



NOAA
FISHERIES

Office of
Science &
Technology

NOAA's Integrated Ecosystem Assessment Program (IEA)

NMFS Office of Science and Technology
Marine Ecosystem Division
Ecosystem Science Review
Silver Spring, MD

NOAA's



INTEGRATED ECOSYSTEM ASSESSMENT

Program

July 26, 2016

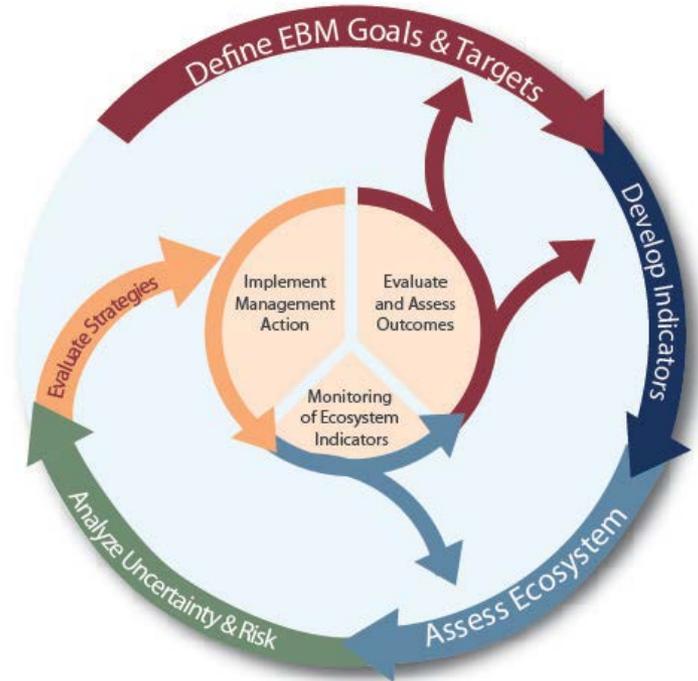
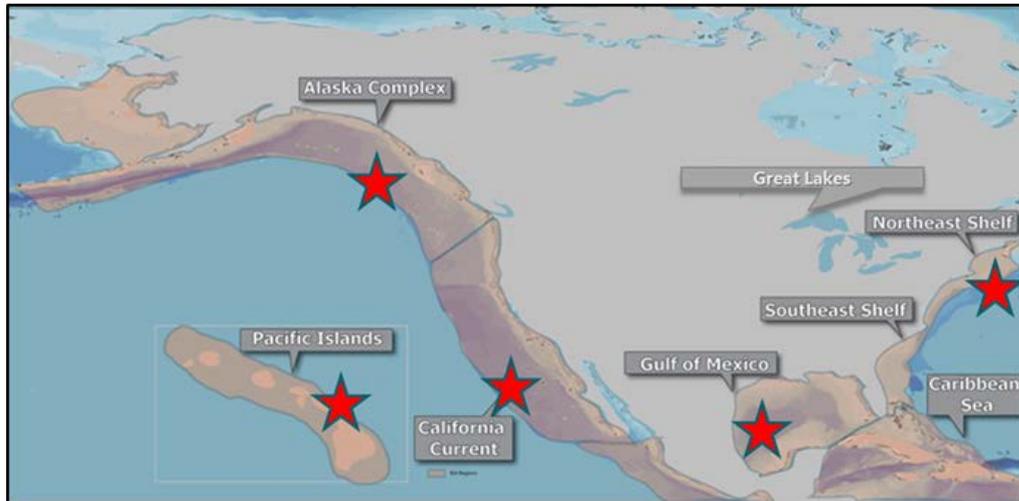
Outline

- The NOAA IEA Program, Framework, and Vision
- Origin and History of NOAA IEA
- NOAA IEA Program Structure
- Why NOAA IEA
- NOAA IEA Program Planning and Implementation
- Communications
- Strengths, Challenges, Solutions

NOAA's Integrated Ecosystem Assessment (IEA) Program, Framework, and Vision



IEAs Provide an Analytical Framework to Implement EBM



Vision:

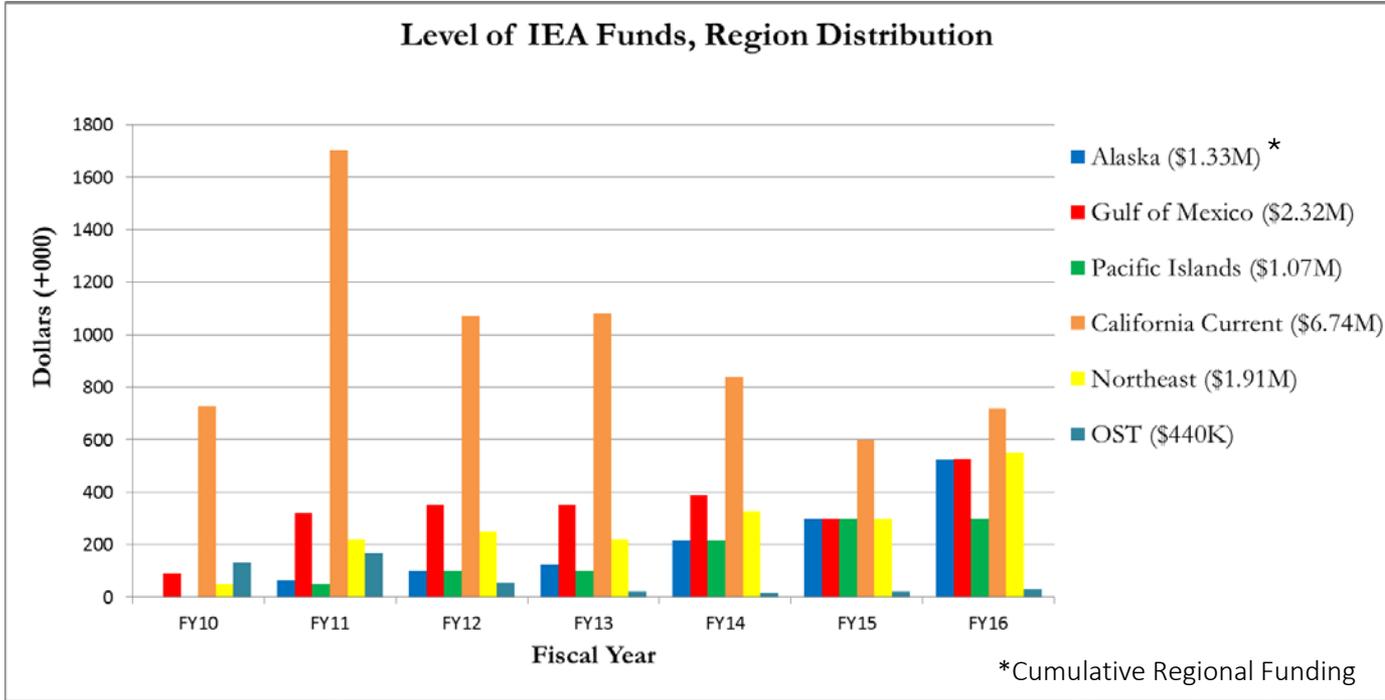
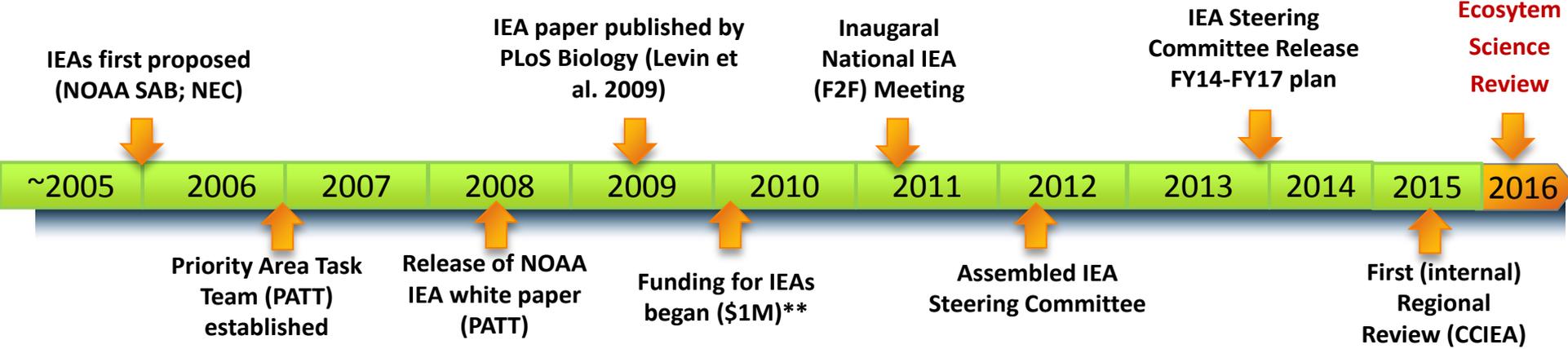
To provide the sound interdisciplinary, ecosystem-based science, tradeoff evaluation, and management advice required to ensure the sustainable delivery of a broad spectrum of benefits and services from our Nation's marine, coastal, estuarine, and Great Lakes ecosystems; thus, enhancing the well-being of current and future generations.

NOAA IEA Program Origins (~2005/6)



- NOAA Science Advisory Board External Ecosystem Task Team report:
 - NOAA **must make integrated assessment the normal mode of business** for assessing the status of marine ecosystems and their components, and evaluating options for human uses
 - IEAs require structured, accountable **collaboration among multiple LOs**, with partners and clients
 - **Regionally based IEAs** should be the central products of NOAA ecosystem science. Expand IEAs at the regional level now.
- NOAA Executive Council calls for IEAs:
 - Use a science-driven, problem-centered approach to **integrating NOAA-wide capabilities** on common geographic framework to provide IEAs
 - Draw heavily on existing or emerging work products from goals and line offices
 - Established IEA Priority Area Task Team (PATT) – recognized IEA concept to organize and **integrate NOAA ecosystem science** into a value-added product area.

NOAA IEA Program - History



97% of funds have gone out to the regions to develop and implement NOAA IEA

NOAA IEA Program Structure

National IEA Steering Committee

Line Office members

Regional members

Advisory members

NOS

NMFS

OAR

NESDIS

CC

GoMX

NE

AK

PI

Climate

Socio-Econ

As needed

As needed

National IEA Program Office

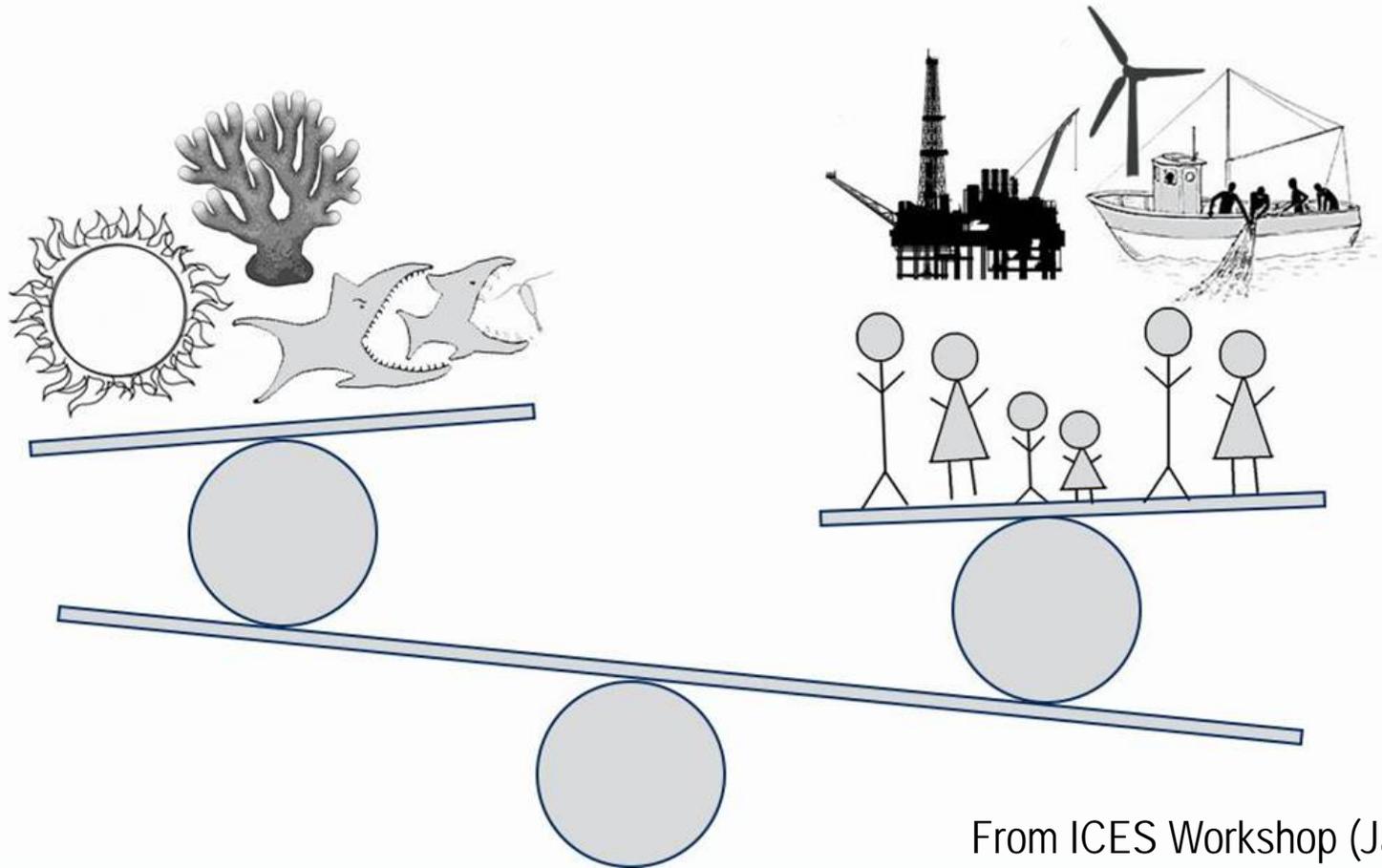
IEA program manager

Chris Kelble (Gulf of Mexico, OAR; Chair)
 Mark Monaco (NOS)
 Rost Parsons (NESDIS)
 Chris Harvey (NMFS)
 Josh Lindsay (Cali. Curr.; NMFS)
 Mike Fogarty (NE Shelf; NMFS)
 Kerim Aydin (Alaska; NMFS)
 Jamie Gove (Pac. Islands; NMFS)
 Mike Alexander (Climate; OAR)
 Stephen Kasperski (Socio-Econ; NMFS)
 Becky Shuford (PM; NMFS)
 Doug Lipton (Socio-Econ; NMFS -Advisory)

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Why NOAA IEA: Balancing Human Activities and Environmental Stewardship

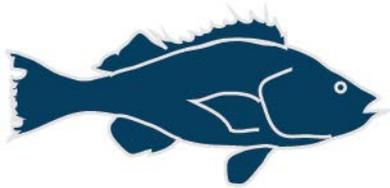


From ICES Workshop (Jan. 2016):
Operationalizing the Ecosystem Approach

Why NOAA IEA: The EBM Continuum/ Spectrum



No EBM or Low EBM



Or



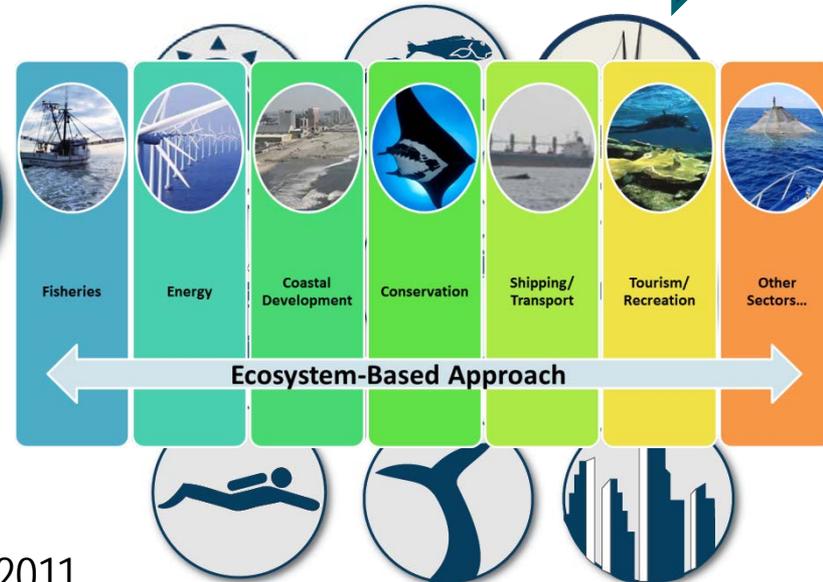
Incremental EBM



Or



Comprehensive EBM

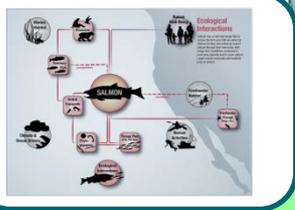


Adapted from UNEP, 2011

Why NOAA IEA: IEA in action



CONCEPTUAL MODELS and SCOPING EFFORTS help frame the issues

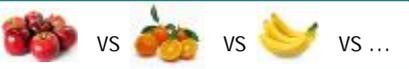


Is the ecosystem "healthy"?

Field and remote data provide STATUS AND TRENDS



How vulnerable is the ecosystem to human uses and natural perturbations?



Now what do we do?

SCENARIOS generate estimates of alternative futures and tradeoffs



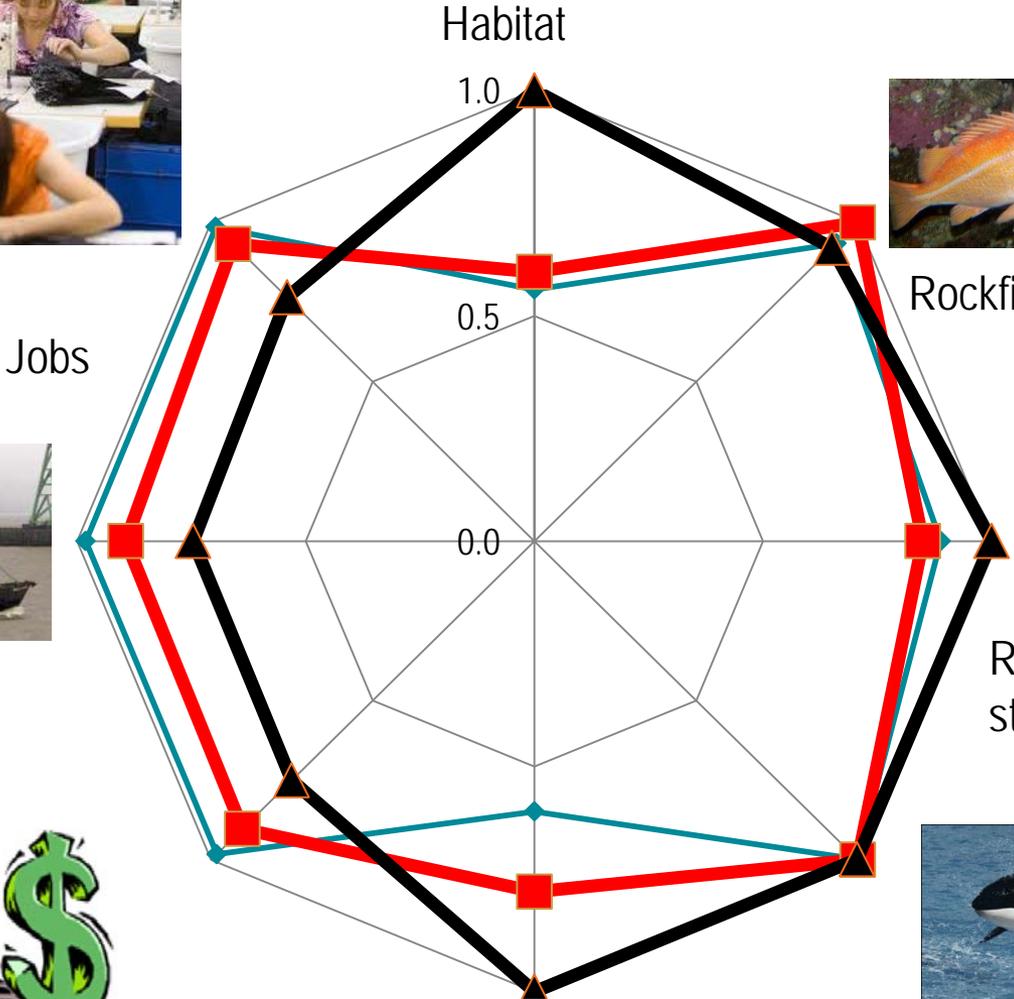
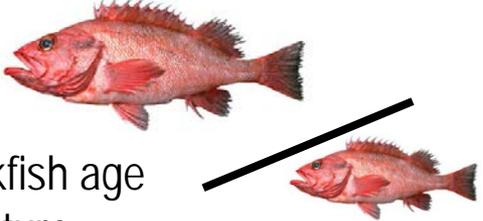
IEA PRODUCTS



...and then, the next iteration of the IEA loop begins



Why NOAA IEA: Tradeoffs



- ◆ Status Quo
- Gear Shift
- ▲ RCA Closure to all Bottom Contact

Outline

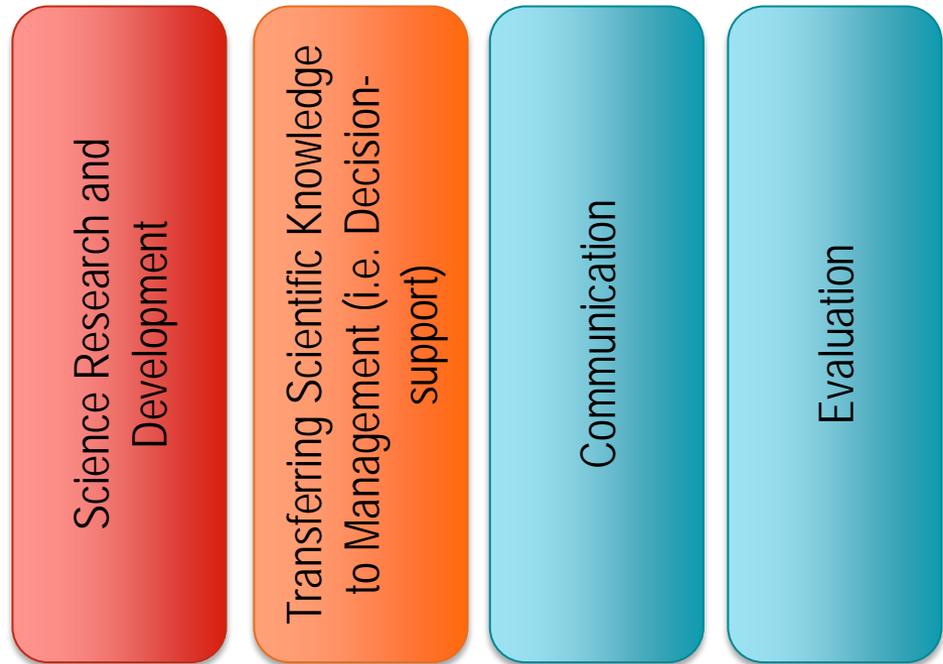
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NOAA IEA Program Planning and Implementation

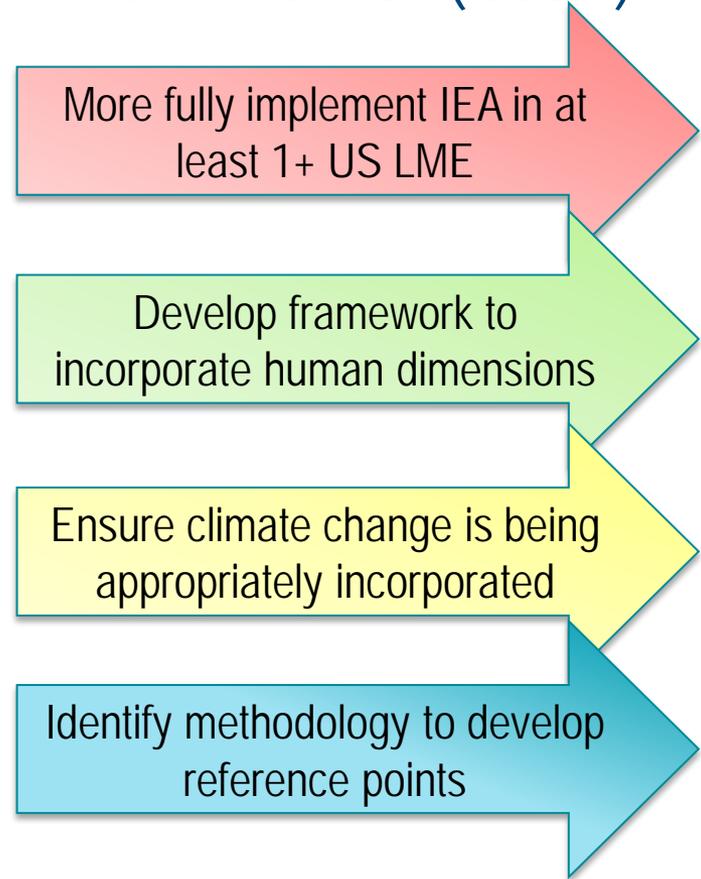
National IEA 3-year plan (FY14-FY17)



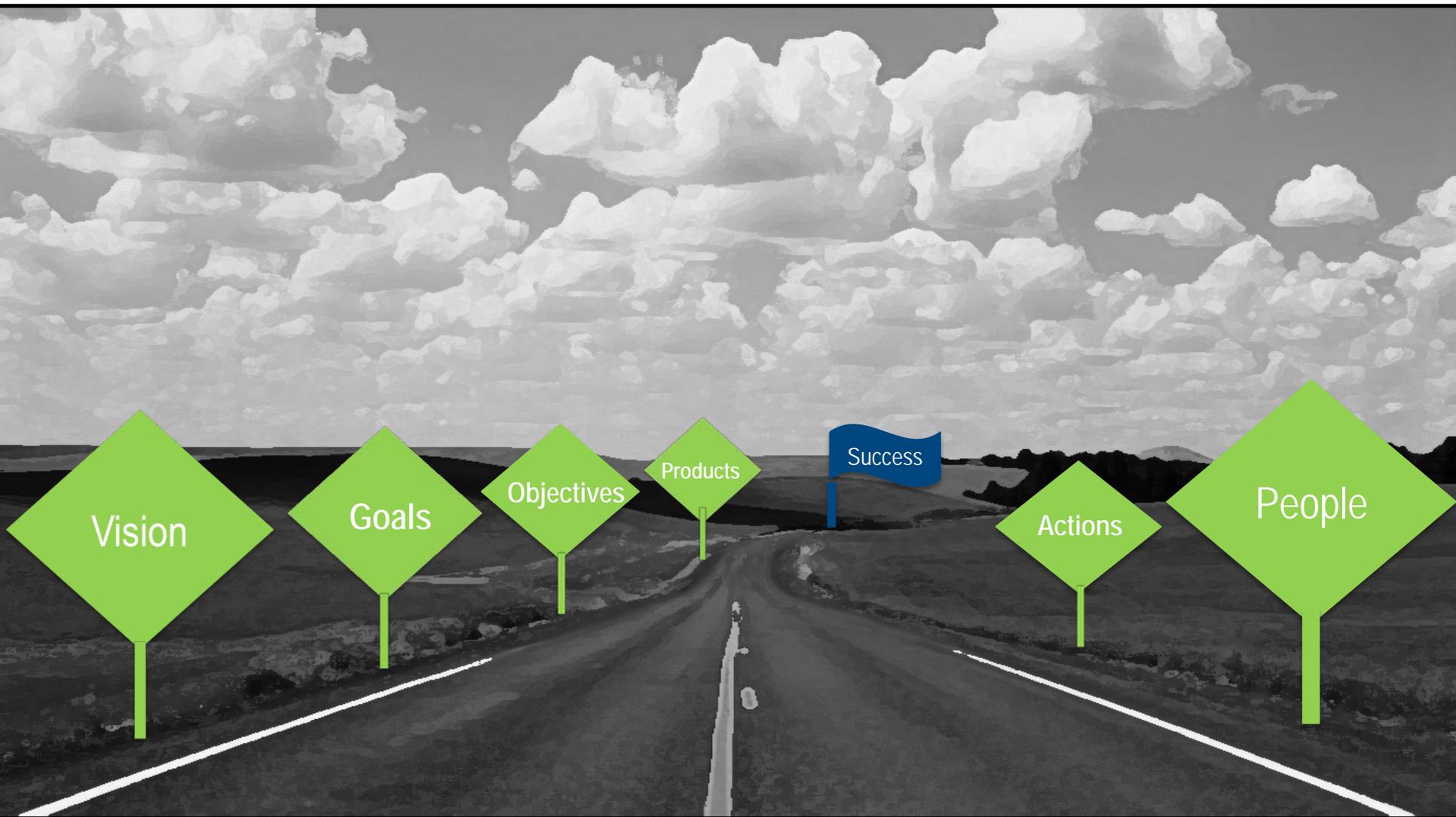
4 Pillars of the Plan:



4 Main Priorities (Goals)



NOAA IEA Program Planning and Implementation Regional Work Plans FY16 – FY18



NOAA IEA Program Planning and Implementation

Regional Work Plan Focus Areas



Advance IEA development in all regions

- Core capacity building
 - E.g.'s of progress on Human Dimensions & Climate Change
- Strategic projects (towards end-to-end IEA)
- Cross-regional IEA National meeting & topical working groups**

NOAA IEA Program Planning and Implementation Core Capacity Building (e.g. Alaska Region)



Region	3-yr Regional Work Plan Priority Goals
Alaska	1: Next-gen ecosystem-based assessment & MSE for Bering Sea (NPFMC – FEP)
	2: Develop Ecopath and Ecosim R modeling tools
	3: Bering Sea and Gulf of Alaska scoping and conceptual modeling to support FEPs

Please see [backup slides](#) for more detail on priority goals and associated objectives; including for the 4 other regions

NOAA IEA Program Planning and Implementation

Regional Work Plan Focus Areas



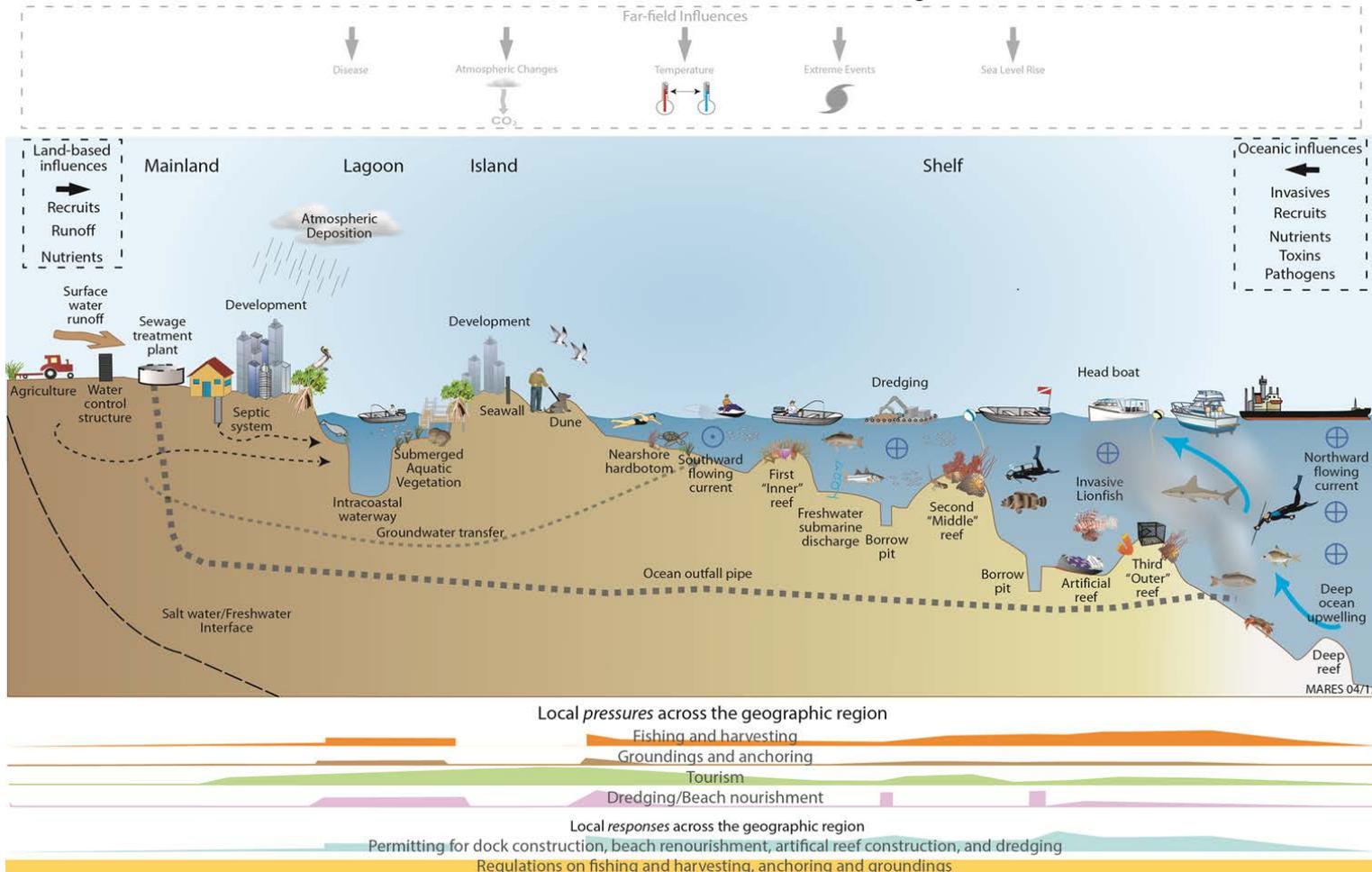
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Better incorporation of Human Dimensions: Conceptual Models of the Socio-Ecological System



Marine and Estuarine Goal Setting for South Florida
Characterization of the Southeast Florida Coast Subregion

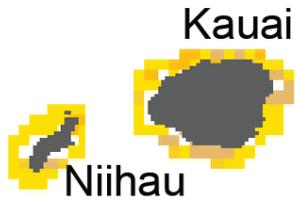


Fletcher et al., 2014

Better incorporation of Human Dimensions: Social Wellbeing in Marine Management (SWIMM)



Examples of incorporation of climate change: Projecting Future Coral Bleaching in West Hawai'i



Molokai

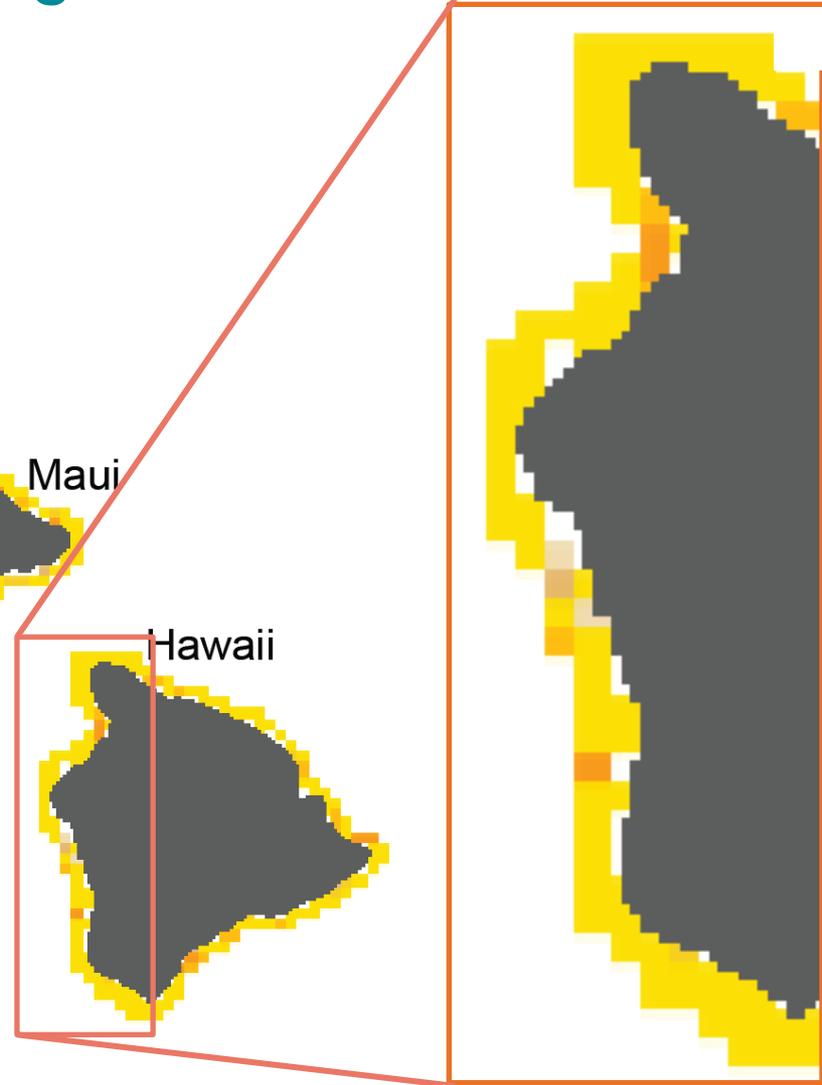
Maui

Lanai

Kohoolawe

Main Hawaiian Islands

Hawaii



Examples of incorporation of climate change: NOAA's Climate Change Web Portal

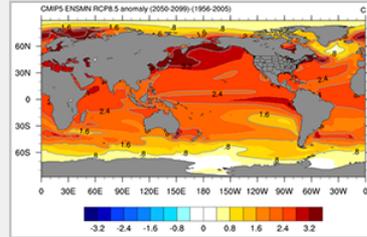
Climate Change Web Portal

- Home
- Land & Rivers
- Oceans & Marine Ecosystems**
 - SSA
 - Detailed Overview

NOAA Climate Change Web Portal

How climate changes in response to increases in man-made greenhouse gases is one of the foremost questions for the scientific community, policy makers and the general public.

A key approach for examining climate, especially how it will change in the future, uses complex computer models of the climate system that include atmosphere, ocean, sea ice and land components. Some models also include additional aspects of the earth system, including chemistry and biology.



PSD Branches

- Climate Analysis
- Water Cycle
- Weather & Climate Physics

Model:

Field:

Statistic:

Time Period

Season:

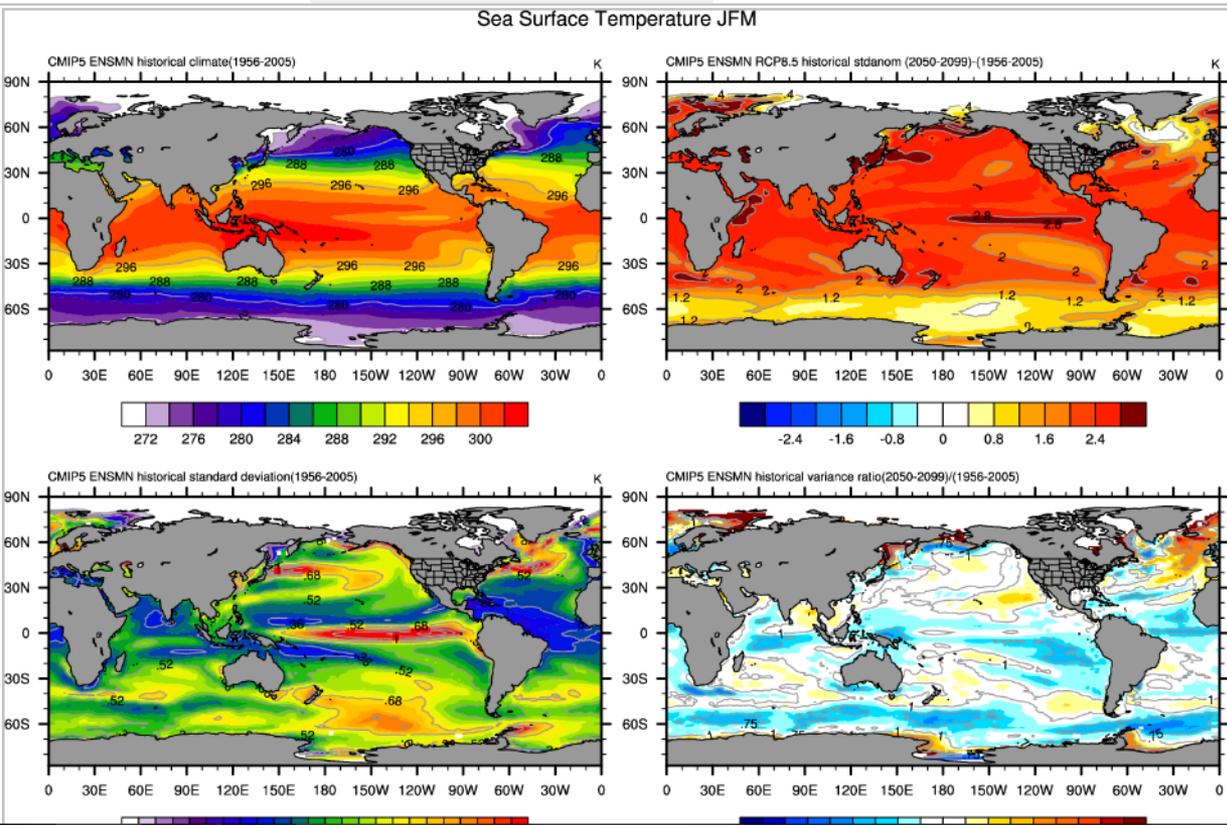
21st Century Period:

Region

Shift-Drag to select custom region | Clear

Double-click to zoom; Click and drag to pan

N:
W: E
S:

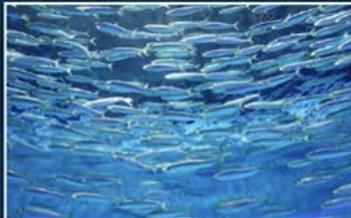


Examples of incorporation of climate change: J-SCOPE



J-SCOPE

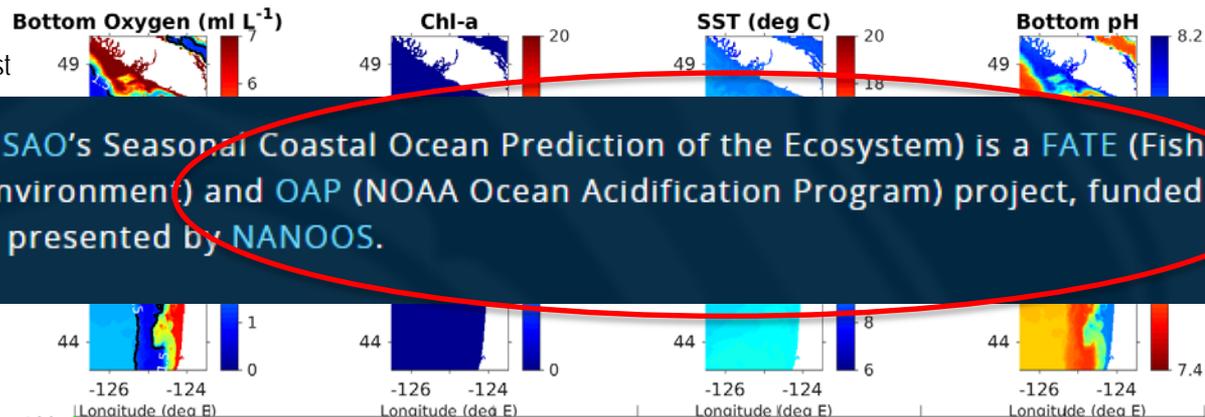
JISAO Seasonal Coastal Ocean Prediction of the Ecosystem



The J-SCOPE forecasts are developed to support the California Current Integrated Ecosystem Assessment. Integrated Ecosystem Assessments (IEAs) are a framework for informing ecosystem-based management, which aims to take into account interactions among ecosystem components and managed sectors, as well as cumulative impacts of a wide spectrum of ocean-use sectors (Rosenberg and McLeod 2005). IEAs are a synthesis and quantitative analysis of information on relevant natural and socioeconomic factors, in relation to ecosystem management objectives (Levin et al. 2009).

In the context of the California Current IEA, JSCOPE provides short term (six to nine month) forecasts of ocean condition that are testable and relevant to management decisions for fisheries, protected species and ecosystem health. Results will directly inform the IEA process, and will forecast indicators requested by the Pacific Fishery Management Council.

January 2016 J-SCOPE forecast

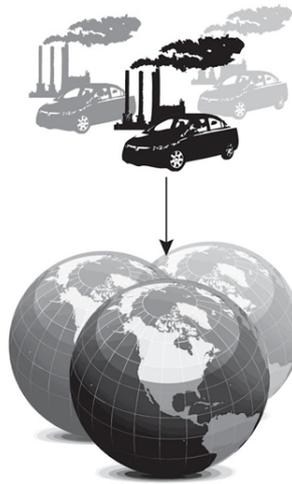


J-SCOPE (JISAO's Seasonal Coastal Ocean Prediction of the Ecosystem) is a FATE (Fisheries And The Environment) and OAP (NOAA Ocean Acidification Program) project, funded by NOAA and presented by NANOOS.

Alaska CLIMate Project

Anne Hollowed (AFSC, SSMA/REFM)
Kirstin Holsman (AFSC, REEM/REFM)
Alan Haynie (AFSC ESSR/REFM)
Stephen Kasperski (AFSC ESSR/REFM)
Jim Ianelli (AFSC, SSMA/REFM)
Kerim Aydin (AFSC, REEM/REFM)
Trond Kristiansen (IMR, Norway)
Al Hermann (UW JISAO/PMEL)
Wei Cheng (UW JISAO/PMEL)
André Punt (UW SAFS)

FATE: Fisheries & the Environment
SAAM: Stock Assessment Analytical Methods
S&T: Climate Regimes & Ecosystem Productivity



IPCC Scenarios (x3)

AR4 A1B
AR5 RCP6.0
AR5 RCP8.5

Global Climate Models (x 11)

ECHO-G (AR4 A1B)
MIROC3.2 med res. (AR4 A1B)
CGCM3-t47 (AR4 A1B)
CCSM4-NCAR- PO (AR5 RCP 6.0 & 8.5)
MIROCESM-C- PO (AR5 RCP 6.0 & 8.5)
GFDL-ESM2M*- PO (AR5 RCP 6.0 & 8.5)
GFDL-ESM2M*- PON (AR5 RCP 6.0 & 8.5)

Future Climate Scenarios



Climate-enhanced Biological Models



Fishing Scenarios



Bering Sea Models

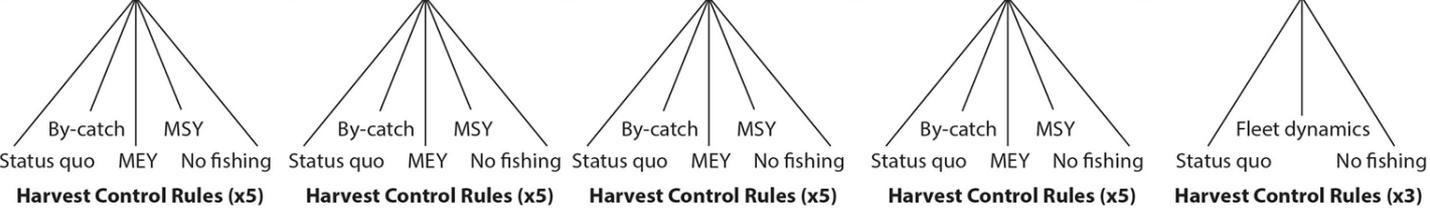
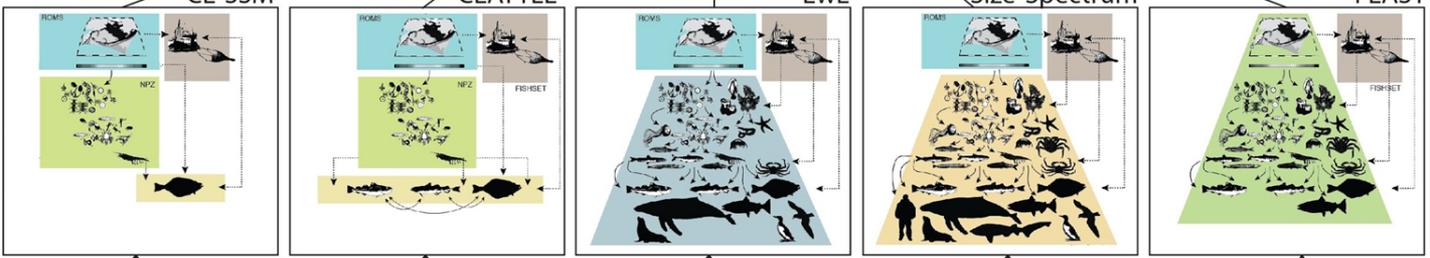
CE-SSM

CEATTLE

EwE

Size-Spectrum

FEAST



multiple non-linear pressures

multiple non-linear interacting pressures

NOAA IEA Program Planning and Implementation

Regional Work Plan Focus Areas



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- Core capacity building
 - E.g.'s of progress on Human Dimensions & Climate Change
- **Strategic projects (towards end-to-end IEA)**
- Cross-regional IEA National meeting & topical working groups**

Strategic projects: Partnership with National Marine Sanctuaries



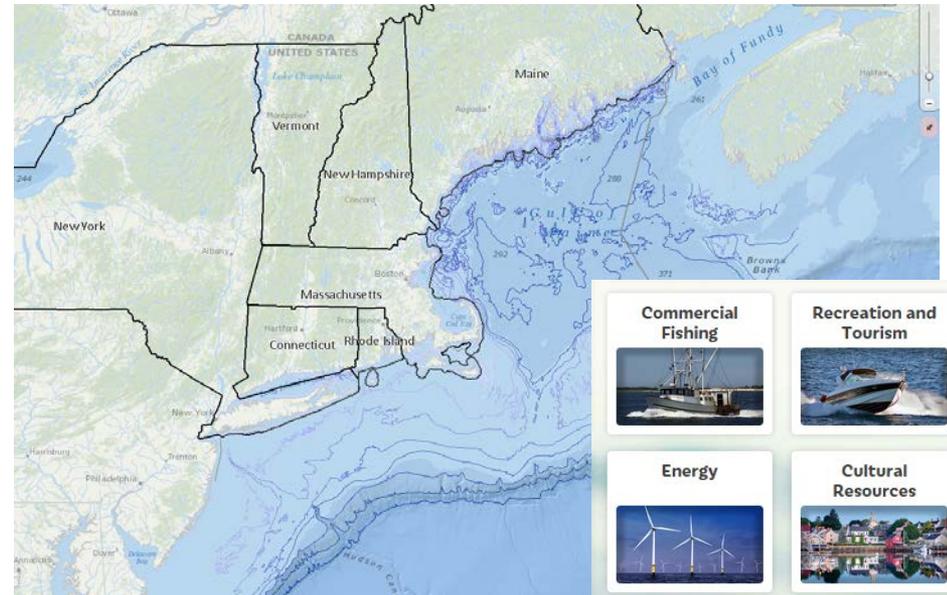
- Develop status assessments, risk analysis, and management strategies for West Coast Sanctuaries; incorporate into Condition Reports and management plans
- Activities include:
 - New spatially-relevant indicators to fill gaps for resource protection issues at species, community, & habitat levels
 - Identify and screen ecosystem indicators for Monterey Bay & Channel Islands Condition Reports
- Working towards full iteration of IEA
 - Complete cycle of loop in the Channel Islands NMS,
 - Focus on biodiversity and habitat questions in prior Condition Reports



Strategic projects: Engaged with the Northeast and Mid-Atlantic RPBs to support ocean planning



- Support the Northeast and Mid-Atlantic Regional Planning Bodies in establishing regional ocean management plans
 - continue collaborative efforts to further develop Ocean Data Portals & Regional Ocean Assessments
- Activities include:
 - Region-specific ecosystem service indicators & metrics
 - Maps for marine planning - use patterns, ecologically important/ vulnerable) areas
 - Directly contribute to the development of Ocean Management Plans



Commercial Fishing 	Recreation and Tourism 
Energy 	Cultural Resources 
Marine Life and Habitat 	Maritime Commerce 
Aquaculture 	Government Coordination 
Baseline Assessment 	

Strategic projects: River Diversions in Louisiana



Partnership between NOAA (SERO, AOML, SEFSC), ACE, State

- Support decision-making on Mississippi River diversions; develop adaptive management process to monitor post diversion
- Activities include:
 - Evaluate status, utility, path forward for biophysical & socio-economic modeling to assess diversion benefits & impacts
 - Select indicators (state & federal sources)
 - Use ecosystem services approach to understand ecological/economical trade-offs
 - Provide information for decision-making processes associated with diversion engineering & design, construction, operations, adaptive management



NOAA IEA Program Planning and Implementation

Regional Work Plan Focus Areas



Advance IEA development in all regions

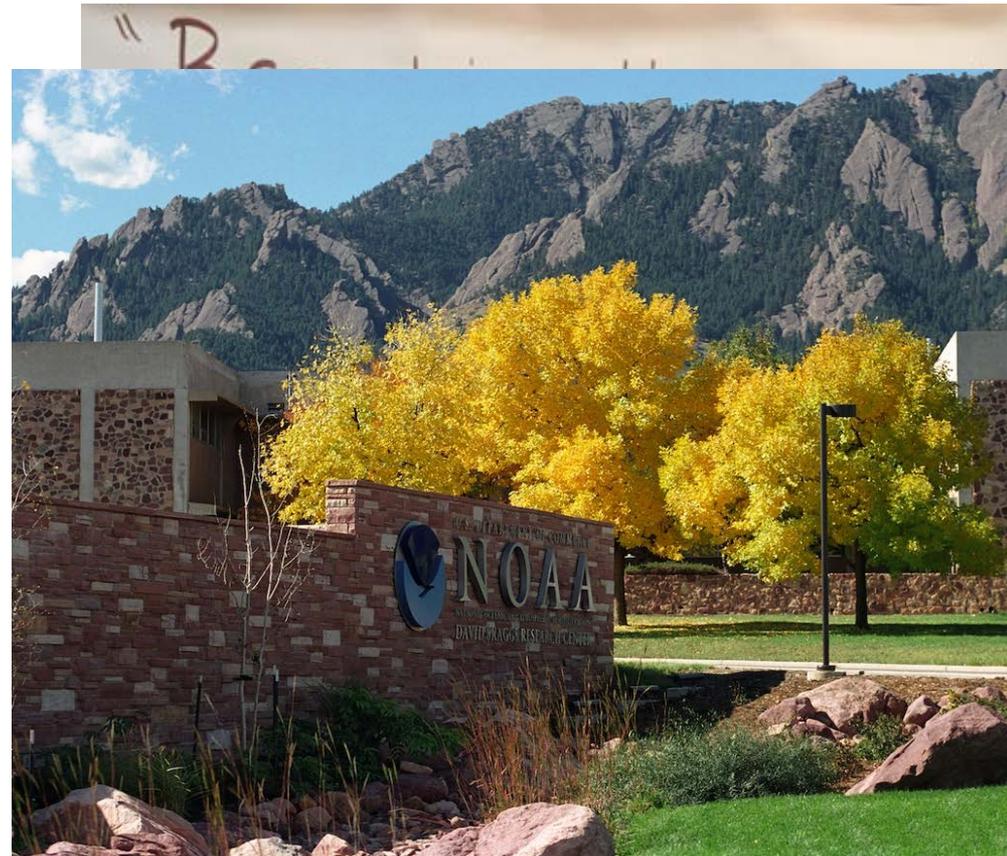
- Core capacity building
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IEA National “Face-to-Face” meetings 2011, 2012, 2014, 2016



2016 Themes:

- Human Dimension in IEA
- Climate Change in IEA
- “Closing the Loop”
- Cross-regional collaborations and WGs



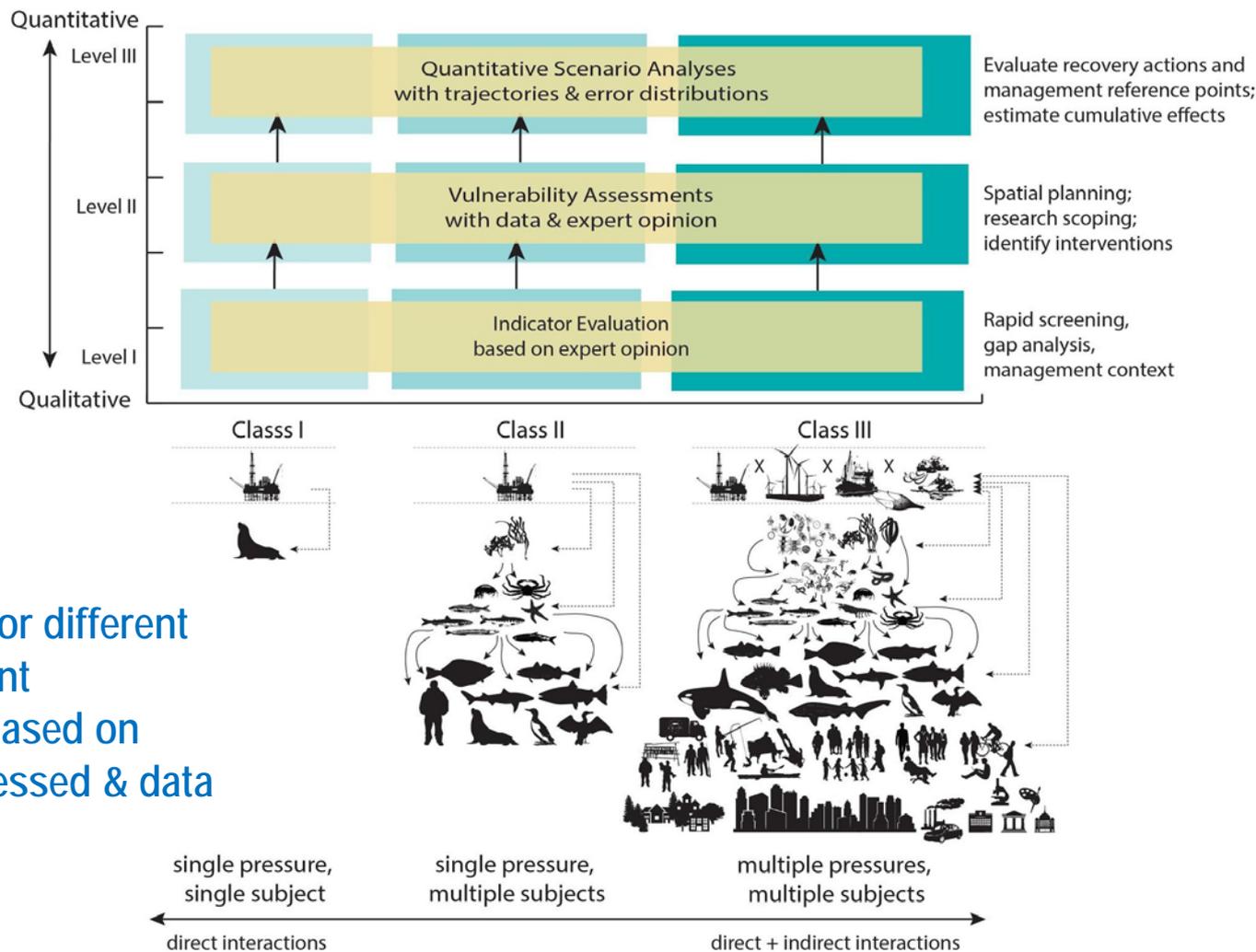
NOAA Escribano Center, Boulder, CO

Cross-Regional Topical Working Groups



- Web Development & Data Visualization
- Human Dimensions
- Climate Change Modeling
- Food Web Modeling
- Conceptual Ecosystem Models & Loop Analysis
- Thresholds & Reference Points (continued?)
- Risk Assessment (continued?)

Working Group product: Ecosystem Risk Assessment Framework



Methodology for different risk assessment complexities based on question addressed & data availability

Holsman, Samhuri, Cook et al. *in prep*

NOAA IEA and Fishery Management Councils

Engagement with Gulf of Mexico Fishery Management Council



March 2013 Standing & Ecosystem SSCs recommend Gulf of Mexico IEA, state, & academic partners:

- Work with SSCs to expand integration of ecosystem components in assessment & management of fishery resources
- Work in collaboration with SEDAR SC; data & assessment working groups to develop products to integrate ecosystem analyses into stock assessments



Engagement with Gulf of Mexico Fishery Management Council



IEA introduced ecosystem considerations in stock assessment model for gag grouper:

- Consideration of red tide mortality:
 - improved model fit
 - explained 36% of variation in natural mortality
 - incorporated into base stock assessment model
- Estimates of annual recruitment anomalies due to environmental conditions:
 - explained 1/3 of the variation;
 - inclusion in the model informed recent years of assessment where cohort strength was poorly estimated

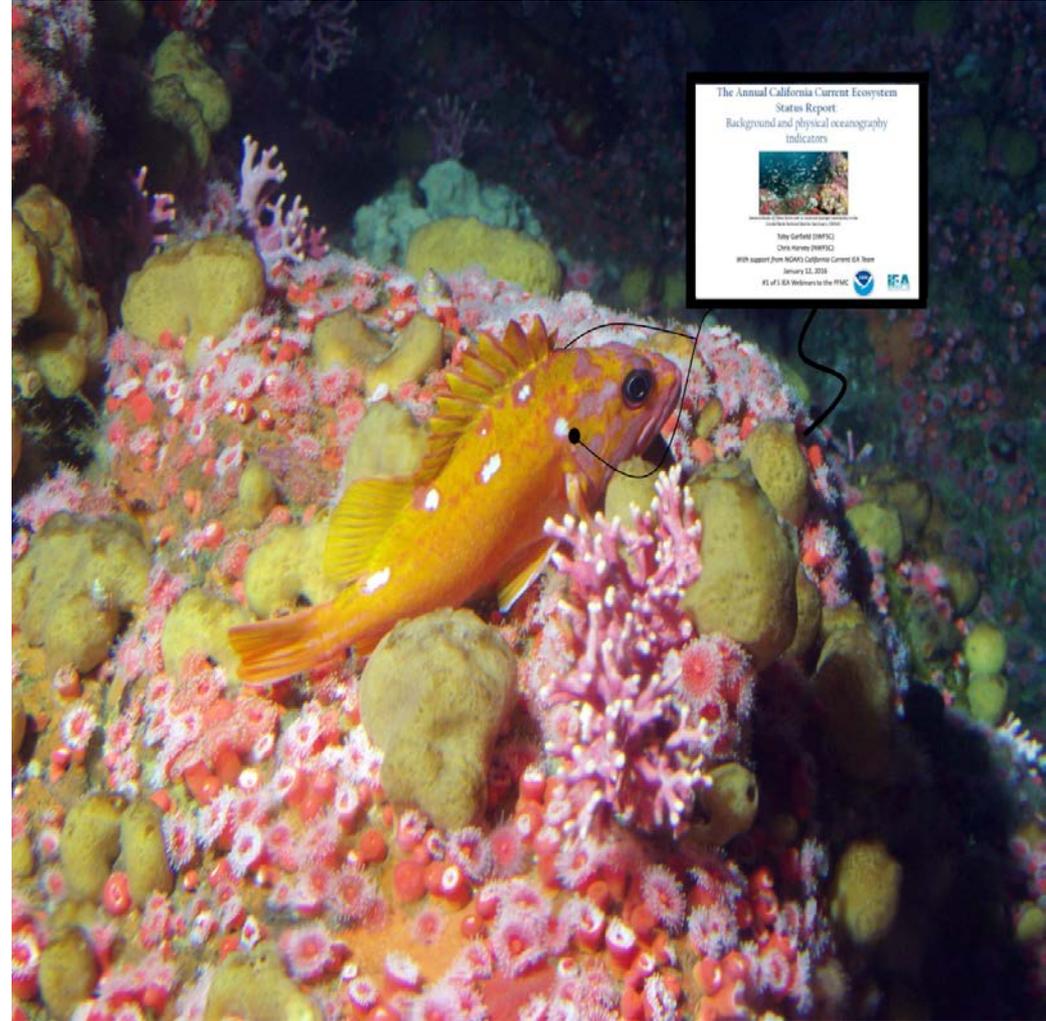


Engagement with the Pacific Fishery Management Council



March 2015:

- Council adopted “Coordinated Ecosystem Indicator Review Initiative” for FEP Scoping
- Directed Ecosystem WG, IEA Team, & SSC Ecosystem Subcommittee to assess performance of the indicators & how to better link to management decision-making.



Rosethorn rockfish watching the first webinar

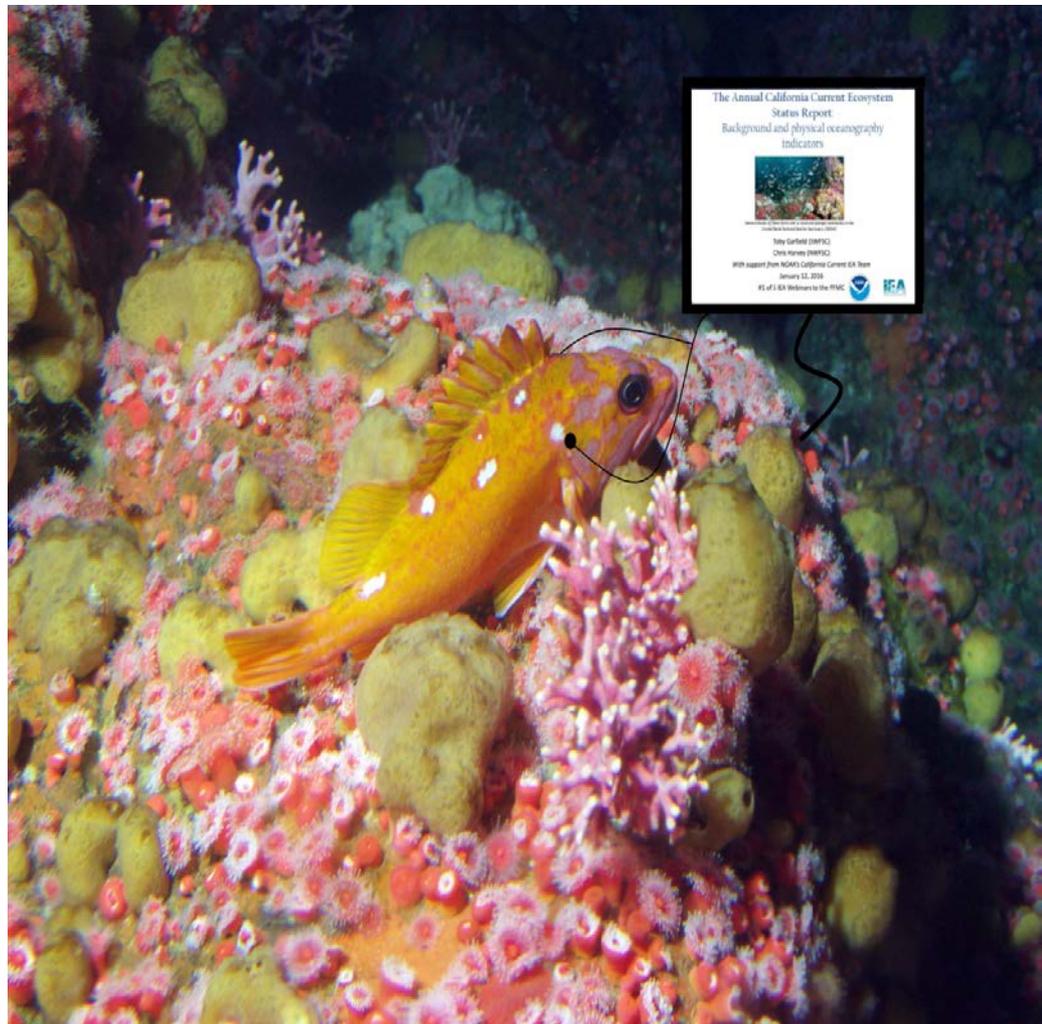
Engagement with the Pacific Fishery Management Council

2016 Webinar series on indicators:

- January 12: Physical Oceanography
- January 14: Biological
- January 26: Human Dimensions
- January 28: Freshwater, Estuarine, & Marine Habitat
- February 2: Risk Assessments & Application of Indicators to Decision Making

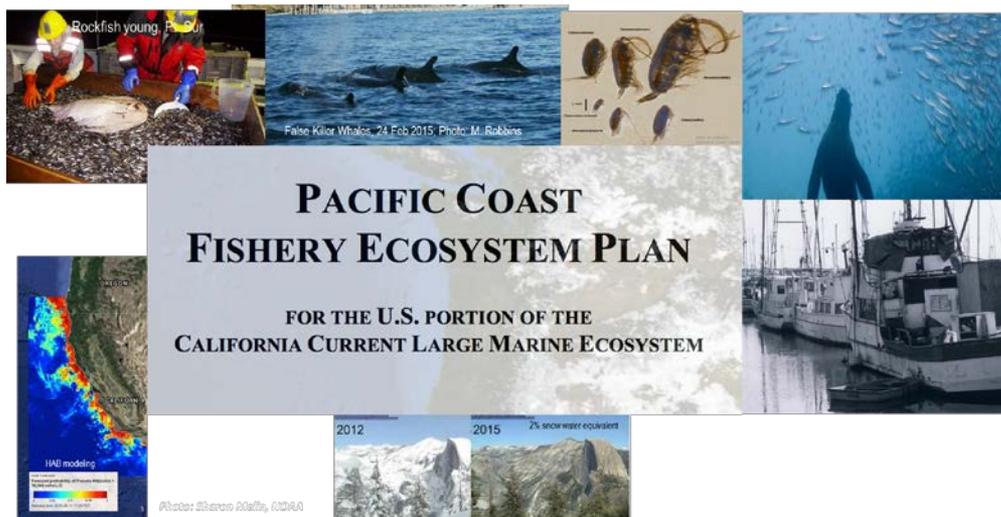
March 2016:

- Council plans to finalize ecosystem indicators at Sept 2016 meeting



Rosethorn rockfish watching the first webinar

Fisheries Ecosystem Plans (FEPs) – IEA support



Rockfish young

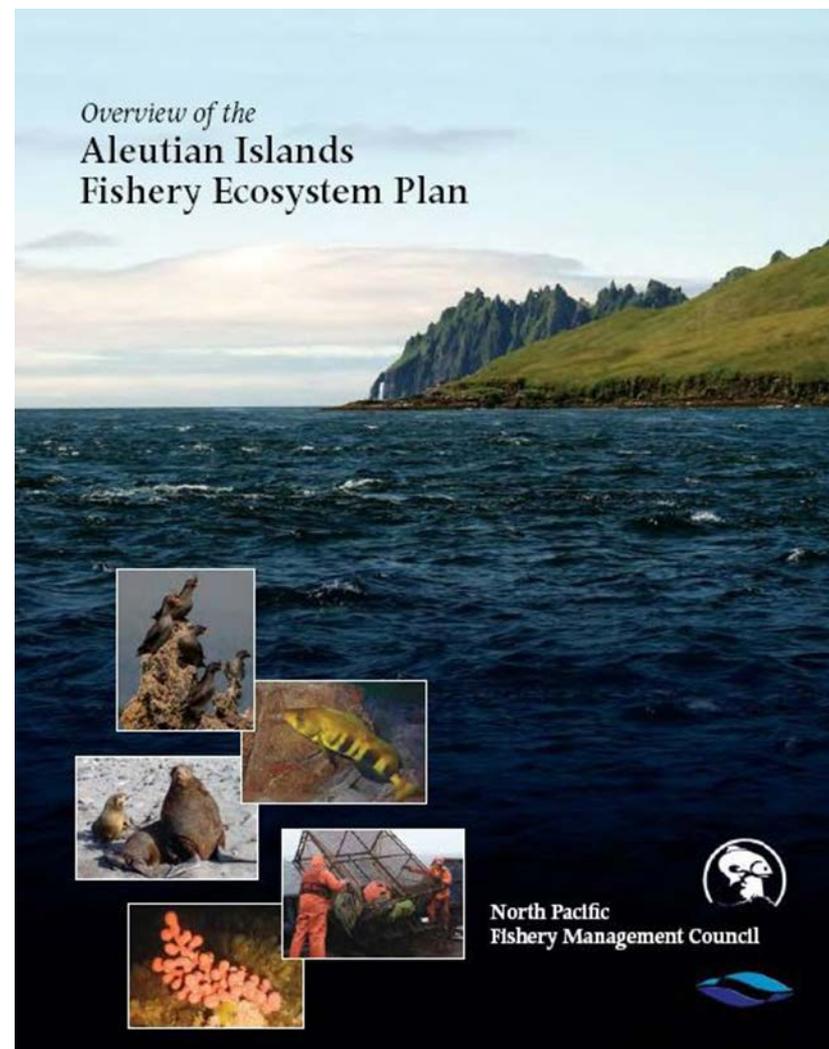
False Killer Whales, 24 Feb 2015, Photo: M. Robbins

**PACIFIC COAST
FISHERY ECOSYSTEM PLAN**

FOR THE U.S. PORTION OF THE
CALIFORNIA CURRENT LARGE MARINE ECOSYSTEM

2012 2015 2% snow water equivalent

Photo: Sharon Atelly, NOAA



Overview of the
Aleutian Islands
Fishery Ecosystem Plan

North Pacific
Fishery Management Council

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Communications: Ecosystem Status Reports/ Status and Trends



CALIFORNIA CURRENT INTEGRATED ECOSYSTEM ASSESSMENT (CCIEA) STATE OF THE CALIFORNIA CURRENT REPORT, 2015

A report of the CCIEA Team (NOAA Northwest, Southwest and Alaska Fisheries Science Centers) to the Pacific Fishery Management Council, March 8, 2015

1 INTRODUCTION

Section 1.4 of the 2013 Fishery Ecosystem Plan (FEP) outlines a reporting process wherein NOAA provides the Council with a yearly update on the state of the California Current Ecosystem (CCE), as derived from environmental, biological and socio-economic indicators. NOAA's California Current Integrated Ecosystem Assessment (CCIEA) team is responsible for this report. This marks our 3rd such report, with prior reports in 2012 and 2014.

The highlights of this report are summarized in Box 1.1. Sections below provide greater detail. In addition, a list of supplemental materials is provided at the end of this document, in response to previous requests from Council members or the Scientific and Statistical Committee (SSC) to provide additional information, or to clarify details within this short report.

Box 1.1: Highlights of this report

- The Northern California Current developed in 2014.
- Basin-wide trends in both shifted.
- After a record average up.
- After several years of sharp decline in 2014, it is up.
- Central Valley trends elsewhere.
- There are preliminary yellow/red trends.
- Following a period of however, productivity.
- Although biomass mortality.
- Commercial species: crab.
- Diversification indicate greater.
- There is some

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 ecosystem components, the physical environment, and human communities, and (3) the recognition that humans are an integral part of the ecosystem. We need to account for the important goods and services derived from marine ecosystems and the diverse and cumulative impacts of human activities in these systems (Figure 1) to forge a sustainable future.

The importance of implementing marine Ecosystem-based Management in the United States has recently been highlighted with the adoption of a new National Ocean Policy, established under

NOAA Technical Memorandum NMFS-SEFSC-653

ECOSYSTEM STATUS REPORT FOR THE GULF OF MEXICO

Mandy Karnaukas, Michael J. Schirripa, Christopher R. Kelble, Geoffrey S. Cook and J. Kevin Craig

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, Florida 33149

December 2013



Figure 1. Examples of some important ecosystem services (blue icons), stressors (red), adverse effects (yellow), and issues of special concern (green) that will be considered in Ecosystem-based Management on the Northeast U.S. Continental Shelf (adapted from image by Barbara Ambrose, National Coastal Data Development Center).

WEST HAWAI'I
INTEGRATED ECOSYSTEM ASSESSMENT
ECOSYSTEM TRENDS AND STATUS REPORT

Alaska Marine Ecosystem Considerations

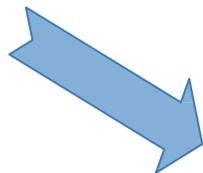
Home Report Assessments Report Cards Hot Topics Links

The Ecosystem Considerations report is produced annually to compile and summarize information about the status of the Alaska Marine Ecosystem for the North Pacific Fisheries Management Council, the scientific community and the public. The report includes ecosystem report cards, ecosystem assessments, and ecosystem and ecosystem-based management indicators for the Eastern Bering Sea (EBS), Aleutian Islands (AI), the Gulf of Alaska (GOA), and Arctic ecosystems.

<p>Eastern Bering Sea</p> <ul style="list-style-type: none"> Assessment Report Card Hot Topics Chum Salmon Bird Sightings 	<p>Aleutian Islands</p> <ul style="list-style-type: none"> Assessment Report Card
<p>Gulf of Alaska</p> <ul style="list-style-type: none"> Assessment Report Card Hot Topics Tox Vilems? Age-U Pollack Marine Mammals 	<p>Arctic</p> <ul style="list-style-type: none"> Assessment Hot Topics Polar Bears



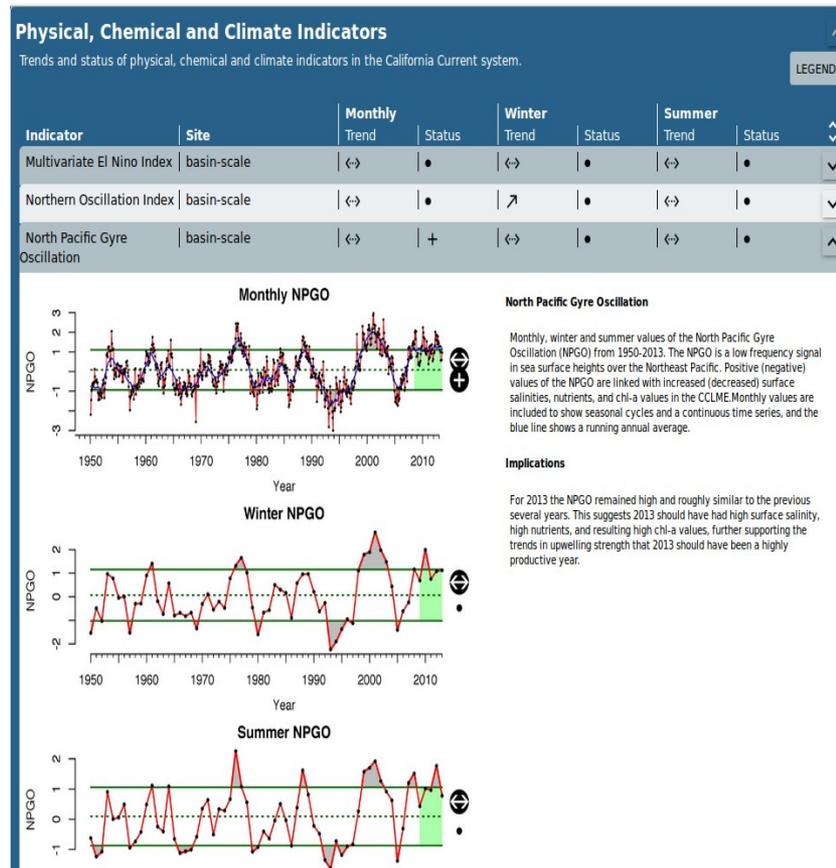
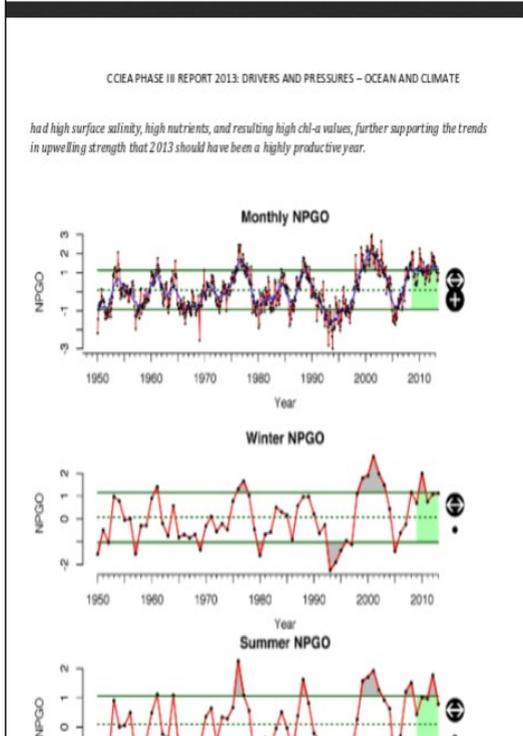
Communications: Transformation of CCIEA PDF report to dynamic web-based report (thanks to ERDDAP)



NPGO

The North Pacific Gyre Oscillation (NPGO) is a low frequency signal in sea surface heights over the Northeast Pacific. Positive (negative) values of the NPGO are linked with increased (decreased) surface salinities, nutrients, and chl-a values in the CCLME (Di Lorenzo et al. 2006). Many NPGO events since 1975 seem to have been more extreme or had a longer duration than those earlier in the time series (Figure OC28). Winter and summer trends were very similar with a broad low from 1991 to 1997 and a peak from 1998 to 2004. Since 2006, values have been increasing with the past 5 years falling around or above 1 standard deviation from the mean. **For 2013, the NPGO remained high and roughly similar to the previous several years. This suggests 2013 should have**

OC-46



<http://www.noaa.gov/iea/regions/california-current-region/indicators/climate-and-ocean-drivers.html>

Communications: Tri-fold Brochure

A New Era of Ocean Stewardship

Do you know...?

- The current condition of the oceans and coasts?
- The many benefits provided to society by the oceans and coasts?
- How human activities and environmental variability may affect ocean and coastal condition and benefits to society?
- What actions can be taken to sustain ocean and coastal ecosystems and support human well-being?

To answer these questions, look to Ecosystem-Based Management (EBM)

Ocean and coastal ecosystems, and the benefits they provide, are vital to human well-being. Ecosystem-Based Management differs from traditional management approaches, which focus on a single species, sector, or activity. EBM includes humans as part of the ecosystem. It provides a basic framework to more effectively manage ocean and coastal ecosystems and consider both human and environmental pressures. Implementing an ecosystem-based approach may seem daunting, but with the right tools it can be done.

Where do you start? With an Integrated Ecosystem Assessment (IEA)

Why conduct an IEA?

Ocean and coastal resource management is increasingly complex. Addressing management challenges in a changing environment and across multiple and competing ocean and coastal uses is critical for effective decision-making and management. This is needed to sustain ecosystem services that are desired by society. By providing ecosystem-based decision-support, an IEA promotes healthier ecosystems, sustainable practices, and long-term social and economic benefits for you and your community.

What does an IEA provide?

An IEA develops a number of diverse products that provide scientific information and knowledge to the management community. An IEA is tailored to each IEA region and management question.

Examples of General IEA Products:

Conceptual and quantitative models	Forecasts of future ecosystem conditions and services	Ecosystem Status Reports
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Ultimate product: Comprehensive information provided to managers to support and inform ecosystem-based management decisions

Examples of Specific IEA Products:

Evaluation of trade-offs between provision of clean energy from proposed wave energy sites, their potential footprint on the ocean ecosystem, and their interaction with other ocean uses or conservation strategies.	Development of models that examine the effect of management actions on diverse ecosystem services.
Incorporation of effects of climate change and environmental variability on ocean ecosystems and their fisheries to help predict how future changes to the system may influence availability of fish to the industry and for human consumption.	Analysis of whale population density and ocean conditions to map habitat use, which allows managers to forecast probability of whale presence and assess critical habitat enabling development of ecosystem-based protection measures.
	Assessment of competing uses of space among different sectors and potential cumulative impacts and threats to ecosystem services.

An IEA...

Considers multiple, interacting human and natural influences on ocean and coastal ecosystems	Predicts outcomes of alternative management actions, enabling informed decisions
Helps decision-makers balance trade-offs between ocean and coastal uses and ecological and societal priorities	Fosters healthy and productive ocean and coastal ecosystems to better serve human interests now and in the future

Steps of the IEA process

1. Define ecosystem-based management goals
2. Define ecosystem indicators
3. Assess the ecosystem
4. Analyze uncertainty and risk
5. Evaluate management strategies
6. Implement management action
7. Monitor ecosystem indicators
8. Evaluate, assess outcomes

The process is iterative to allow for improved understanding and management of the ecosystem over time.

What is an IEA? A Framework to Inform Ecosystem-Based Management

An Assessment (IEA) is an iterative, decision-making process that provides products to managers in an ecosystem context. The process with managers and stakeholders, sale and analysis of information on multiple factors, and considers potential management actions from both human and environmental perspectives.

IEA is to inform Ecosystem-Based Management. EBM promotes ecosystems that are capable of providing diverse ecosystem services to the oceans and coasts.

IEA Regional Snapshots

IEAs are currently being developed for 5 of 8 Regional Ecosystems

The **Alaska Complex** is made up of 3 interconnected high latitude ecosystems: Gulf of Alaska, Aleutian Islands, Beaufort Sea, Eastern Bering Sea, and Chukchi Sea. Focal ecosystem components include climate change, fishing, and energy extraction activities.

The **California Current** spans nearly 3000 km in the eastern North Pacific Ocean from British Columbia, Canada to Baja California, Mexico. Focal ecosystem components include increased coastal population growth, climate change, changing ocean conditions, fishing, and energy (oil, gas, and renewable energy).

The **Gulf of Mexico** is a semi-enclosed, sub-tropical, coastal sea in the Southeast U.S. Focal ecosystem components include climate change, fishing, energy, population growth, recreation and tourism, shipping, and habitat loss.

The **Northeast Shelf** is a temperate system in the Northwest Atlantic Ocean ranging from the Gulf of Maine to Cape Hatteras. Focal ecosystem components include fishing, coastal population growth, shoreline development and alteration, nutrient runoff, industrial pollution runoff, high vessel traffic, and energy (wind farms).

The **Pacific Islands** regional IEA focuses on the Kona coast of Hawaii in the Eastern Tropical Pacific. Focal ecosystem components include fishing, climate change, ecotourism, and aquaculture.



“NOAA’s IEAs are able to simultaneously and quantitatively meet all mandated responsibilities for ocean and trust species stewardship. In fact, it’s the best-developed framework I’ve seen to assess, inform and manage multiple uses of marine ecosystems.”

— Dr. Jason Link, Senior Scientist for Ecosystems, NOAA Fisheries

For more information on IEAs:
www.noaa.gov/iea/



Integrated Ecosystem Assessments

Communications: Recent NMFS Feature Story



NOAA FISHERIES
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

40 MAGNUSON STEVENS ACT
A Journey to Sustainable Fisheries
#MSA40—LEARN MORE

A Missing Ingredient in the Recipe for Healthy Ecosystems
NOAA Fisheries social scientists stress the importance of human dimensions in environmental management.

By Matt Ellis | Posted: June 9, 2016

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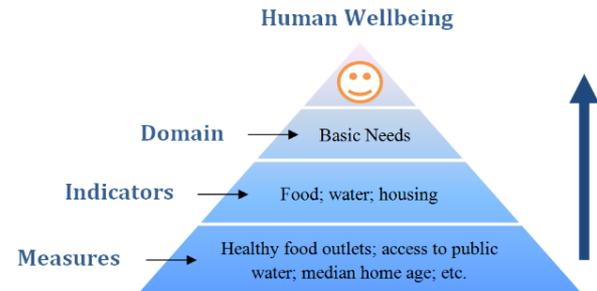


Why are humans essential to the management process?

People are part of the ecosystem, but too often we are guilty of operating as an external entity, overseeing the state of the "natural world" without considering our place in it and our desires for its ideal condition.

This detachment can be detrimental to the effectiveness of management decisions, according to social scientists Karma Norman (NOAA's Northwest Fisheries Science Center) and Melissa Poe (Washington Sea Grant), who co-authored the Science paper with the Social Well-being Indicators for Marine Management (SWIMM) team. Management decisions affect the well-being of the environment, but they affect human well-being too. Human well-being can also drive which management decisions are made in the first place.

Despite this, the concept of human well-being is largely absent from many efforts to pursue sustainability goals. To improve future management decisions, the SWIMM team proposed a set of social indicators that allow human well-being to be incorporated in all management plans.



Measurements inform social indicators, which in turn define the domain. The basic needs domain (illustrated here) is one of ten that make up the social concept of human well-being.

<http://www.nmfs.noaa.gov/stories/2016/06/social-science.html>

Communications: On the Web

WWW.NOAA.GOV/IEA



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Welcome to NOAA's Integrated Ecosystem Assessment Program

NOAA's IEA program supports Ecosystem-Based Management (EBM), a new approach to managing fisheries and other resources by providing a next generation tool and helping transfer scientific knowledge to managers. The program is currently being implemented in 5 regions across the United States.



Multimedia



Regions



Publications

IEAs: A Next Generation Tool

IEAs are intended to provide a structure to assess ecosystem status relative to objectives, account for the holistic impact of management decisions, and guide management evaluations. [Read More...](#)



Transferring Scientific Knowledge to Management

- Ecosystem Function and Response to change
- Ecosystem Status, Trends and Pressures
- Management and Future Ecosystem Conditions

[Read More...](#)

Update, upgrade, relaunch is under development (e.g. IEA Web Development WG)

Outline

- The NOAA IEA Program, Framework, and Vision
- Origin and History of NOAA IEA
- NOAA IEA Program Structure
- Why NOAA IEA
- NOAA IEA Program Planning and Implementation
- Communications
- **Strengths, Challenges, Solutions**

Strengths



- Has provided integrated common framework that brings disciplines (and programs and LOs) together (breaking the silos); Provides framework for ongoing work to be elevated for wider application (synthetic program)
- Has energized new ways of thinking; catalyzing inclusion of ecosystem context into decision processes (e.g. ecosystem models, risk & vulnerability analysis; trade-offs & MSE)
- Platform to communicate, advance & support transition to more ecosystem-based approaches
- Supporting existing agency priorities (e.g. Climate Vulnerability Assessments; Sanctuaries; Diversions; Councils)
- Ready to support emerging more ecosystem-based decision support (e.g. EBFM Roadmap; Regional Climate Action Plans; Regional Planning Bodies)

Challenges *(solutions)*

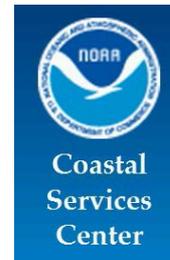
- No clear “institutional” or governance framework/ mandate for IEA products to plug into
 - *Continued outreach to enhance trust w/ current management bodies and policy*
 - *Refinement of existing management policies to be more explicit about ecosystem approach*
- Requests for “ecosystem” context still more informational than operational; often driven by “crisis” [in Councils] (but that is changing); Difficult to track/ trace research results into management (use/ impact)
 - *Ongoing and new partnerships with management bodies providing products that enhance their work*
 - *Strategic projects will provide clear examples of impact/ use of IEA research into management*
- Building capacity for IEA and “closing the loop” takes time – we need to manage expectations!
 - *Importance of establishing relationships, trust and confidence [with partners] should not be underestimated*
- These aspects not firmly in our control
 - *We are in a position to chip away at these challenges – and we are...*
- We need to do a better job of communicating our stories and success – there is still a general lack of appreciation for all the great work we do
 - *Hire dedicated IEA comms specialist*
 - *Update and upgrade web-site/ web-presence*
 - *Key element of regions’ work has always been & continues to be outreach & comms*

LARGE AMBITIOUS GOALS REQUIRE COLLABORATION

(e.g. Gulf of Mexico IEA)



Gulf of Mexico **LME**



The NOAA IEA Approach

Management Strategy Evaluation

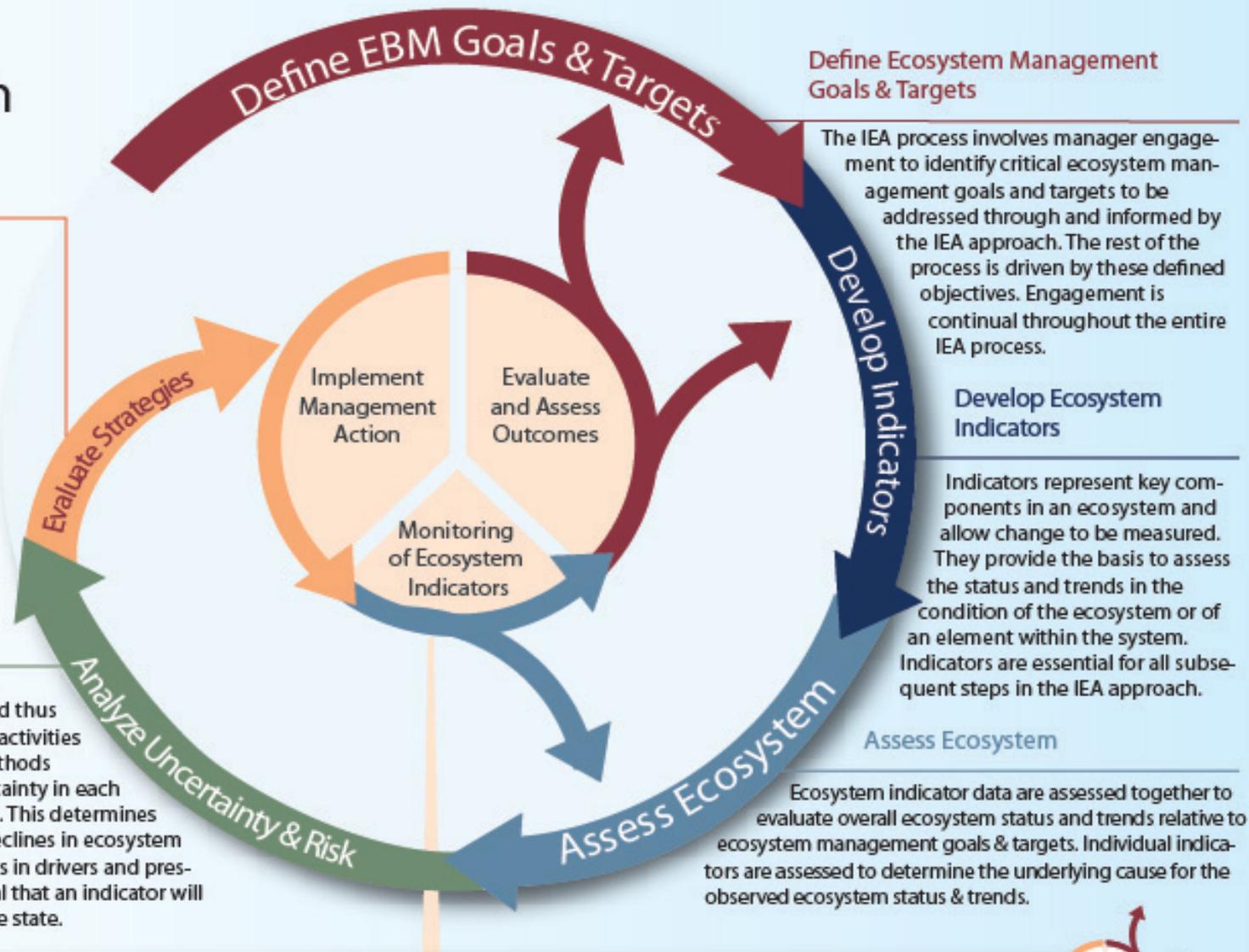
MSE is useful to help resource managers consider the system trade-offs and potential for success in reaching a target which helps make informed decisions. It uses simulation through ecosystem modeling to evaluate the potential of different management strategies to influence the status of natural and human system indicators and to achieve our stated ecosystem objectives.

Analyze & Evaluate Uncertainty & Risk

Ecosystem analyses and models evaluate risk to the indicators and thus the ecosystem posed by human activities and natural processes. These methods incorporate the degree of uncertainty in each indicator's response to pressures. This determines incremental improvements or declines in ecosystem indicators in response to changes in drivers and pressures and to predict the potential that an indicator will reach or remain in an undesirable state.

Taking, Monitoring, and Assessing Action

Based on the MSE, an action is selected and implemented. Monitoring of indicators is important to determine if the action is successful; if yes, the status, trends, and risk to the indicators continue to be analyzed for incremental change; otherwise as part of adaptive management, the outcomes need to be assessed and evaluated to refine goals and targets or indicators towards achieving objectives.



Backup/ additional: Regional Work Plan Priority Goals and Associated Objectives

Core Capacity Building Alaska



- PRIORITY GOAL #1: Next generation ecosystem-based assessments and management strategy evaluations for the Bering Sea
 - Updating & running end-to-end climate-driven modelling suite for the Bering Sea ecosystem, results requested by the NP FMC as part of analyses for FEP
- PRIORITY GOAL #2: The development of Ecopath and Ecosim R modeling tools
 - Complete and release Monte-Carlo simulations and fitting tools designed to quantify uncertainty in Ecopath and Ecosim models
- PRIORITY GOAL #3: Comparative conceptual modeling and scoping of the Bering Sea and Gulf of Alaska (support FEPs)
 - Conceptual models for the Bering Sea and Gulf of Alaska

Core Capacity Building Northeast



- PRIORITY GOAL #1: Complete first iteration of a full IEA cycle for the Northeast Region
 - Enhance ESR with indicators related to ecosystem services, threats sustainable delivery services, and specification of reference points
 - Initiate Formal Tradeoff Analyses as a Decision Support Tool
 - Finalize Conceptual Models Connecting Ecosystem Services to Drivers of Change
 - Enhance Climate Web Portal & High Resolution Climate Model Outputs; apply regionally downscaled climate information in support of EBM
 - Support development of Stellwagen Bank NMS Condition Report(s)
 - Apply new High Resolution Climate Models and regionally downscaled information to support EBM
 - Develop Risk Assessment Framework to Evaluate Vulnerability of Social & Ecological Components of Northeast Shelf Ecosystem to Climate Change & Resource Extraction Policies

Core Capacity Building Northeast con't



- PRIORITY GOAL #2: Support Regional Management Authorities Move To EBM through Participation in Advisory Committees and Panels of RPBs and FMCs
 - Undertake MSE in Support of EBM using Atlantis
 - Implement NCCOS Biogeographic Assessment Framework as a decision support process
 - Complete Development of Multispecies Bioeconomic Model with Climate Inputs for Georges Bank
 - Contribute to development of NE Regional Planning Body (RPB) Ocean Management Plan
 - Continue contributions to development of FEP for the NEFMC
 - Continue contributions to development of EAFM Guidance Document for MAFMC

Core Capacity Building Gulf of Mexico



- PRIORITY GOAL #1: Implement socioecological IEA on SW Florida shelf to inform place based management
 - Select consistent indicators for use throughout that assess full SES & respond to goals of the various management entities
 - Produce SW Florida shelf ESR that nests within the Gulf of Mexico ESR
 - Quantitatively link ecosystem conditions to ecosystem services & human wellbeing
 - Conduct risk assessments to evaluate future conditions of ecosystem states & services
 - Evaluate Management Scenarios that aim to increase resiliency of ecosystem, its services, & well-being of human community under climate change scenarios

Core Capacity Building Gulf of Mexico con't



- PRIORITY GOAL #2: Exchange information between US and Mexico on ecosystem assessments in GoMx & work to develop collaboration strategy on high priority research topics
 - Convene a workshop of U.S. and Mexican scientists to discuss the current state of science throughout the Gulf LME, across a range of disciplines.
 - Develop recommendations for binational research partnerships relevant to IEA

Core Capacity Building Gulf of Mexico con't



- PRIORITY GOAL #3 Continue dialog with Gulf of Mexico FMC & build climate change-ready Harvest Control Rules through MSE
 - Continue dialog with the GMFMC through advisory body, SSC on management performance measures
 - Operationalize red tide index to describe past trends in episodic mortality; develop predictive models for likelihood of changing frequency of future episodic events.
 - Continue work on single- & multi-species MSE to understand if current management frameworks for Florida West Shelf snapper/grouper fishery are robust to predicted and unforeseen climate change
 - Carry out MSE to investigate implementation of optimal yield for the snapper-grouper complex of the WFS

Core Capacity Building Gulf of Mexico con't



- PRIORITY GOAL #4 Conduct an IEA to support NMFS decision-making on Mississippi River diversions and develop adaptive management process to monitor post diversion impacts
 - Review and evaluate status, utility, and path forward of current biophysical and socio-economic modeling efforts to assess diversion benefits and impacts on important resources.
 - Select indicators from a variety of state and federal sources
 - Gap analysis and filling to identify monitoring and/or modeling techniques for indicators identified in previous objective (special emphasis on improving socioeconomic indicators)
 - Use ecosystem services approach to understand ecological/economical trade-offs associated with diversion projects
 - Provide useable information to decision-makers for application to decision-making processes associated with diversion engineering & design, construction, operations and adaptive management.

Core Capacity Building West Hawaii



- PRIORITY GOAL #1: Fully implement IEA for coral reef ecosystems.
 - Select consistent indicators for use throughout the region that assess the full SES & respond to goals of varying management entities
 - Conduct ecosystem modelling of West Hawai'i's coral reef ecosystem
 - Conduct risk assessments of coral reef ecosystem
 - Evaluate Management Scenarios based on Hawai'i's coral reef management plan
- PRIORITY GOAL #2: Expand Human Dimensions within the West Hawai'i IEA
 - Broaden scope of IEA to include human interactions with additional ecosystems (beyond coral reefs)
 - Build-upon recent participatory mapping efforts & better assess spatial variability in human uses and delivery of ecosystem services.
 - Analyze uncertainty and risk to essential ecosystem services identified in 1 & 2
- PRIORITY GOAL #3: Expand Research to Support Community-Based & State Management Efforts
 - Conduct research on management-relevant aspects of marine ecosystem dynamics

Core Capacity Building West Hawaii con't



- PRIORITY GOAL #4: Increase Community Involvement and Collaborative Activities
 - Broaden community input for additional ecosystems (beyond coral reefs)
 - Broaden community & management interest & showcase IEA-related, collaborative ecosystem research
 - Outreach & science-based communications to maximize community input & management uptake
- PRIORITY GOAL #5: Estimating the Impact of Climate Change
 - Downscaled global climate model output of SST from the recent IPCC AR5 climate assessment
 - Assess effects of future warming to marine ecosystem dynamics
 - Evaluate management scenarios that aim to increase resiliency of the ecosystem & its associated services under climate change scenarios

Core Capacity Building California Current



- PRIORITY GOAL #1: Provide key end-users w/ management-relevant, fully integrated science products on the nature & importance of ecosystem variability, at multiple spatiotemporal scales and social-ecological domains
 - Continue working with the PFMC to develop and integrate science products that support EBFM and initiatives in the FEP
 - Provide the WCRO Protected Resources Division w/ integrated science products in support of EBM for protected resources
 - Conduct full IEA loop to develop estimates of baleen whale ship strike likelihood under future climate conditions & shipping scenarios
 - Provide the PFMC, WCRO, & other end users w/ ecosystem model outputs to evaluate management strategy alternatives and tradeoffs

Core Capacity Building California Current con't



- PRIORITY GOAL #2: Develop status assessments, risk analysis, and management strategies for West Coast National Marine Sanctuaries, and incorporate them into Sanctuary Condition Reports and management plans
 - Identify and screen ecosystem indicators for inclusion in Monterey Bay NMS Condition Report
 - Complete a cycle of the IEA loop in the Channel Islands NMS with a focus on biodiversity and habitat questions from prior Condition Reports
 - Facilitate other integrated ecosystem research collaborations between West Coast NMFS Science Centers and West Coast Sanctuaries to support Condition Reports, develop indicator time series, and close data gaps

Core Capacity Building California Current con't



- PRIORITY GOAL #3: Develop robust metrics of human wellbeing, activities, risk, & vulnerability to changes in marine resource status, condition & management along coast.
 - Continue development and application of indicators for human wellbeing
 - Develop & assess community social vulnerability indicators for coastal communities
 - Develop frameworks to determine how fishery effort, participation & revenues respond to changes in environment & fisheries management actions
 - Assess economic impacts of drought and freshwater allocation on multiple sectors of water users in Central California
 - Conduct spatial analysis of human activities indicators for use in place-based marine EBM

Core Capacity Building California Current con't



- PRIORITY GOAL #4: Provide key end-users w/ management-relevant, fully integrated science products on the nature & importance of long-term climate change in the CC
 - Develop quantitative risk assessments of forage fish species & forage fish fisheries to climate change
 - Assess climate change risk to CCLME fauna as a function of life history
 - Estimate impacts of ocean acidification on the CCLME through ecosystem modeling, MSE & economic modeling
 - Estimate socio-cultural risks posed by OA to coastal communities
 - Estimate the potential changes in CCLME habitats caused by climate change
 - Determine extent LMR distributions in the CCLME are changing spatiotemporally & if those changes may be connected to climate change

Core Capacity Building California Current con't



- PRIORITY GOAL #5: Identify ecosystem reference points & early warning indicators using advanced statistical methods
 - Develop framework for quantifying ecosystem reference points & apply framework to indicator time series
 - Develop a State Index & Early Warning Index, based on summaries of biological time series, that can be used as management tools to detect future ecological regime shifts
- PRIORITY GOAL #6: Enhance CCIEA communication, coordination, data sharing, outreach, & transferability of products.
 - Improve CCIEA website & accessibility of web-based data and products
 - Develop & improve visualization tools that illustrate CC ecosystem status, trends, processes, relationships & responses
 - Provide templates of products and tools to other IEA regions
 - Build contacts w/ other agencies, institutions, & regional/global science organizations