Accounting for Shifting Distributions and Changing Productivity in the Development of Scientific Advice for Fisheries Management

From Data Collection to Management Action

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Office of Science & Technology

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Washington, DC

Background & Motivation

Environment

Hundreds of fish species will be forced to migrate north to escape effects of climate change

'If you're fishing for black sea bass, and you have to travel 300 or 400 extra miles to do it, that's a real problem'

Josh Gabbatiss Science Correspondent | @josh_gabbatiss | Wednesday 16 May 2018 18:13 BST

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Global Fish Catch Could Plummet as Climate Change Takes Hold

Over the next two centuries, warming oceans could trap nutrients at the poles and starve out many of the world's fisheries, according to a recent study.

Jefferson Keith Moore | May 17, 2018 | Approx. 5 minutes

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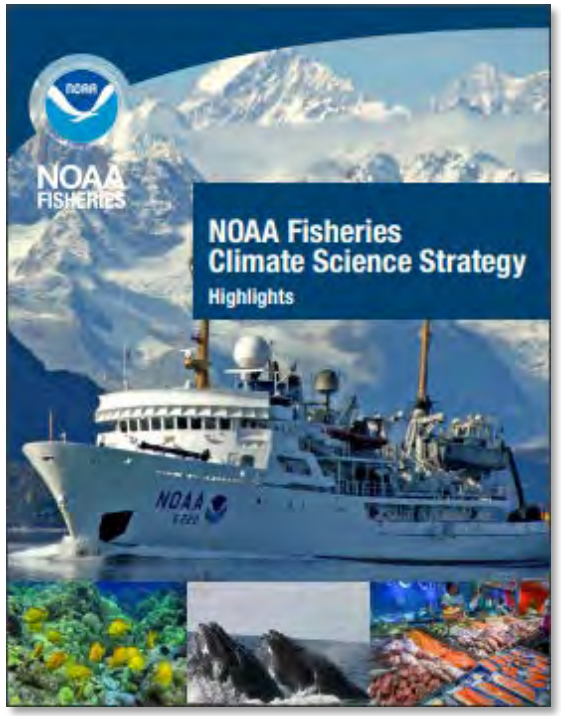

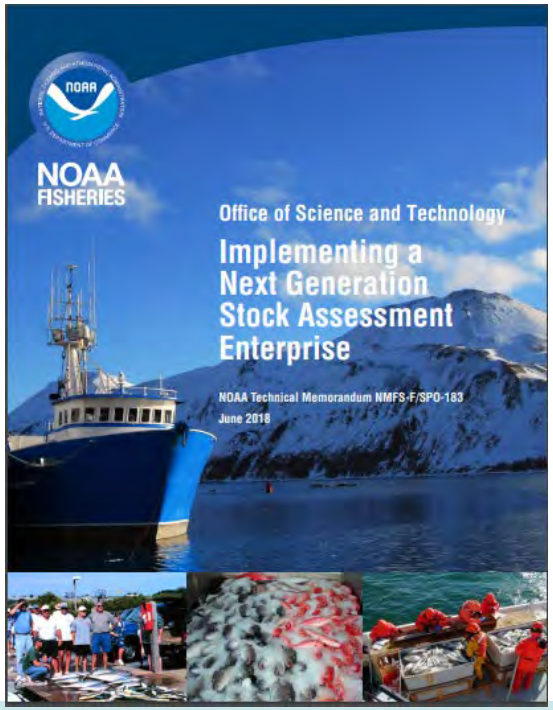

NMFSI 01-120-01 November 16, 2016

Department of Commerce · National Oceanic & Atmospheric Administration · National Marine Fisheries Service

NATIONAL MARINE FISHERIES SERVICE INSTRUCTION 01-120-01
November 17, 2016

Fisheries Management
Ecosystem-Based Fisheries Management Policy

NOAA FISHERIES ECOSYSTEM-BASED FISHERIES MANAGEMENT ROAD MAP

NOTICE: This publication is available at:
http://www.nmfs.noaa.gov/op/pds/index.html

OPR: F (J. Link) **Certified by:** F (J. Link)
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SUMMARY OF REVISIONS:

Objective

To develop specific, actionable recommendations for NOAA Fisheries to **increase its ability to incorporate environmental and climate information into the fisheries management process.**

Two Issues: (1) Shifting species distributions, and (2) changing stock and system productivity

Shifting Species Distributions

A potential permanent, or multi-decadal to centennial, shift in spatial distribution of a stock from its traditional region or habitat to a new region or habitat

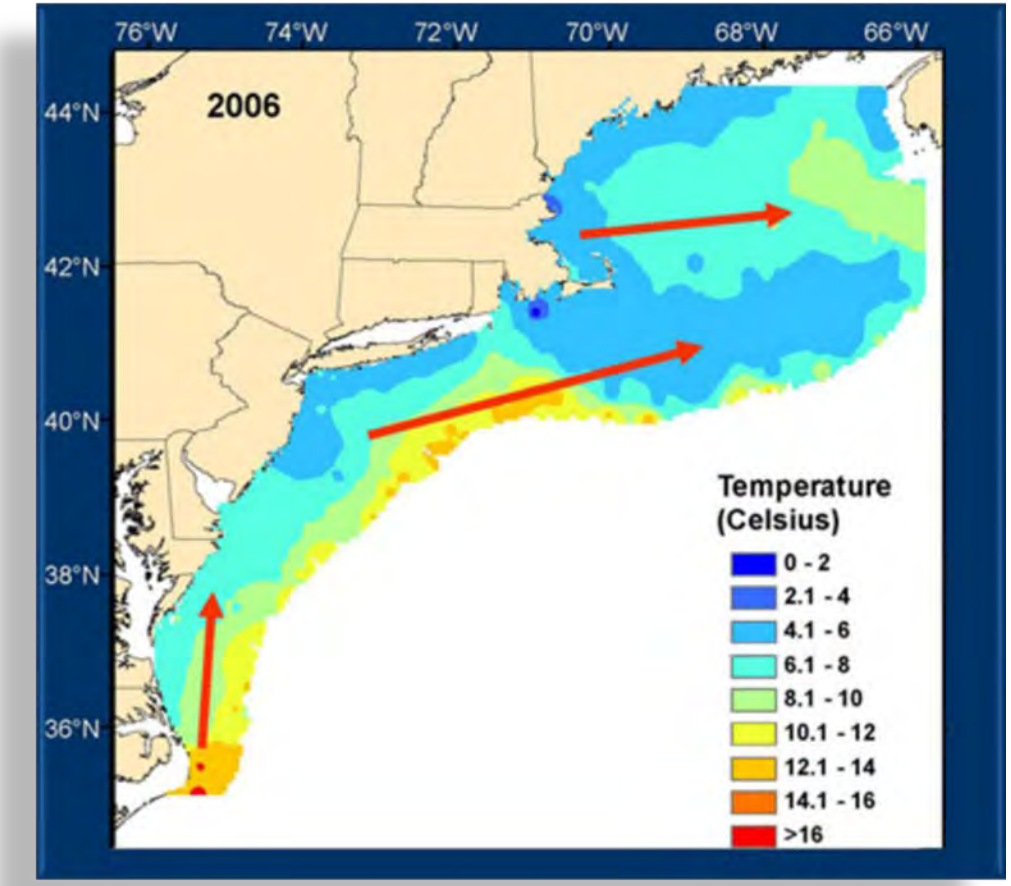


Figure credit: www.fisheries.noaa.gov (Janet Nye)

Shifting Species Distributions

- Misspecification of stock status
  - Apparent stock size within an area may be different then actual stock size
- Allocation and access issues as fish move across jurisdictional boundaries
- Traditional spatial management tools (time-area closures) my lose their effectiveness
- Changing species and gear interactions

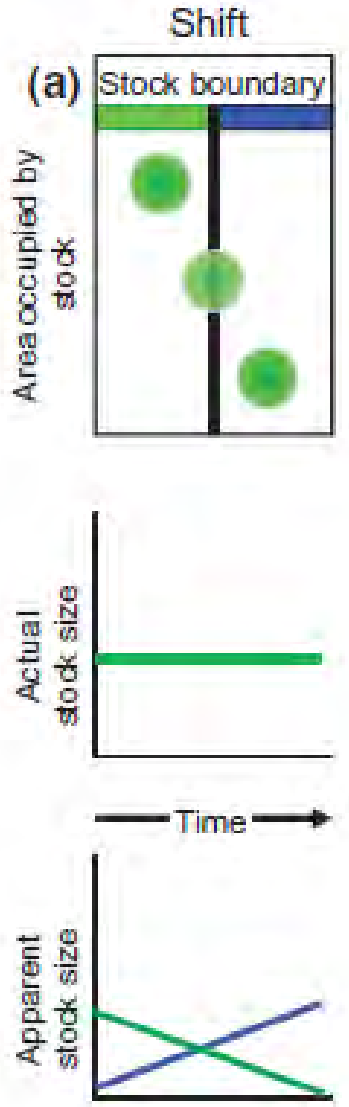


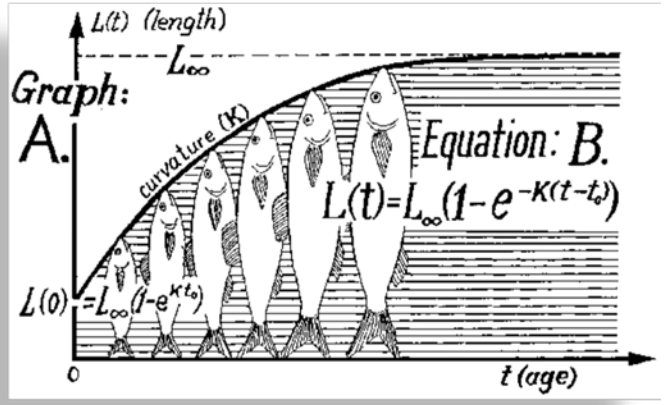
Figure modified from Link et al. 2011, Fish and Fisheries 12:461-469

Changing Stock & Ecosystem Productivity

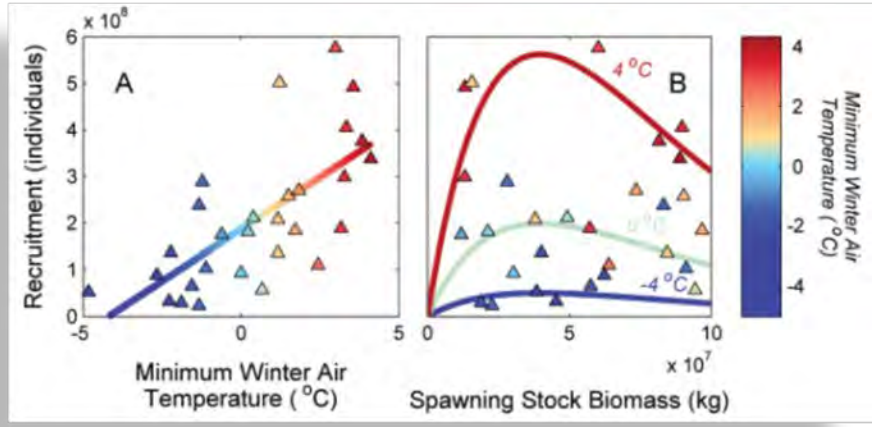
Productivity = total biomass of fish *or* amount of yield a stock can support

Climate change impacts on habitat productivity

CREDIT: THE OCEAN AGENCY / XL CATLIN SEAVIEW SURVEY



http://www.fao.org/docrep/W5449e/w5449e05.htm

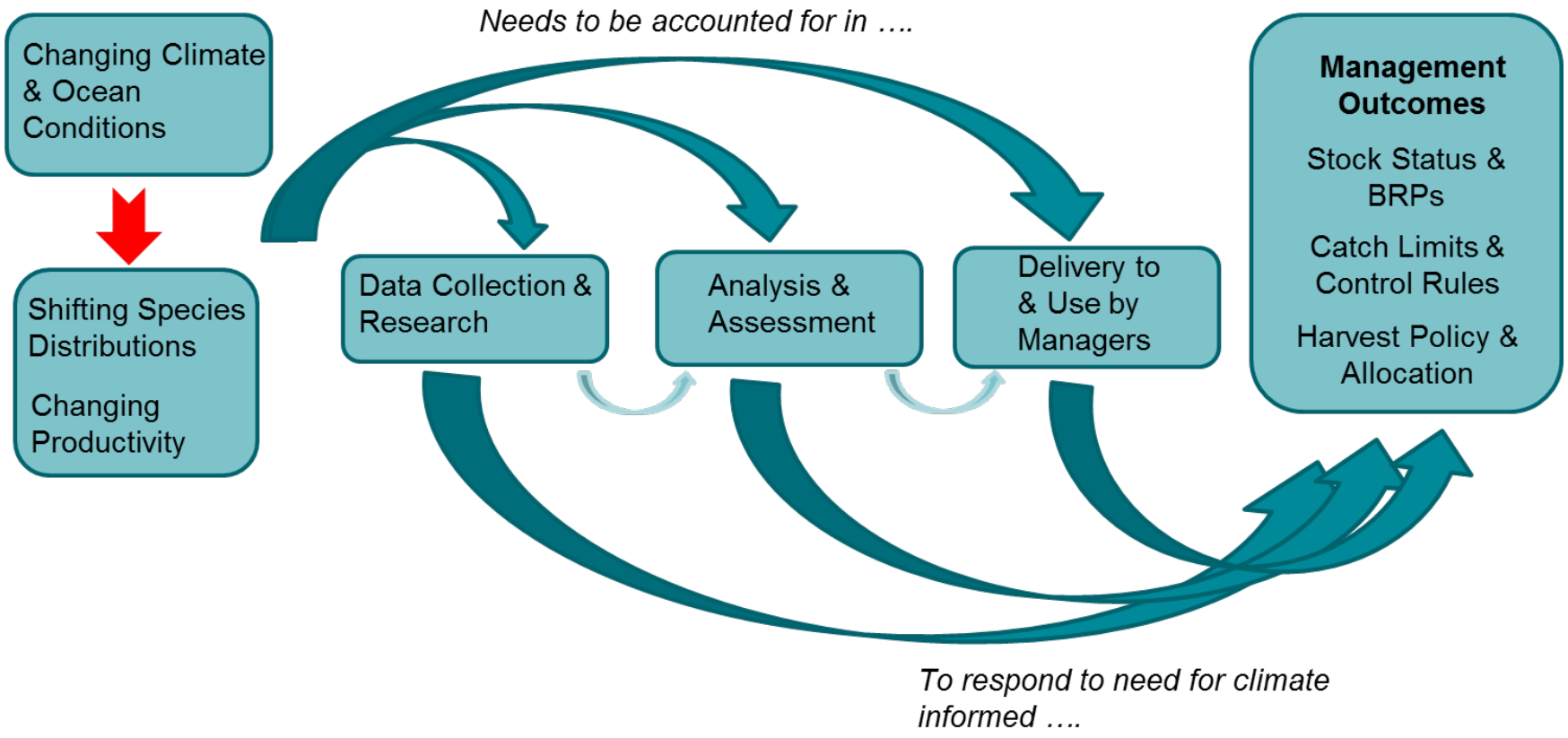


CREDIT: HARE ET AL, 2010

Climate change impacts on stock productivity (e.g. life-history parameters)

Science-to-management Process

- Current Practices (regional perspectives)
- Challenges
- Recommendations



Data Collection & Monitoring

- Improving detection capabilities
  - Expand the spatial and temporal coverage of surveys
    - Facilitate survey flexibility to track changes in species distributions
    - Engage and leverage capacity of fishermen and other stakeholder groups
  - Coordinate research and survey efforts across neighboring jurisdictions
- Understanding the underlying mechanisms
  - Design experiments to estimate catchability and selectivity in relation to ambient environmental and habitat conditions

http://www.fisherycouncils.org/

Analysis & Assessment

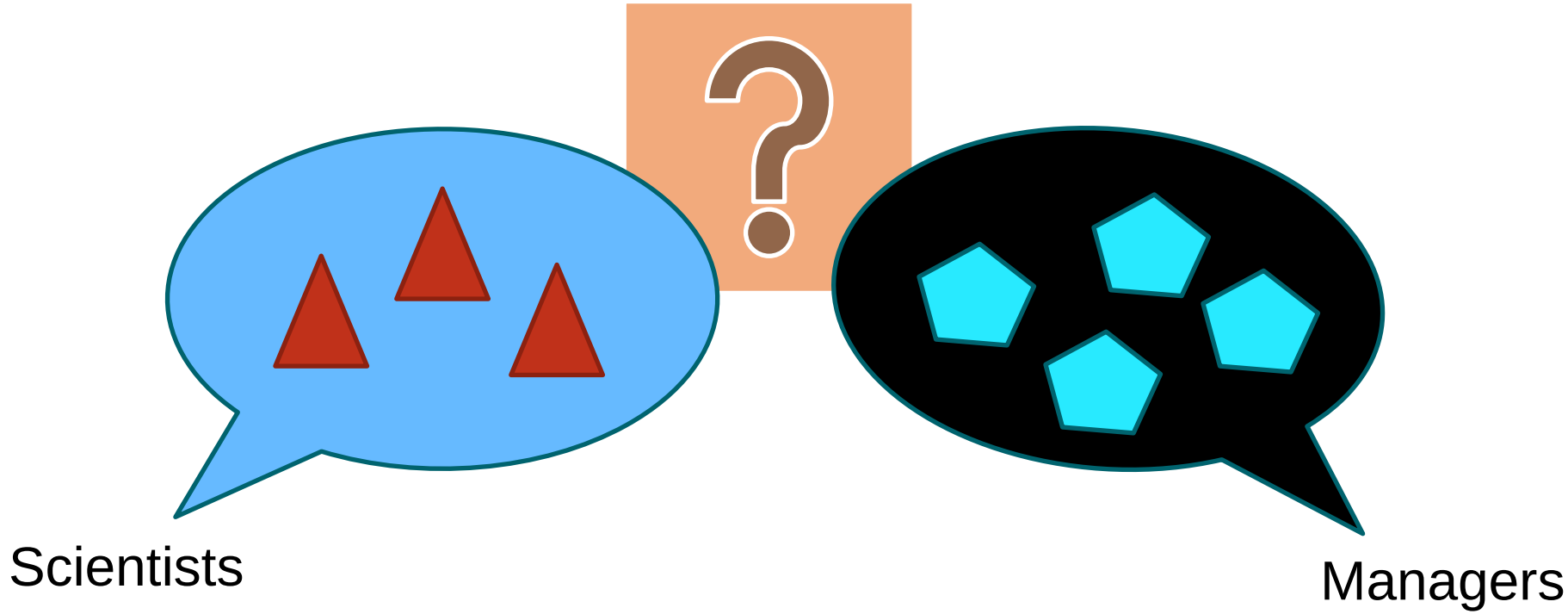
1. Determine ‘when’ to include distribution and productivity changes in the assessment
    - Include ecosystem considerations in Terms of Reference (outline assessment procedures and goals) for stock assessment and assessment reviewers
    - Run climate vulnerability and risk assessments to identify species at greatest risk from climate change
    - Use geospatial statistical techniques to evaluate the significance of distribution shifts, and sensitivity analysis to evaluate impacts of such shifts on the condition of a population or ecosystem

2. Run the assessment
    - Explore ways to account for environmental effects on population parameters (e.g. growth, maturity, mortality, catchability)
    - Explore multiple hypothesis – e.g. management strategy evaluation, ensemble modeling

3. Operationalize forecasts
    - Evaluate the predictive skill of models with environmental linkages and present results to managers along with a characterization of uncertainty around the environmental linkages and resulting forecasts

Delivering & Communicating Advice

- Importance of communication
  - Communication issues can lead to lack of clarity on when and how the information can be used to adjust management actions

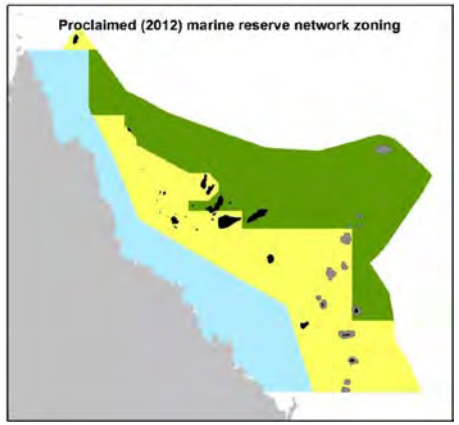


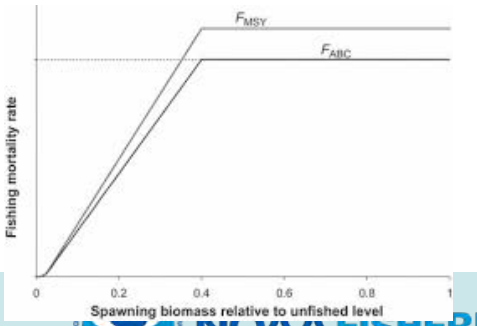
Communicating Results

- Establish routine reporting and standardized templates to report information on ecosystem dynamics, species distributions, and productivity
  - e.g. Ecosystem-Socioeconomic Profiles (Shotwell, pers. communication)
- Utilize and include decision support tools in stock assessment reports
  - e.g. decision tables and decision trees to communicate risk and tradeoffs
- Regular engagement between scientists and managers through regular and open dialogue at workshops and debriefs
  - Timing is important!

	2015	2016	2017
	But Rec is not		
Set ABC assuming high recruitment (rec)	P(overfishing | Med rec)		
0.3	36%	39%	40%
0.35	41%	45%	47%
0.4	46%	51%	54%
0.45	51%	56%	60%
0.5	56%	62%	66%
	P(overfishing | Low rec)		
0.3	43%	54%	59%
0.35	49%	63%	68%
0.4	56%	70%	76%
0.45	62%	77%	82%
0.5	68%	82%	87%

Management Actions





- Plan for future scenarios
  - Structured scenario planning, management strategy evaluations
  - Plan for emerging fisheries
    - Management bodies should update and track which fisheries and gears are allowed in their jurisdictions
  - Develop plans with neighboring jurisdictions
- Spatial and temporal management approaches
  - Use more ‘responsive ocean management’ to evaluate and adjust spatial/temporal management approaches using near real-time biological, social, economic, ecological data
- Responsive harvest strategies and control rules
  - Adjust Council risk policy
  - Empirical management procedures
  - Explicitly estimate changing biological reference points that respond to recruitment forecasts and regime shift information

Conclusions

- Traditional methods and assumptions may need to be adapted to account for changing species distribution and productivity
  - Management bodies should **explore future scenarios**, **re-evaluate their spatial and temporal management procedures**, and **develop responsive HCR**
  - Improve **collaboration and communication** between scientists and management partners
    - e.g. regular and open dialogue at workshops and debriefs, and standardized reporting of species distribution and productivity changes
  - Improve **capabilities to detect changes** as they occur and **understand why changes are occurring**
    - e.g. flexible sampling, leverage capacity of fishermen

Acknowledgement

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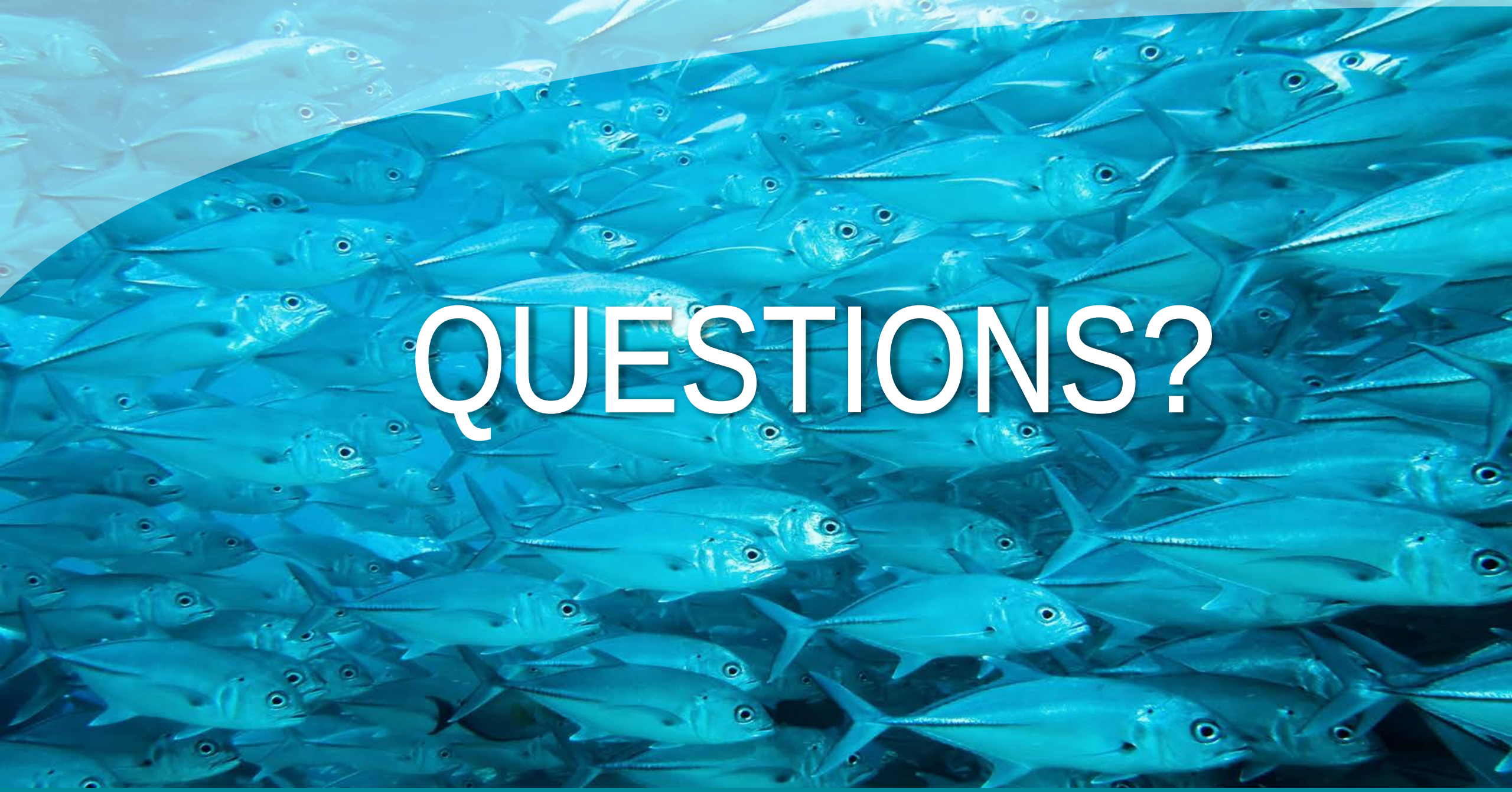
QUESTIONS?