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FISHERIES**

Northeast
Fisheries
Science Center

An Overview of Ecosystem Science at the Northeast Fisheries Science Center

Michael J. Fogarty, Jon
Hare & Thomas Noji

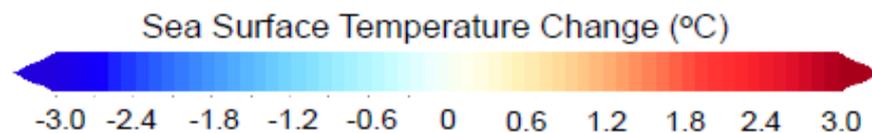
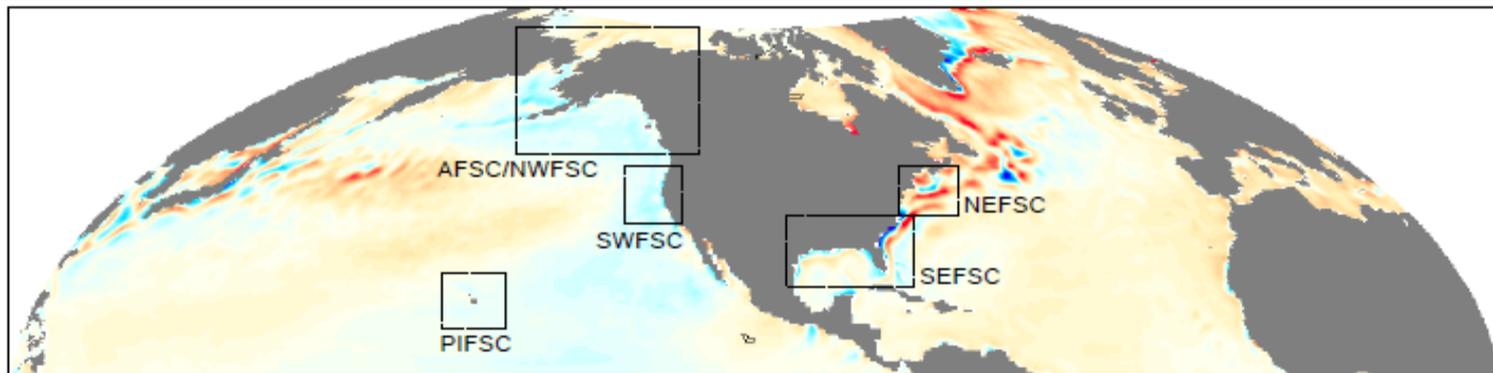
NEFSC Ecosystem and Climate Science Program Review

Introduction to NEFSC Science Session

June 6, 2016

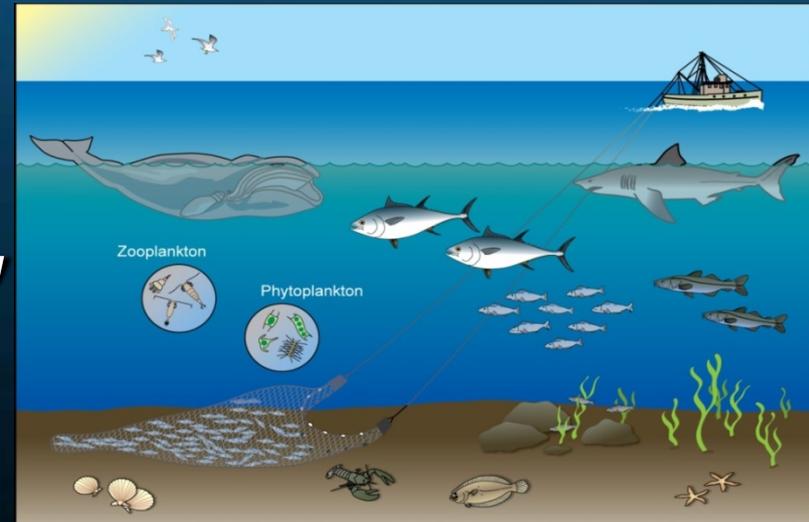
Northeast U.S. Continental Shelf : A Highly Dynamic and Rapidly Changing System

- High rates of temperature change
- Dramatic changes in species distribution
- Decadal shifts in productivity states
- Long history of anthropogenic impacts
- High risk to coastal communities



Ecosystem-Based Management Requires a Multidisciplinary Approach:

“U.S. ocean and coastal resources should be managed to reflect the *relationships* among all ecosystem components, including *human* and nonhuman species and the *environments* in which they live. Applying this principle will require defining relevant *geographic management areas* based on ecosystem, rather than political, boundaries (USCOP 2004)”



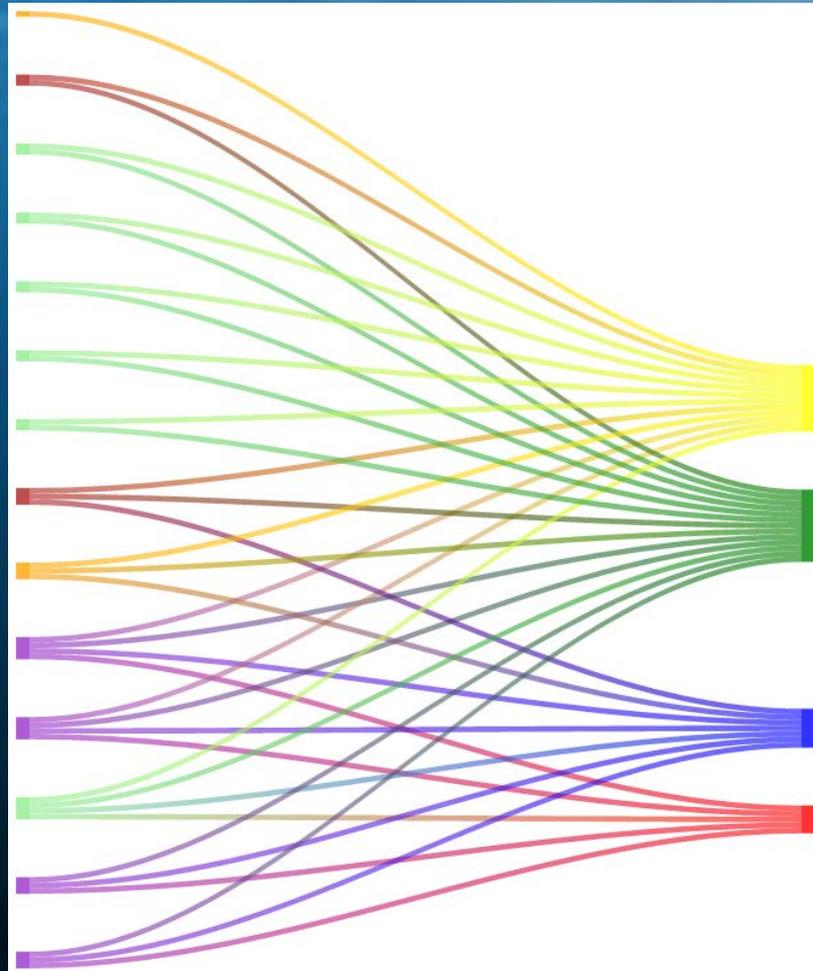
Cross-Divisional Contribution to Ecosystem Science and Management

NEFSC Research Branches

Science & Management

Activities

Fisheries Sampling
Ecosystem Surveys
Aquaculture Sustainability
Aquaculture Systems
Coastal Ecology
Habitat Ecology
Fisheries Ecology
Population Biology
Cooperative Research
Social Sciences
Protected Species
Oceans & Climate
Population Dynamics
Ecosystem Dynamics



Ecosystem Data

Research, Modeling
& Analysis

Synthesis &
Assessment

Management
Advice

NEFSC Cross-Divisional Collaboration & Coordination

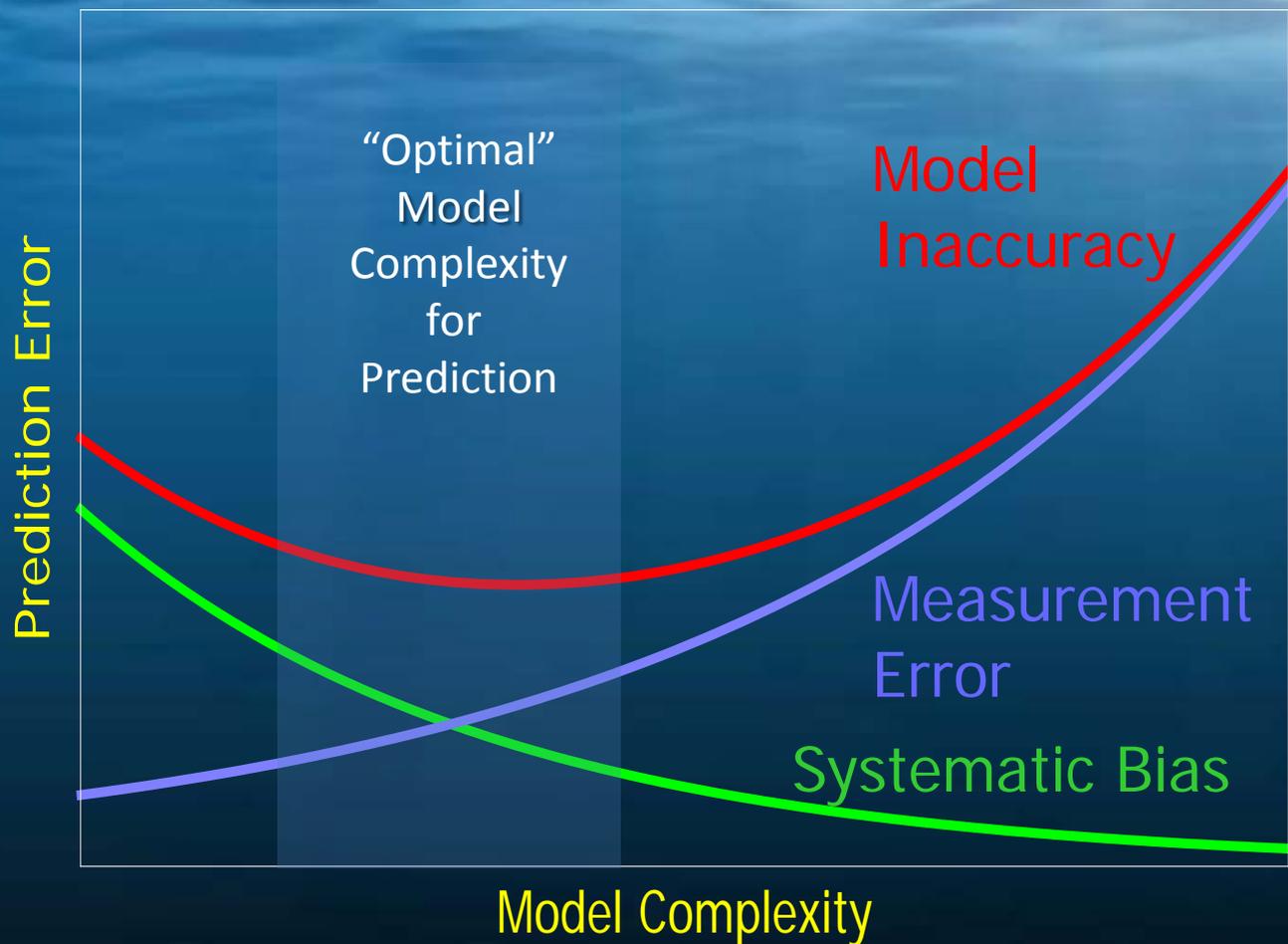
Climate, Ecosystem, & Habitat Steering Group

A leadership group to provide structure and direction the NEFSC efforts to include climate, ecosystem, and habitat factors into fishery and protected species assessments.

- Multispecies Working Group
- Regime Shift Working Group
- Management Strategy Evaluation Working Group



Confronting Complexity: Can We Use Simpler Models and Analytical Approaches?



NMFS Ecosystem Science Review

Theme Areas

Theme 1 – Strategic Planning

Theme 2 – Ecosystem Data

Theme 3 – Ecosystem Modeling & Analysis

Theme 4 – Incorporation into Management

Theme 5 – Communication & Peer Review



NEFSC Strategic Planning

Ecosystem-based
Science Supporting
Stewardship of
Living Marine
Resource
Under Changing
Climatic Conditions



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Northeast Fisheries Science Center
Strategic Science Plan
2016 - 2021

*Ecosystem-based science supporting stewardship of living
marine resources under changing climatic conditions*



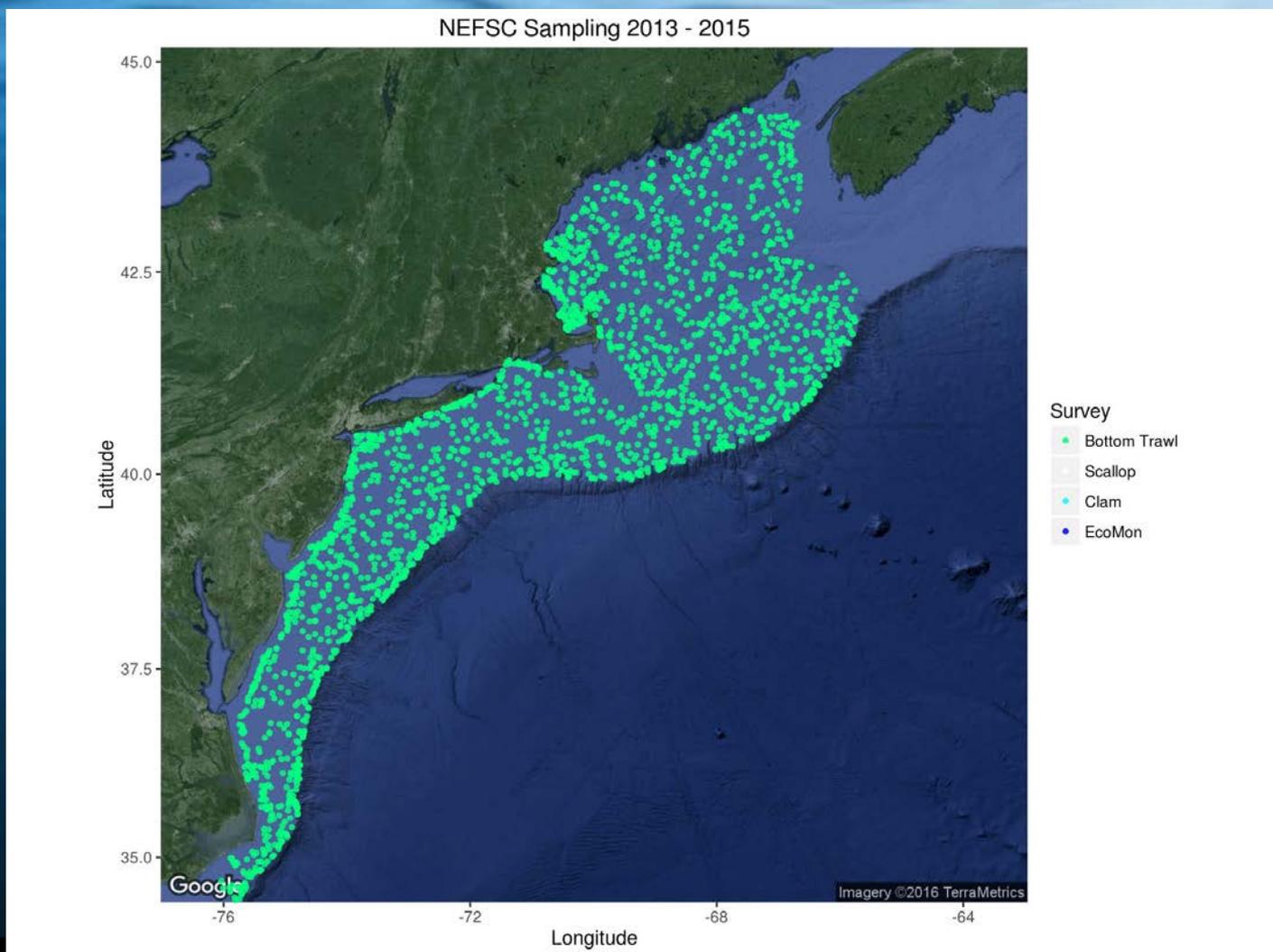
Ecosystem Data: NEFSC Ecosystem Observing Program Elements



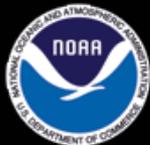
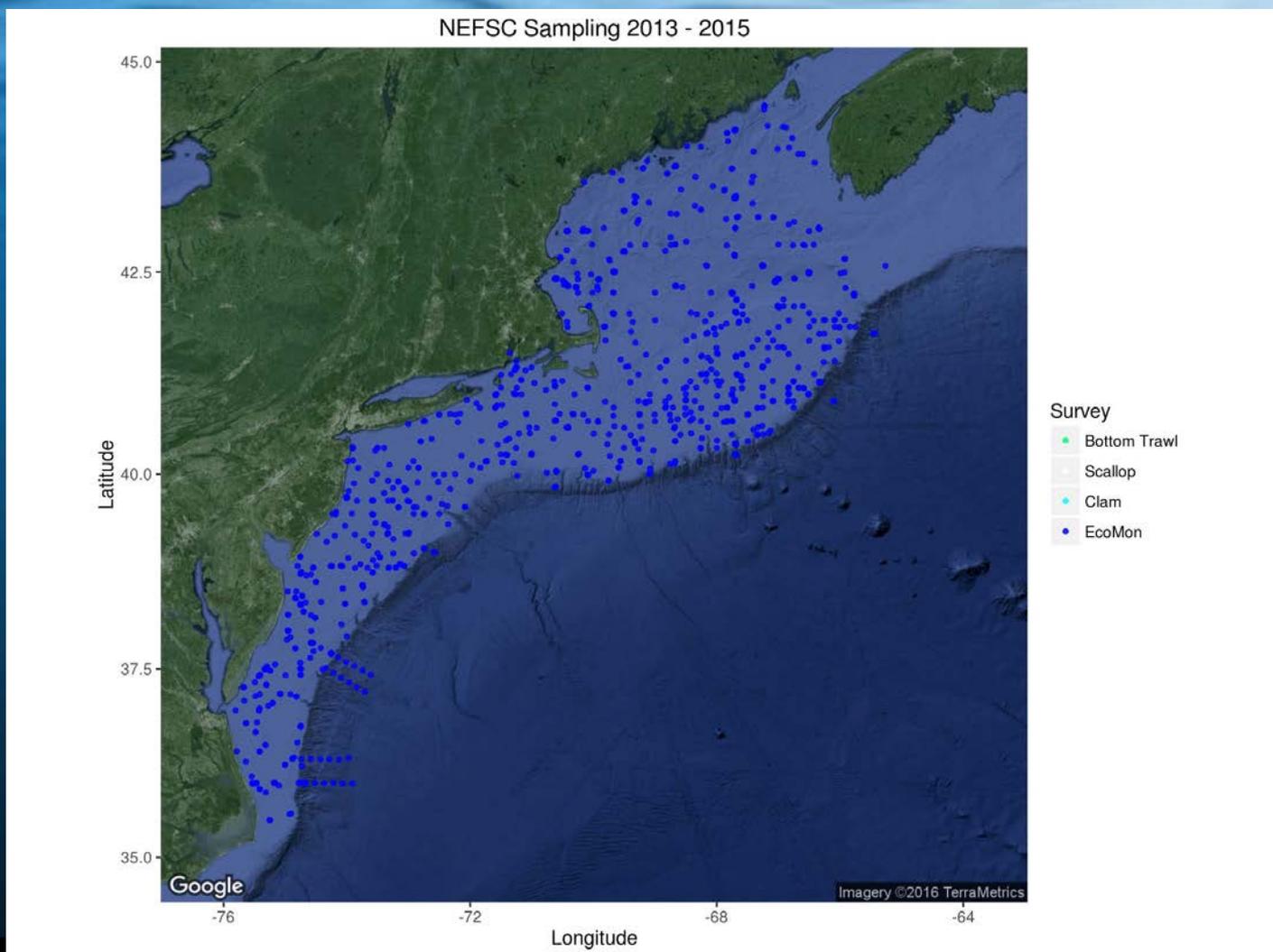
- Satellites
- Oceanographic Buoys
- Standardized Surveys
 - Trawl & Acoustics
 - Plankton
 - Shellfish Dredges
 - Longlines
 - Air Craft
- Observer Program
- Cooperative Industry Research
- Fishery Reporting System
- Fishermen Interviews



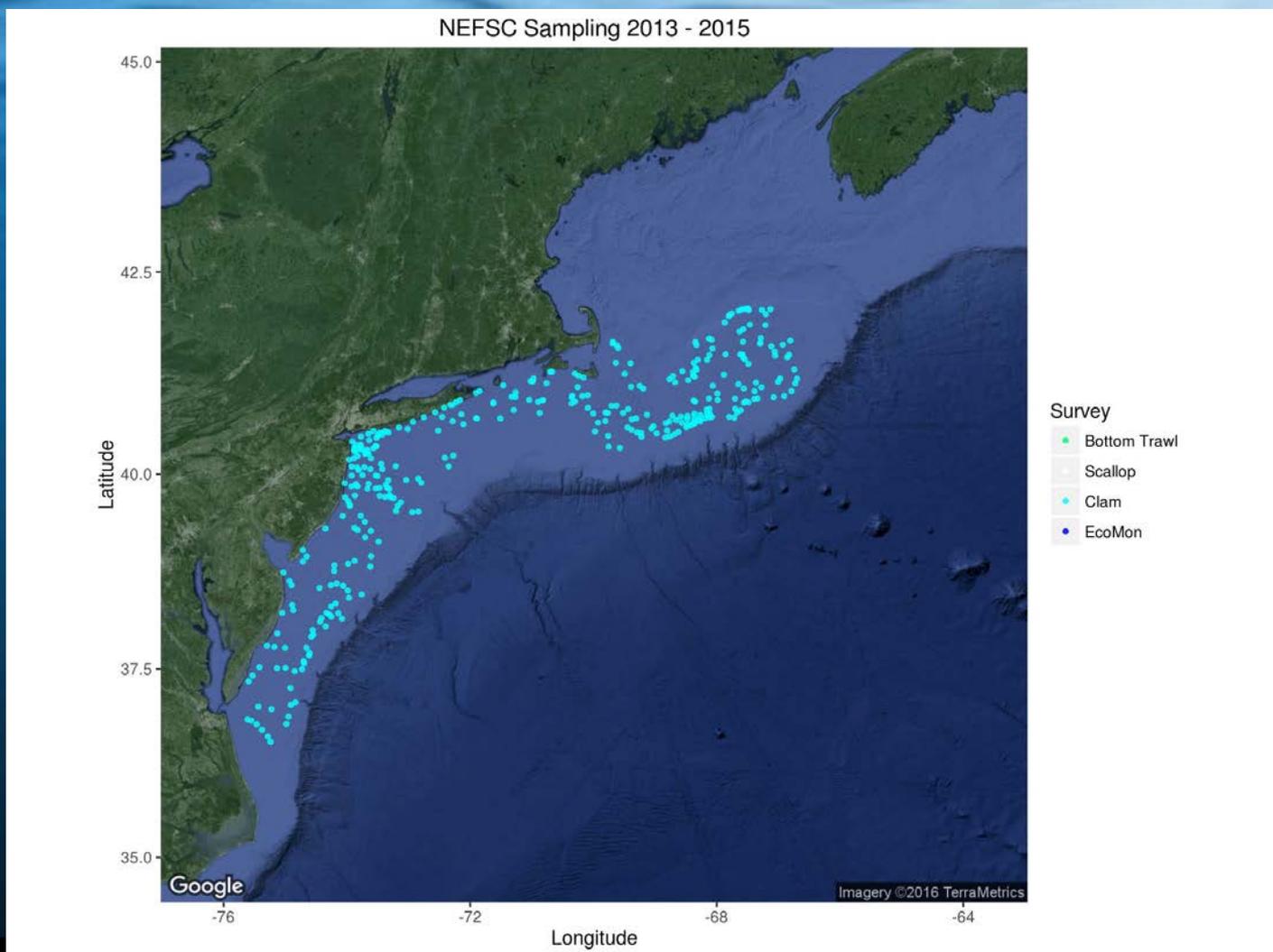
Ecosystem Data: Shipboard Operations



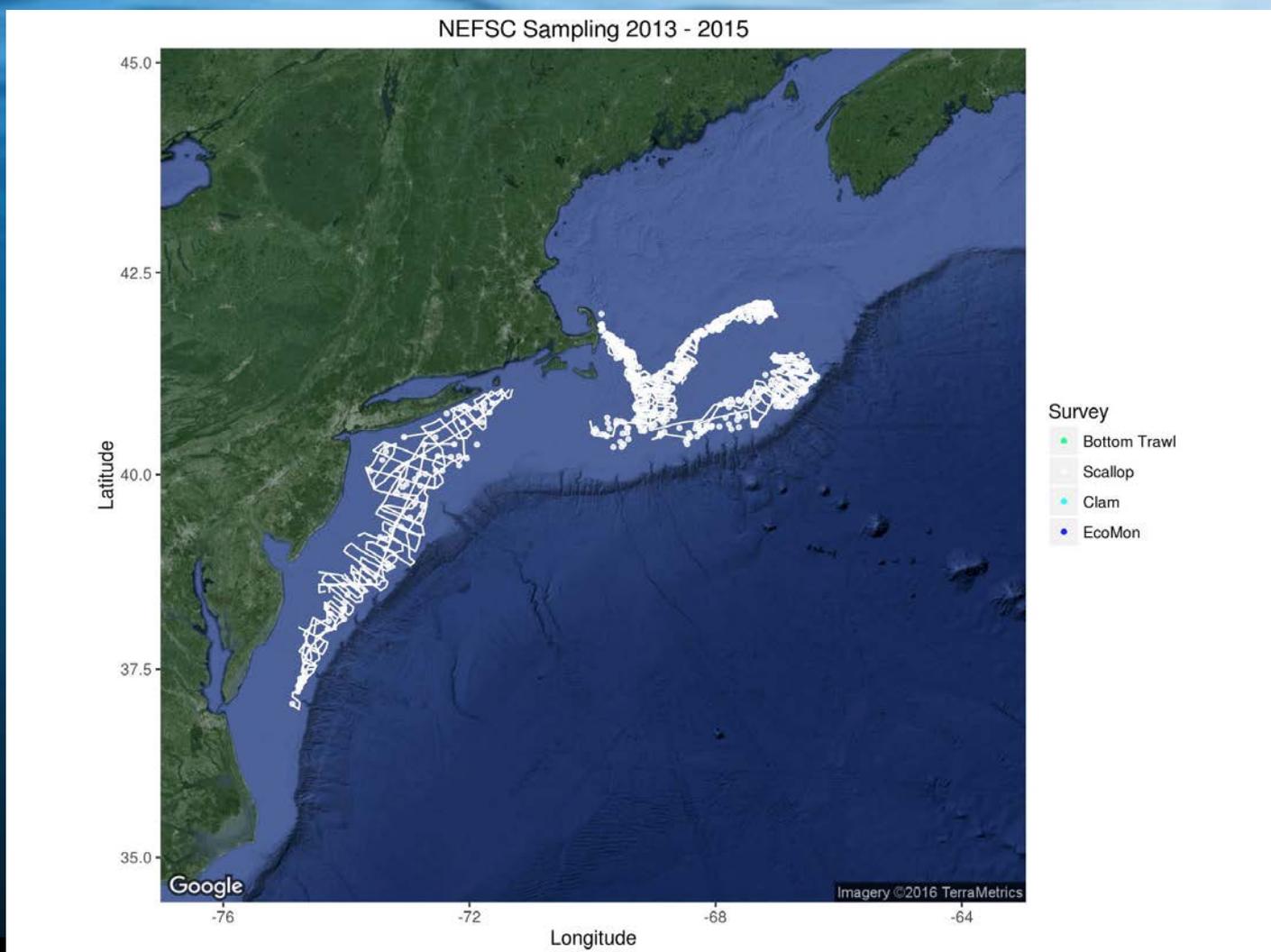
Ecosystem Data: Shipboard Operations



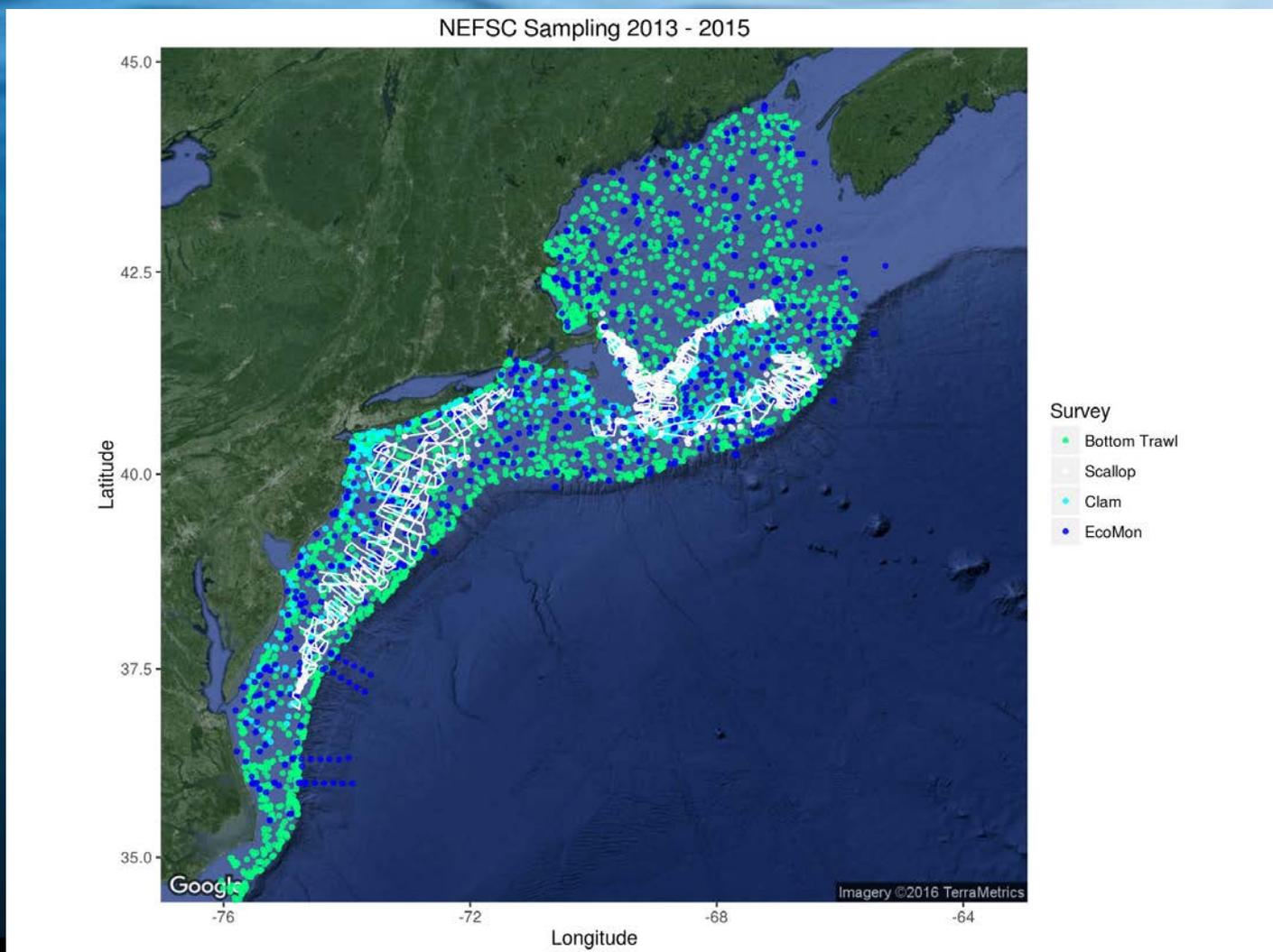
Ecosystem Data: Shipboard Operations



Ecosystem Data: Shipboard Operations



Ecosystem Data: Shipboard Operations



NEFSC Modeling and Analysis: Core Elements

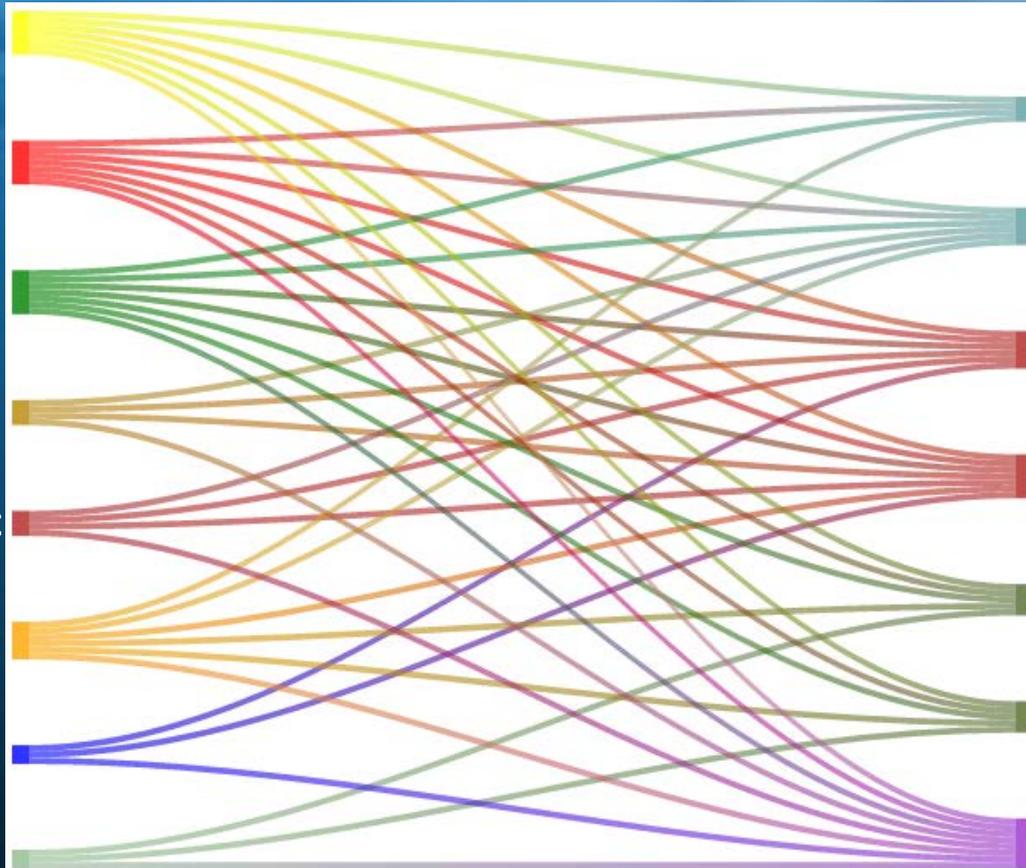
- Define Ecological Production Units
- Integrated Analysis of Climate, Physics, Ecology, Human Use, Social & Economic Considerations
- Management Strategy Evaluation
- Multi-model inference to Address Model Uncertainty
- Management Procedures for Tactical Management Advice



Ecosystem Modeling and Analysis: Synthesis and Integration

DATA

Fishery
Independent
Fishery
Dependent
Food Habits
Hydrography
Socio- Economic
Demography
Climate
Plankton



MODELS

Multispecies
Statistical Catch-at-Age
Multispecies Length
Structured
Multispecies Production
Multispecies Delay-
Difference
Production Potential
Ecopath w EcoSim
Atlantis



Incorporation into Sectoral Management

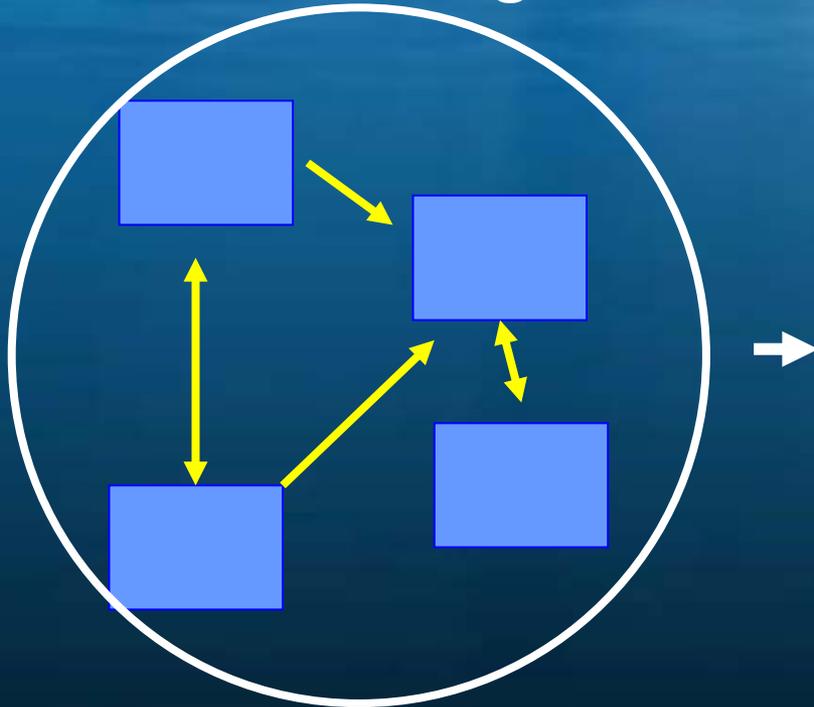


- Extended Single-Species Analyses
- NEFMC EBFM Plan Development Team
- MAFMC EAFM Working Group
- Scientific & Statistical Committees of NEFMC and MAFMC
- GARFO Protected Species Management Teams
- GARFO Habitat Assessment Teams



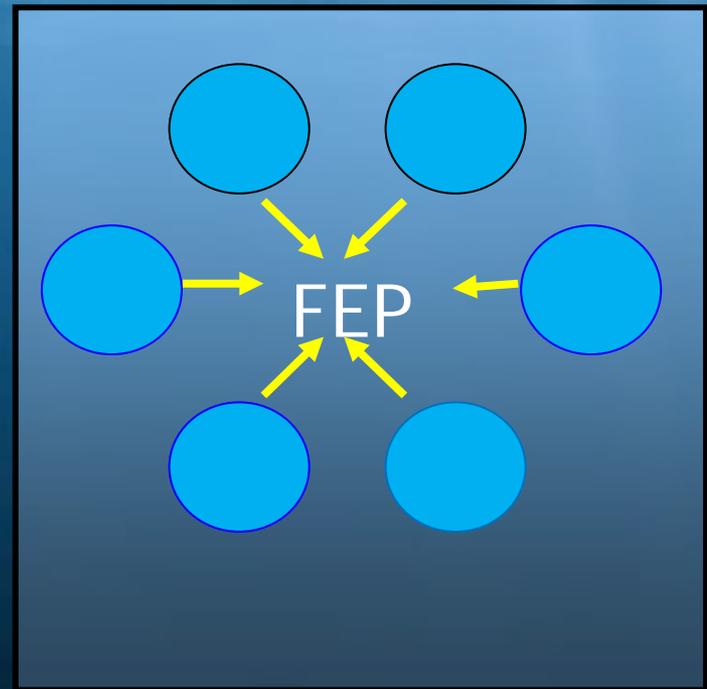
Ecosystem Approach to Fisheries Management vs Ecosystem-Based Fisheries Management

Ecosystem Approach to Fisheries Management



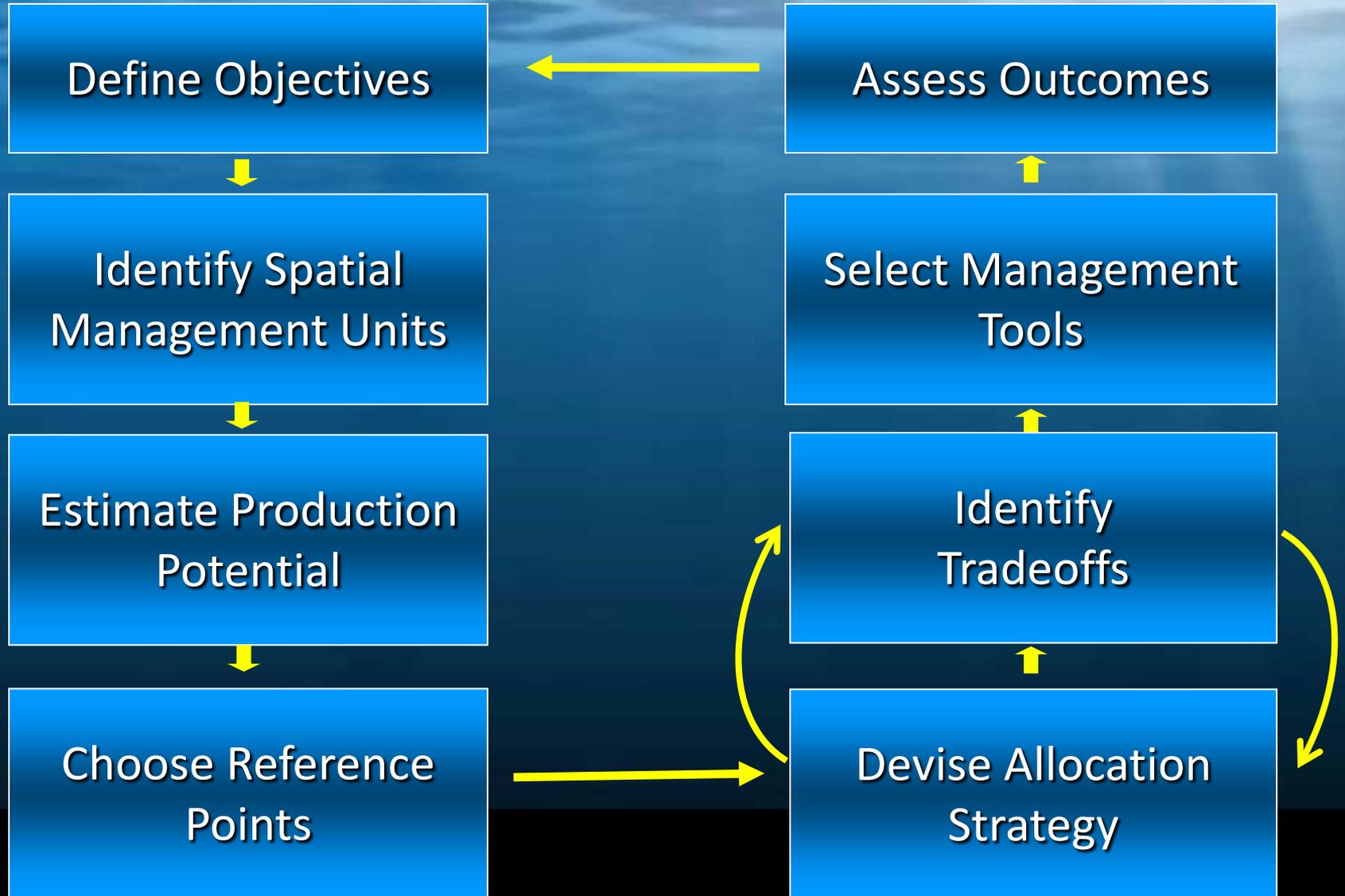
Retain Separate Management Plans
but Consider Species and
Environmental Interactions

Ecosystem-Based Fisheries Management

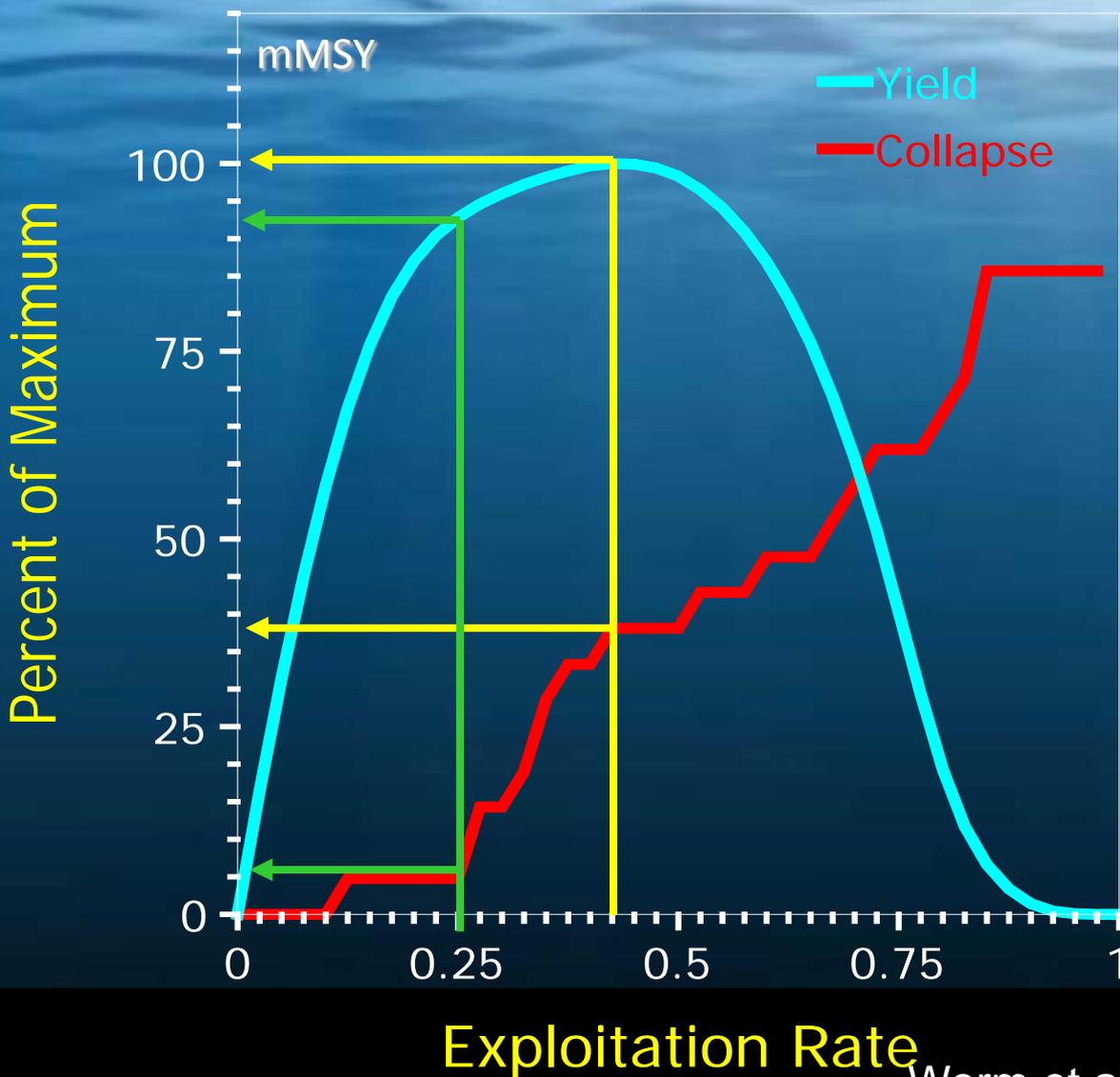


Develop Integrated Fishery
Ecosystem Plans for Defined
Ecoregions

EBFM Road Map



Multispecies Management Reference Points



Incorporation into Multi-Sectoral Management

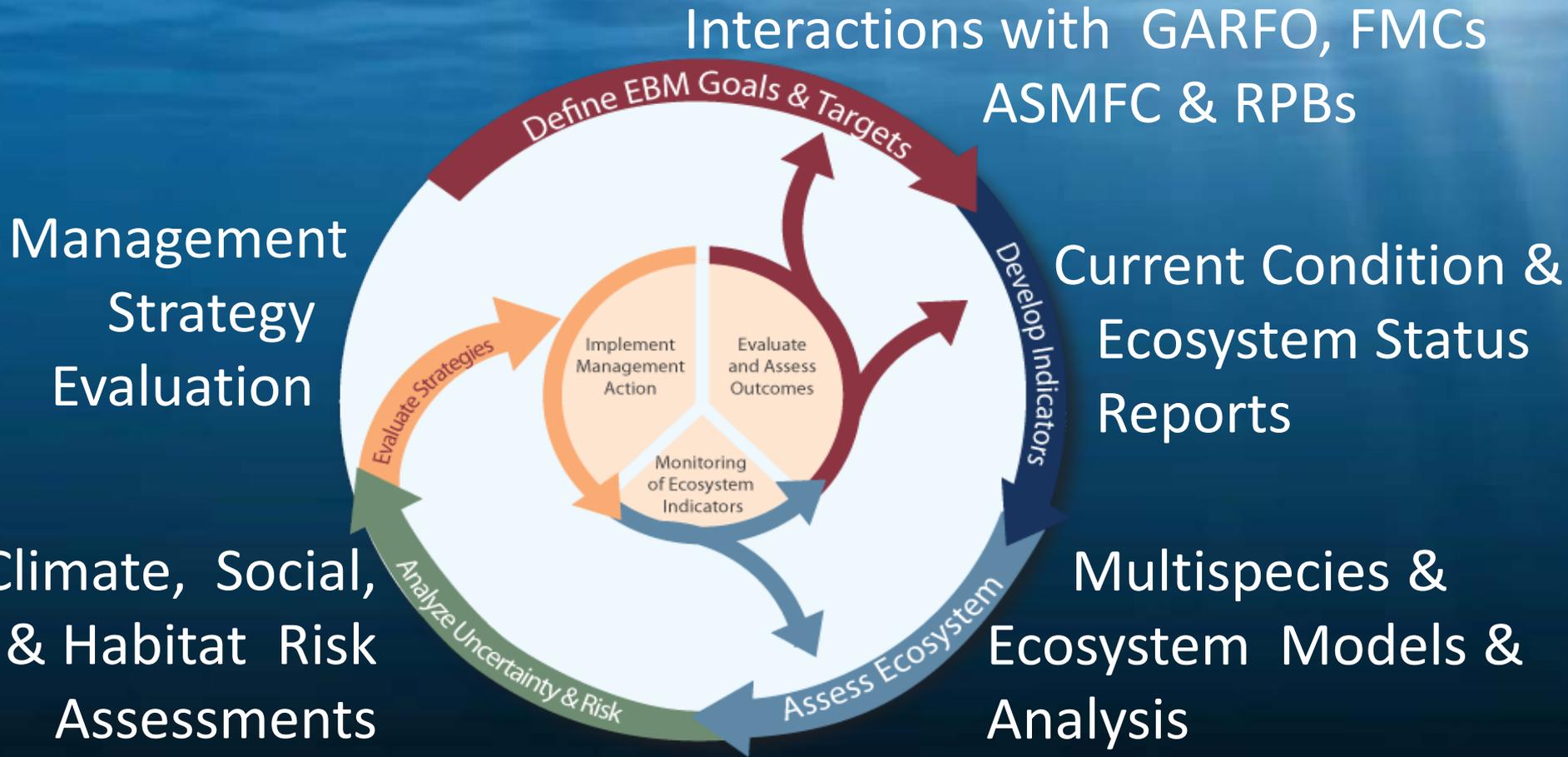


NEFSC Supporting Development of Ocean Management Plans by Northeast and Mid-Atlantic Regional Planning Bodies through:

- Marine Data Assessment Team (NRPB and MARPB)
- Ecosystem-Based Management Committee (NRPB)



Integrated Ecosystem Assessments to Support Management Bodies



International Management Setting

NAFO Working Group on Ecosystem Science and Assessment:

- Adopted NEFSC Approach to Defining Ecological Production Units and Ecosystem Production Potential

ICES Working Group on North Atlantic Regional Seas

- Adopted NEFSC Approach to Conceptual Modeling and IEA Development



Communication

Northeast Fisheries Science Center
Ecosystem Considerations

EcoAp Links NEFSC Links

Ecology of the Ecosystem
Background information on the structure and function of the Northeast Shelf Ecosystem

Climate Change
Impact of Climate Change on the Ecosystem and Fisheries Species

Ecosystem Status
Assessment of Ecosystem Condition and Socioeconomic Impacts

Current Conditions
Semiannual Review of the Physical and Biological Status of Ecosystem

Spatial Analyses
Species Distribution Patterns and Related Consideration

There is now broad agreement that we need to adopt a more holistic approach to marine resource management at both the national and international levels. To accomplish this goal, the foundation of marine Ecosystem-based Management is now being developed and refined. Virtually all specifications of marine EBM share at least three common elements: (1) a commitment to establishing spatial management units based on ecological rather than political boundaries, (2) consideration of the relationships among



Figure 1. Examples of some important ecosystem services (blue)

Commercial Fisheries News

February 2011 • Volume 38 Number 6 • A Compass Publication

New ecosystem approach: Space vs. species

Fishermen are keen observers of nature. A successful fishing trip depends on knowing where the fish are at different times and how changes in the environment affect the ebb and flow of various species over time. These rhythms reflect the dynamics of the broader ecosystem of which fish are a part and how they are affected by natural and human-related changes. For some time now, there has been a movement to bring a broader range of ecosystem considerations into fisheries management. The adoption of concepts such as "essential fish habitat" is one manifestation of this trend. The momentum toward an ecosystem perspective increased recently when President Obama signed an executive order implementing a new National Ocean Policy. The policy establishes ecosystem-based management (EBM) as its guiding principle. This change is coming and we need to be ready for it.

Statistical Committee, we have worked with our colleagues to help define what this might look like in the Northeast. We are working in consultation with the Mid-Atlantic council, the Atlantic States Marine Fisheries Commission (ASMFC), and stakeholder groups. The scientific underpinnings of the overall approach have been developed by the Ecosystem Assessment Program of the Northeast Fisheries Science Center. Together, we are trying to make sure that the approach we develop toward ecosystem-based fishery management can be fully integrated into the more comprehensive EBM framework. This framework will consider not only

replace them with substantially fewer place-based plans. Because the idea of developing management strategies using ecological boundaries is so central to the concept of EBM, it's worth explaining some of what goes into deciding how to choose spatial management areas. Spatial is the term we use to mean "geographic space." Marine ecosystems are shaped by a number of factors, including:

- The basic physical geography of the seabed;
- Ocean currents and other features such as frontal zones and tidal mixing areas;
- Distinctive water mass characteristics based on temperature and salinity; and
- The amount of food coming in at the base of the food web, usually in the form of microscopic plants called phytoplankton.

Each of these factors plays an important role in how fish are distributed in the ocean, what types of marine life are found together, and, ultimately,



Science, Service, Stewardship

FS-2010-02

NOAA FISHERIES SERVICE

Ecosystem-based Fishery Management for the Northeast Continental Shelf

A New National Ocean Policy
A new era in ocean resource management was ushered in on July 19, 2010 when the President signed an Executive Order implementing his recently issued National Ocean Policy. The objective of Ecosystem-based Fishery Management (EBFM) is to make...

There is now broad agreement that we need to recognize both the many benefits derived from our connections to the sea and the many ways in which human activities affect the ocean in order to chart a sustainable course of action. This holistic approach will require some form of Ecosystem-based Management (EBM; see "A New Ocean Policy," left). Virtually all definitions of marine EBM share at least three common elements: (1) a commitment to establishing spatial management units based on ecological rather than political boundaries, (2) consideration of the relationships among ecosystem components, the physical environment, and human communities, and (3) the recognition that humans are an integral part of the ecosystem. The dimension of EBM that deals specifically with fishing is Ecosystem-based Fishery Management (EBFM). We need to make...



Ecology of the Northeast Continental Shelf

Toward an Ecosystem Approach to Fisheries Management



Northeast Fisheries Science Center and Northeast Regional Office, National Marine Fisheries Service



Education and Outreach



**Woods Hole
Partnership Education
Program**



**Marine Resource
Education Program**

