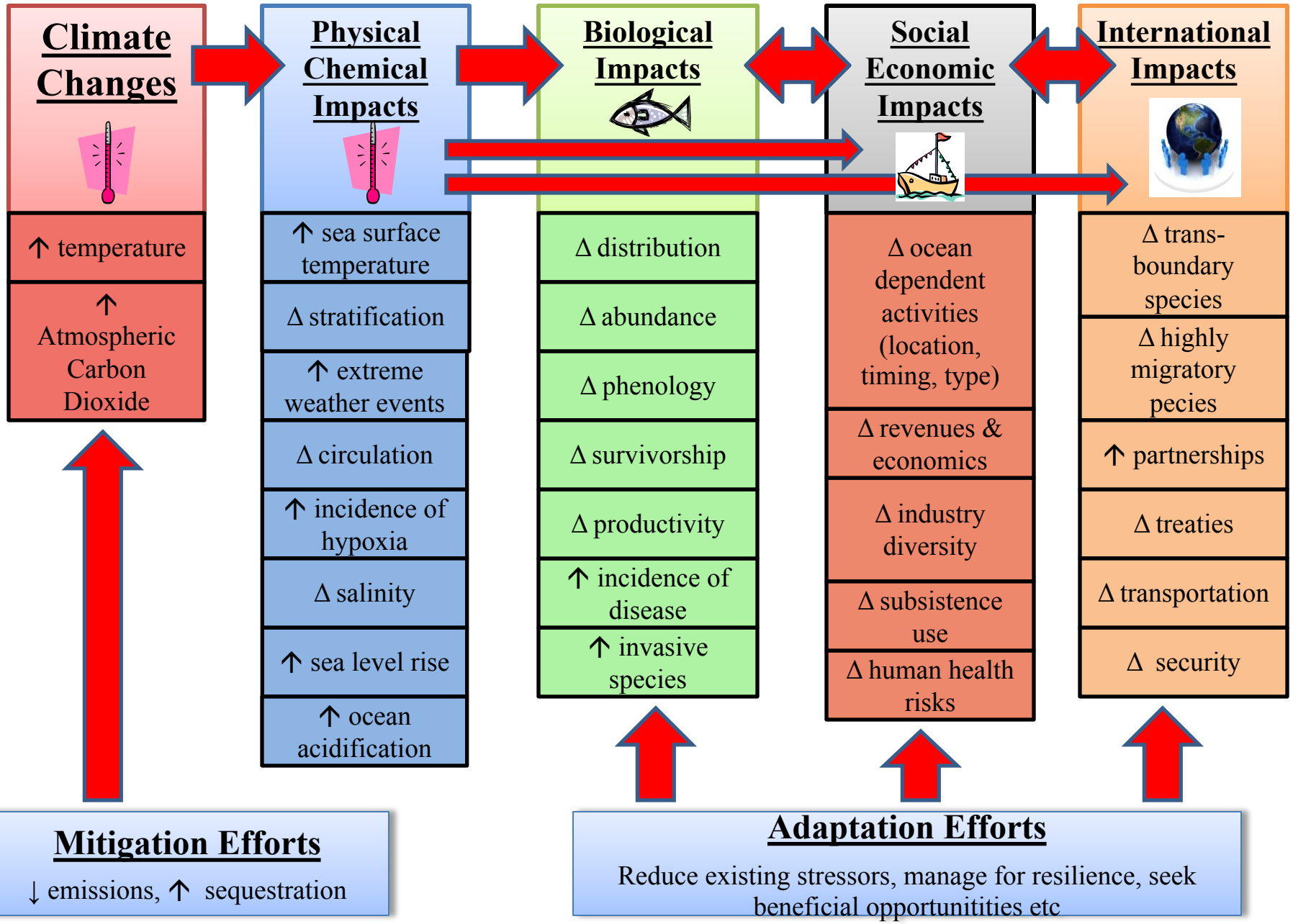
- **Climate change is already impacting marine ecosystems** and the communities & economies that depend on them.
- **These impacts are expected to increase.**
- **There is much at risk** domestically and internationally (food, jobs, revenue, human health, security, heritage etc).
  - Food: 1.5 billion people (world-wide)
  - Fisheries Jobs: 43.5 million (world-wide), 1.3 million (US)
  - Fisheries economies: $200 B in sales/income impacts (US)
  - Coastal economies: 60 % GDP (US)
  - Transportation: Shipping, commerce, safety
  - International relations and security issues

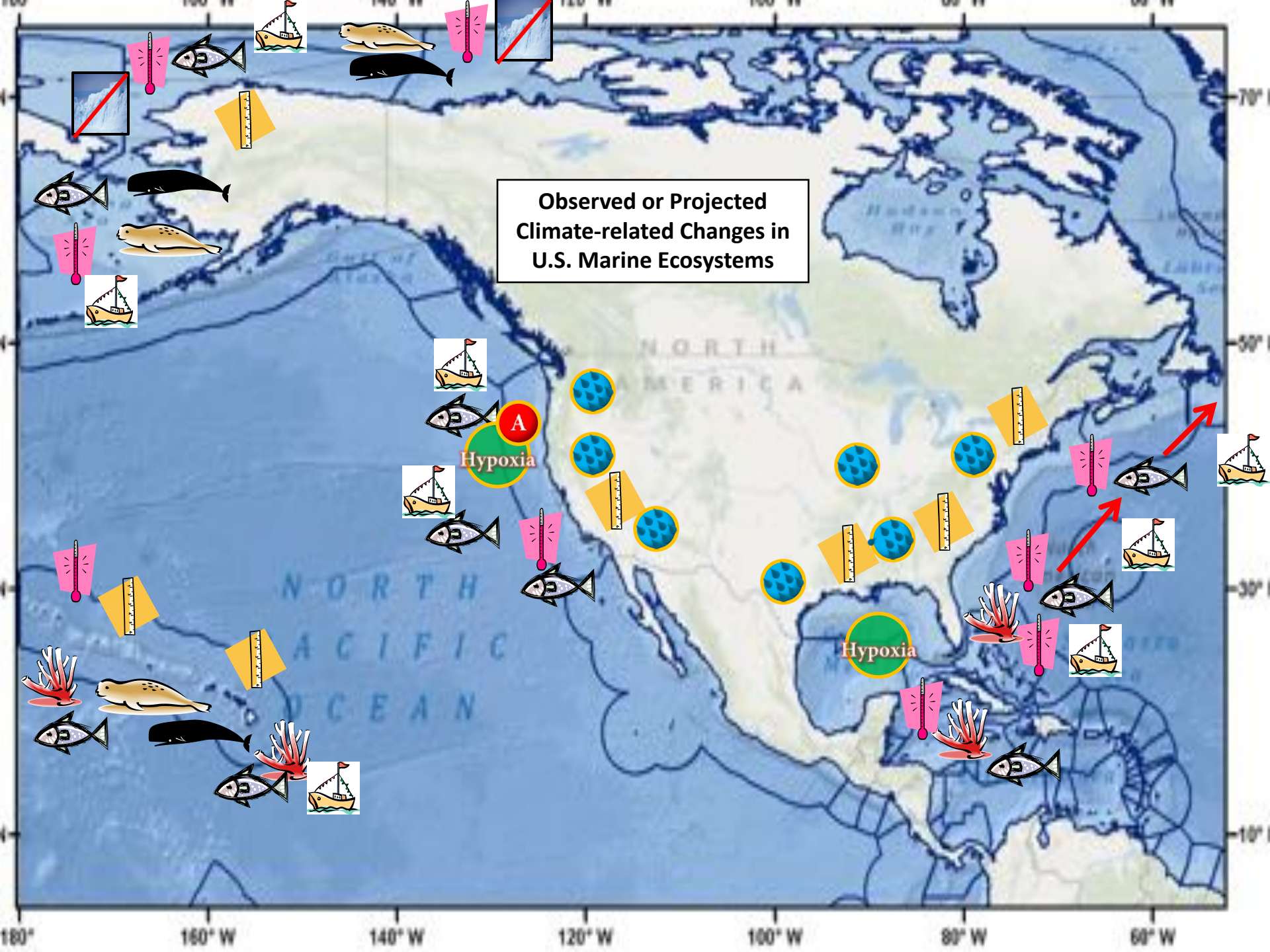
The Challenge 2: Growing Demand

- **Diverse audience for marine-climate products and services**
  - *Living marine resource scientists and managers*
    - Federal govt (NOAA, USFWS, USGS, EPA)
    - State govts (35 State Fish and Wildlife Agencies)
    - Indigenous govts (Tribal Fish and Wildlife Agencies)
    - Academic partners (NSF, Sea Grant, universities)
  - *Ocean use scientists and managers* (DOI, DOD, DOT, DHS-USCG)
  - *Ocean-dependent industries* (energy, aquaculture, fishing, tourism, shipping)
  - *Ocean-dependent communities & economies* (local, state, regional)

- **Increasing demand for *regional* products and services**
  - What has changed? Why has it changed?
  - **How will it change?** **When will it change?**
  - How prepare? How reduce impacts?

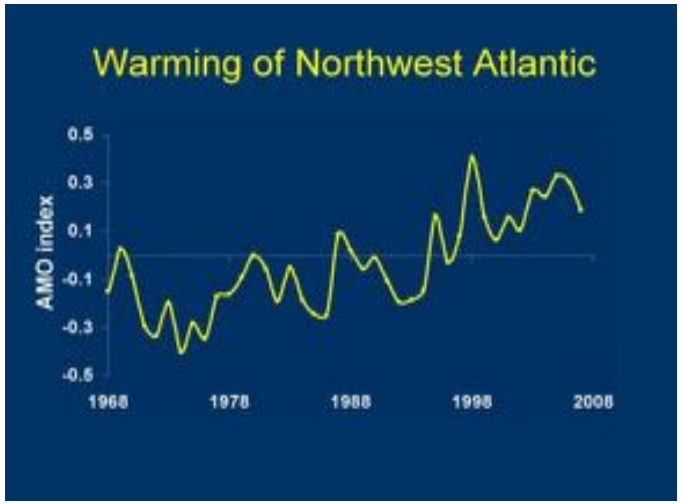
Impacts of Climate Change on Marine Ecosystems

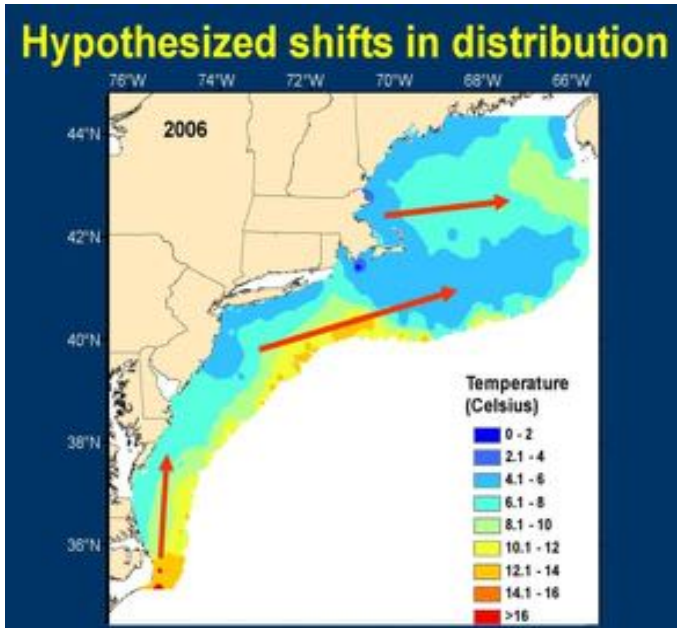



Observed or Projected
Climate-related Changes in
U.S. Marine Ecosystems
A
Hypoxia
Hypoxia
NORTH
AMERICA
NORTH
PACIFIC
OCEAN
180°
160° W
140° W
120° W
100° W
80° W
60° W
70°
50°
30°
10°

Shifting Fish Distributions with Warming Ocean Temperatures

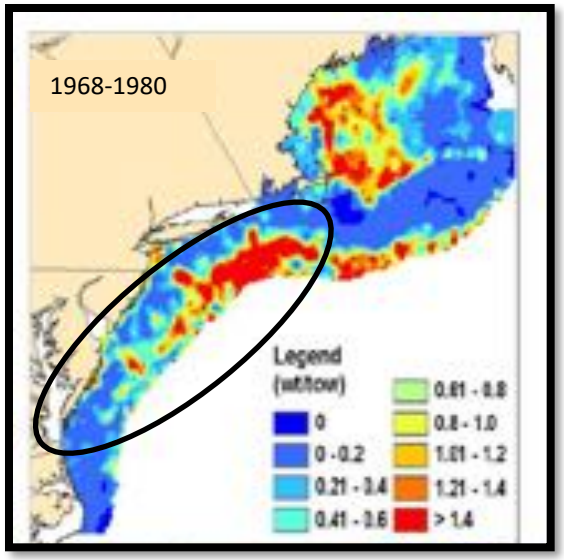
Eastern U.S. Waters (Cape Hatteras to Canadian Border)

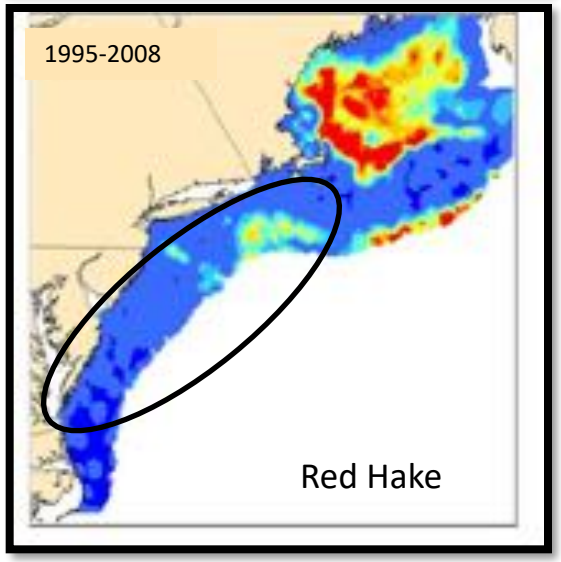




Over past 40 yrs:

- **60% major fish stocks have shifted** distributions poleward (1 mile yr^{-1}) and/or deeper (0.8 ft yr^{-1}).
- **Species shifting at different rates** (25-200 miles poleward)
- **Also changes in** abundance, phenology, species assemblages
- **Why changing?** Future changes?





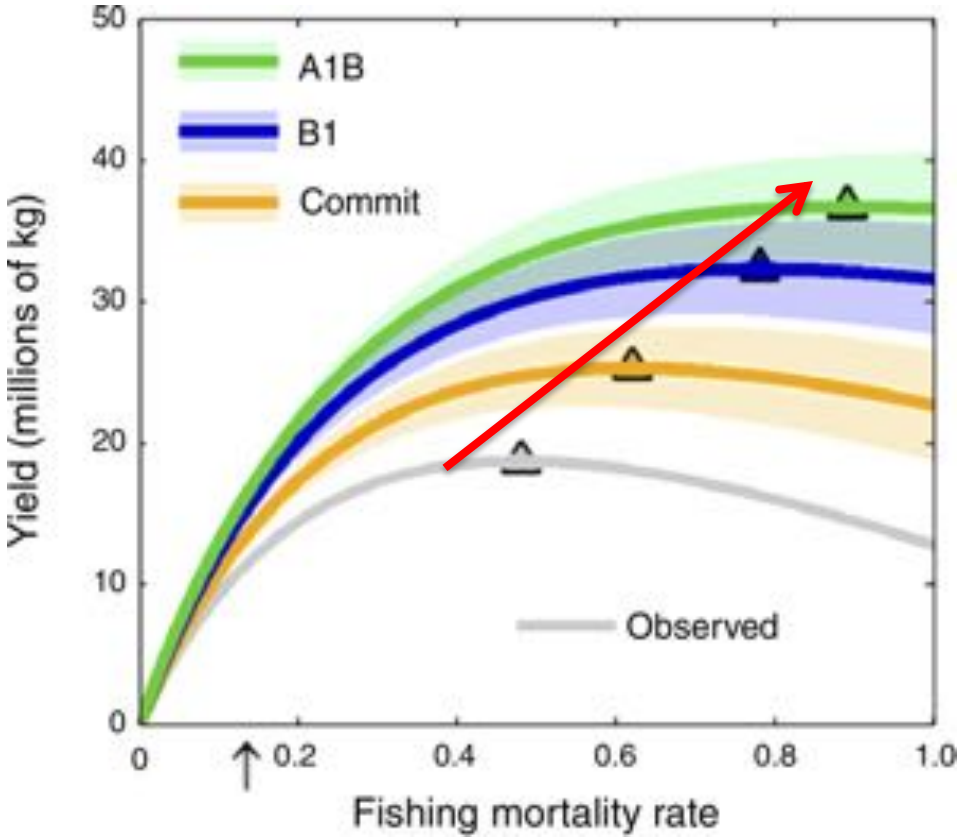
Source: Nye JA et al. (2009), Hare et al. (2010)

Will Some Species Thrive In A Changing Climate?

Projected Increase in Atlantic Croaker Populations

PROJECTIONS:

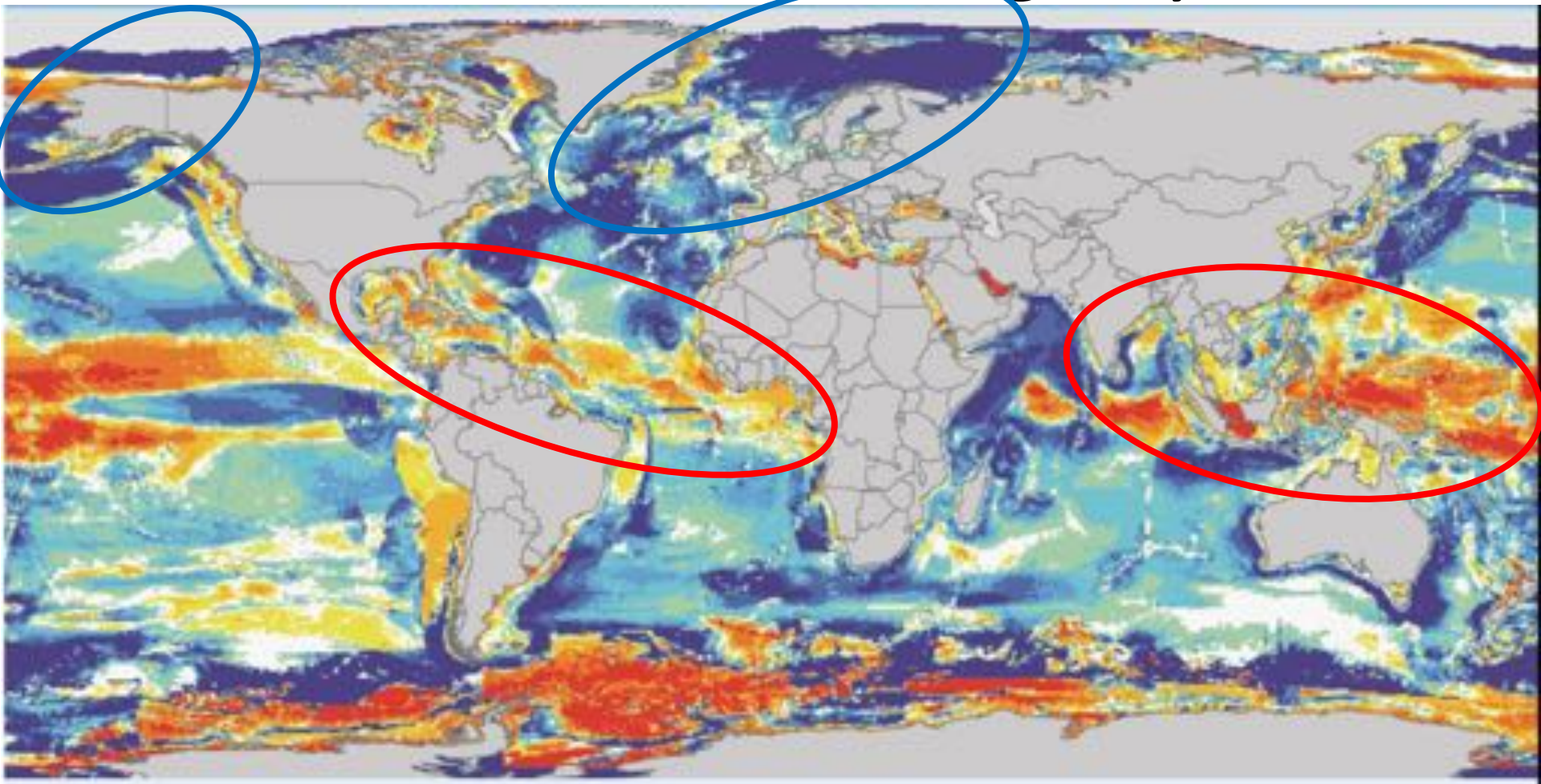
- Increased juvenile recruitment.
- 50-100 km northward shift in distribution.
- 60-100% increased biomass.
- 30-100% increased maximum sustainable yield.
- Potential increased fisheries?



Triangles = fishing rates at maximum sustainable yields (FMSY) .

From Hare et al 2010.

How will fish catch change by 2100?

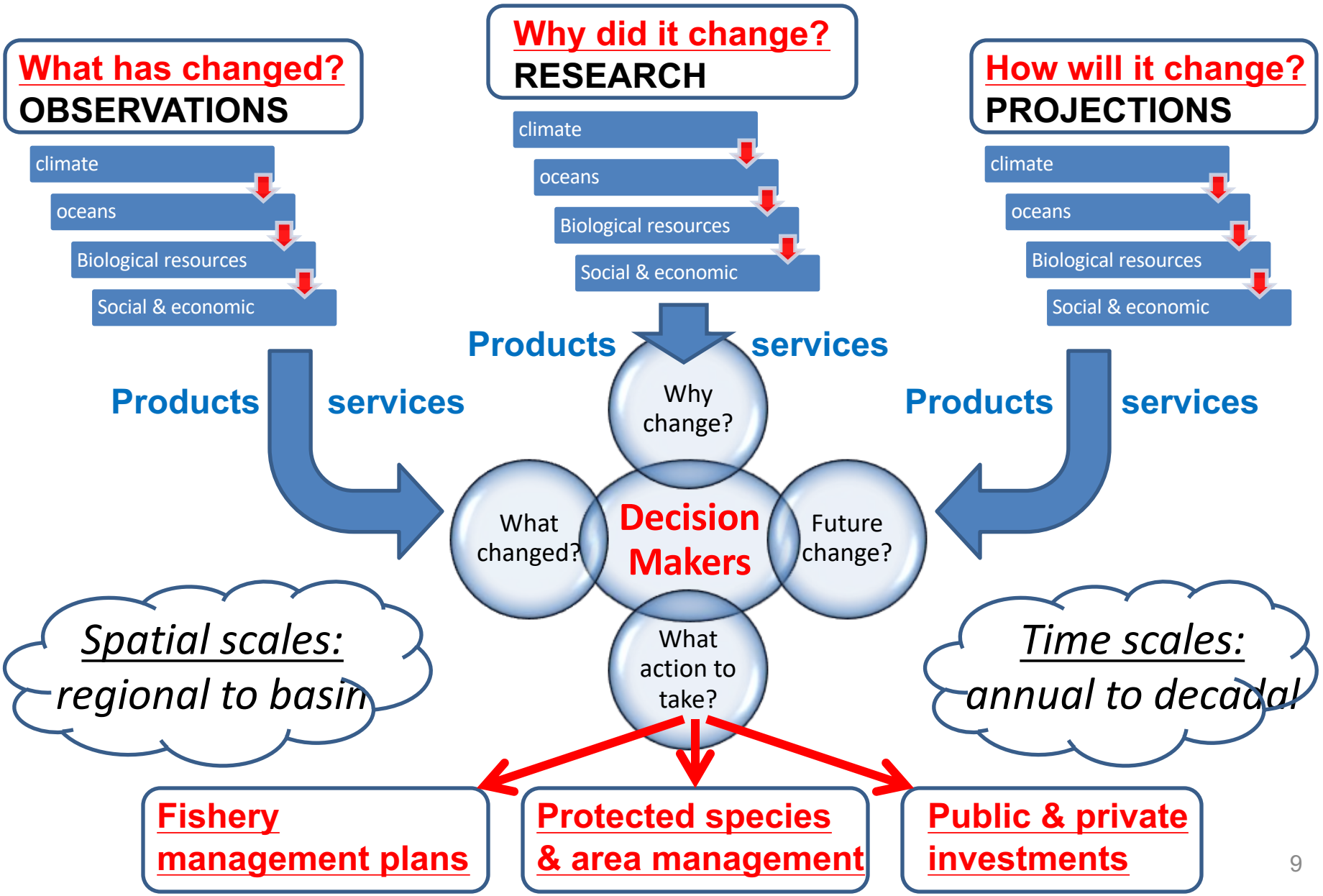


Change in Catch Potential (% relative to 2005)

< (-50)	(-31) – (-15)	(-6) – 5	16 – 30	51 – 100
(-50) – (-30)	(-16) – (-5)	6 – 15	31 – 50	> 100

Cheung et al. 2009: Redistribution of Fish Catch by Climate Change. Global Change Biology

The Challenge 3: Lack of integrated products and services



Outline from the Vision and Strategy Document

Vision:

Marine resource managers and other decision-makers will have access to, and sufficient knowledge to apply, best available information to manage large marine ecosystems in a changing climate.

Strategy:

Build and sustain core set of products & services:

- coordinated observations,
- targeted research &
- integrated physical-biological models.

Key Accomplishments

1. **Delivering ocean data & products (Global Ocean Observing System):**
   - SST products based on satellite data and in-situ validation network.
   - Salinity data from Argo (to 2000m depth) to assess salinity variability.
   - Continuous high resolution regional observations from remote, moored and ship-board platforms (Bering Sea, Calif Current etc).
   - Growing ocean acidification observation network.

2. **Advancing assessments & projections:**
   - New modeling tools (e.g., Earth System Models, Cobalt)
   - Regional projections (Bering Sea, Calif Current, North Atlantic)
   - Rapid assessment protocol – fisheries climate vulnerability

3. **Building understanding and capacity:**
   - Targeted research on ocean-climate linkages (NMFS, OAR, NOS)
   - New support for application of climate info in marine management (COCA, RISA)
   - Needs Assessment (Climate Ready Marine Resource Management)

Focus Area Organization

Executive Working Group

- Director, NMFS/Science & Tech (Chair)
- Director, OAR/CPO
- Director, OAR/GFDL
- Director, OAR/ESRL
- Director, OAR/PMEL & AOML
- Director, NESDIS/NODC
- Director, NESDIS/NCDC
- Director, NWS/CPC
- Director, NOS/NCCOS

* PROPOSED

Project Lead

- Roger Griffis, NMFS/Science & Tech

Working Group

Advisory Group & external partners

Project Plan

Regional Pilots

Execution Agreements

Key Scientific and Technical Issues

- **What are the critical observing requirements** (physical, biogeochemical, etc) for early warnings and projections of climate impacts in marine systems?
- **What are the key physical, chemical and biological indicators** to track?
- **How integrate observations and modeling** with sufficient spatial and temporal resolution to enable skillful marine ecosystem predictions?
- **What are the best modeling tools/approaches** to provide regional scale projections of climate impacts on marine resources?
- **What changes & impacts have already happened?**
- **How well can we project climate impacts** on species or users?
- **What spatial and temporal resolution is most useful** to decision-makers – and can we deliver at these scales?
- **Can the resource management process incorporate and respond** to information on past and future climate impacts?

Discussion with CWG

1. **FOCUS AREA**: Regional projections of climate impacts on marine resources
2. **PRODUCT LINE**:
   - Impact assessments (to date)
   - Risk assessments (outlooks, projections)
   - Spatial scale? Temporal scale? Species? Format?
3. **ISSUES**:
   - Integrating efforts across NOAA
   - Integrating efforts with non-NOAA partners (e.g., other feds, academia, regional ocean observing systems, state agencies)
   - Engaging decision makers
   - Engaging ocean-dependent sectors, users
   - Leveraging federal, state and non-govt science enterprise

Backup

Managing Fisheries In Changing Climate

Bering Sea Pollock

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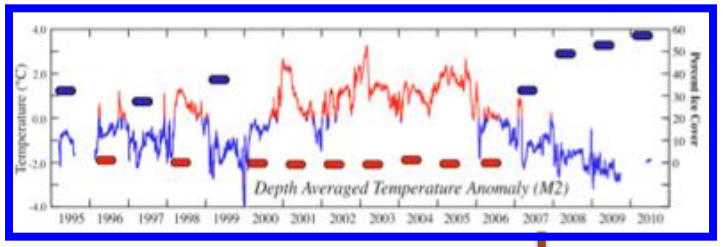
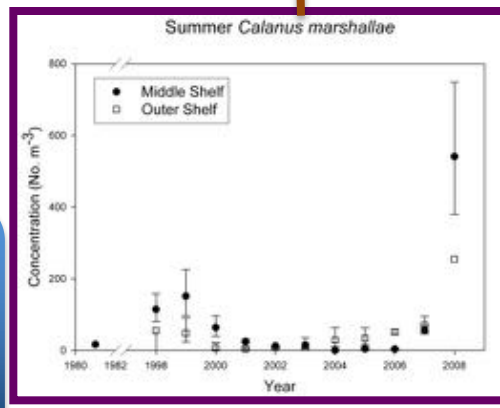
2005 moored temperature and zooplankton data reveal unfavorable ocean conditions for recruitment

1





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NPCREP

Help?

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Managing Fisheries In Changing Climate

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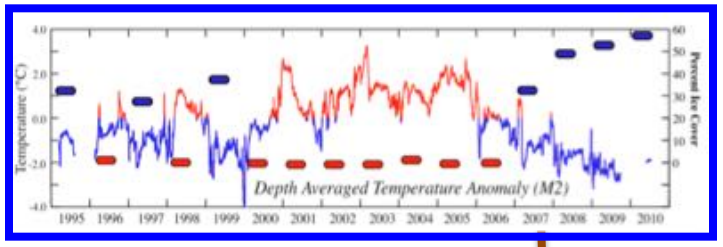

NPCREP - Mooring 2

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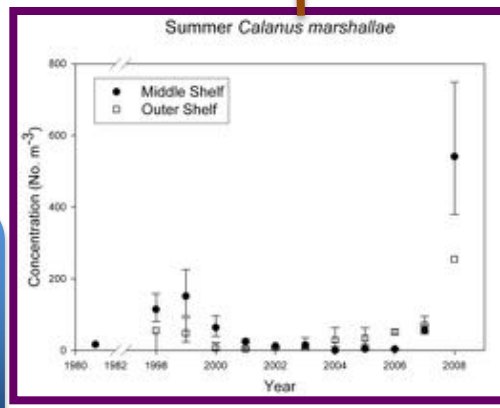

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Stock assessment model reveals low/declining recruitment

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Managing Fisheries In Changing Climate

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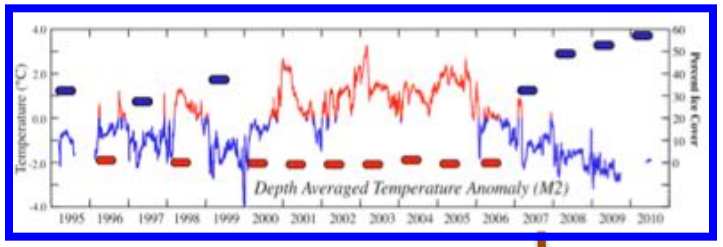

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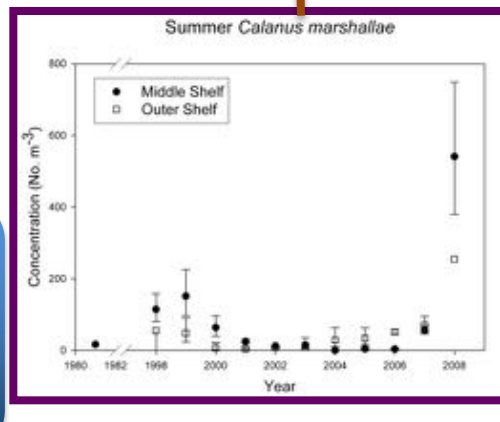

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NPCREP warning of poor environmental conditions reported in assessment documents

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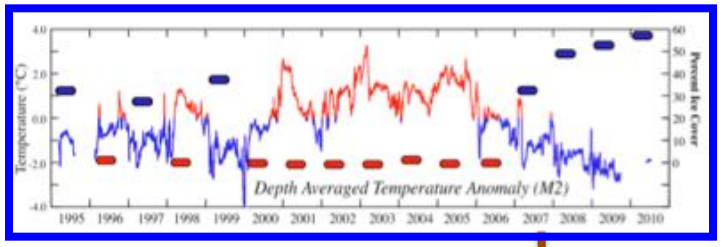

North Pacific Fishery Management Council

NPCREP

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Fishery Management Council's Science and Statistical Committee (SSC) receives warning

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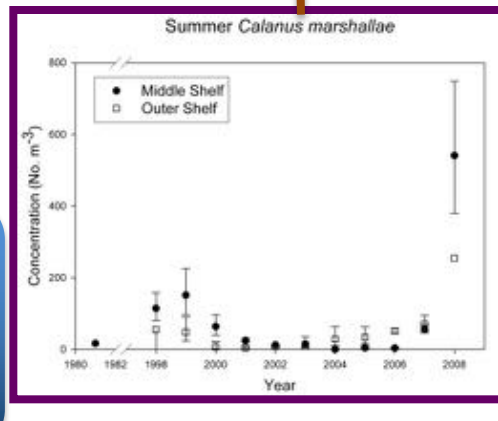
Help?



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NOAA

Managing Fisheries In Changing Climate

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North Pacific Fishery Management Council

Council adopts SSC recommendation to reduce pollock harvest based on assessment and continuation of poor (warm) environmental conditions

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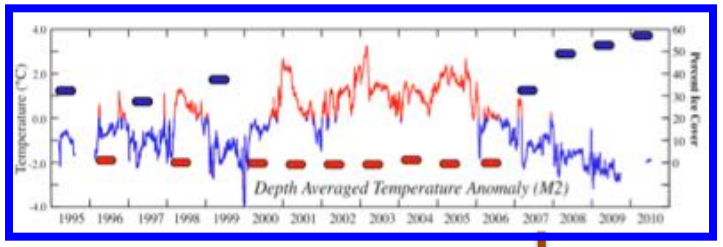

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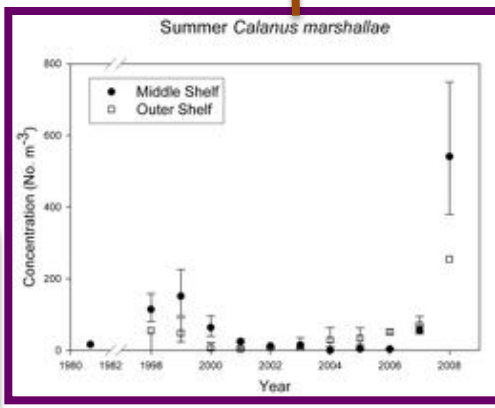

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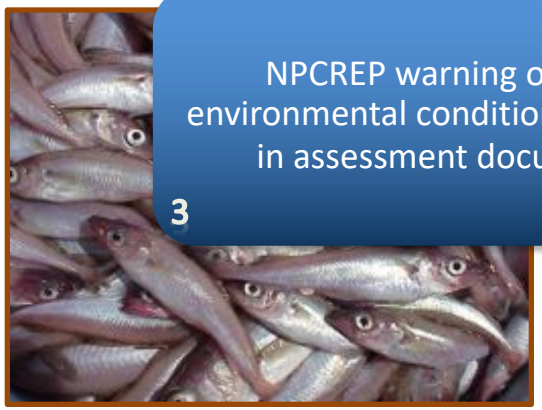

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Managing Fisheries In Changing Climate

Quota cut from 1.6 to 0.8 million tons

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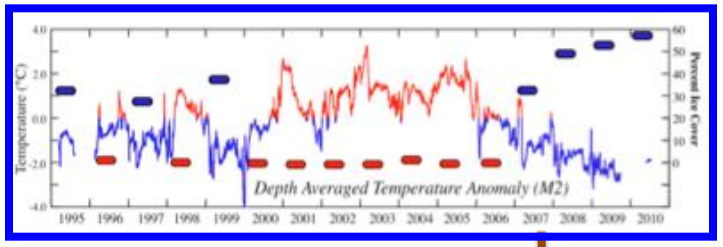

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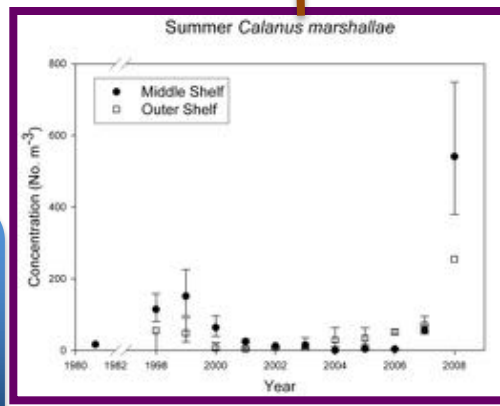

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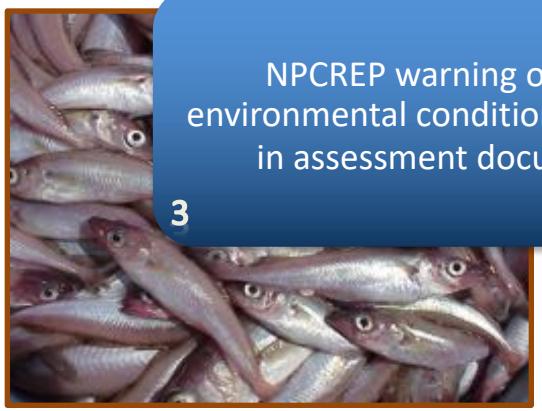

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