Ecosystem-Based Fisheries Management

NOAA FISHERIES
Office of Science & Technology

Council Member Training

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October 23, 2013

Outline

- Definitions
- Why do we need to focus on ecosystems?
- What are the important characteristics and benefits of Ecosystem-Based (Fisheries) Management (EB(F)M)?
- Some ongoing efforts to coordinate science & management for EBFM.

What is an ecosystem?

<u>NOAA's Ecosystem Definition</u>

A geographically specified system of organisms (including humans), and the environment and the processes that control its dynamics.

The environment is the biological, chemical, physical and social conditions that surround organisms.

What is Ecosystem-Based Management?

- Ecosystem-based management (EBM) is:
  - geographically specified (place based)
  - adaptive
  - takes account of ecosystem knowledge & uncertainties
  - considers multiple external influences
  - strives to balance diverse social objectives (tradeoffs between sectors)

What is Ecosystem-Based Fisheries Management?

- The dimension of EBM that deals specifically with fisheries.
- Need to make sure that as an EBFM approach is developed, it can be fully integrated into the more comprehensive EBM framework.
- Ultimately, EBFM initiatives by the Councils will become a key component of EBM.

Ecosystem-based fishery management recognizes the physical, biological, economic and social interactions among the affected components of the ecosystem and attempts to manage fisheries to achieve a stipulated spectrum of societal goals, some of which may be in competition.

3 Levels of Marine Ecosystem Management

1. Ecosystem-Based Management (EBM)
– multiple ocean use sectors are discussed and strategic decisions made as to various tradeoffs among sectors

2. Ecosystem-Based Fisheries Management (EBFM)
– has facets of both strategic & tactical decisions solely within the fisheries sector

3. Ecosystem Approach to Fisheries (EAF)
– adds ecosystem factors into fisheries stock assessments for tactical management decisions

Based on: Ihde & Townsend. 2013. Interview with Jason Link. Fisheries 38(8) 363-369.

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- **Why do we need to focus on ecosystems?**
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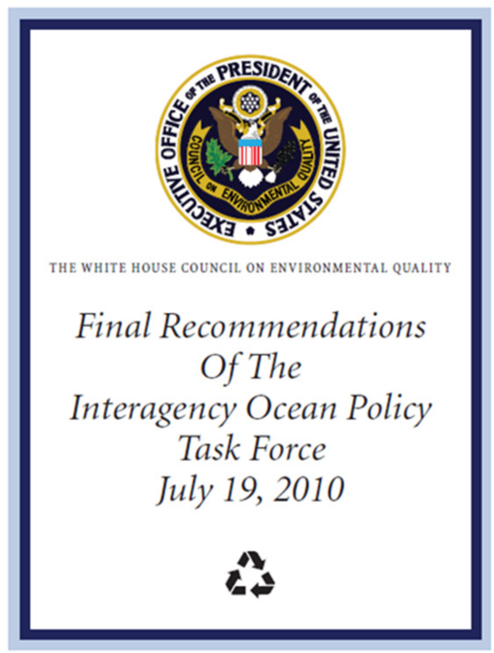
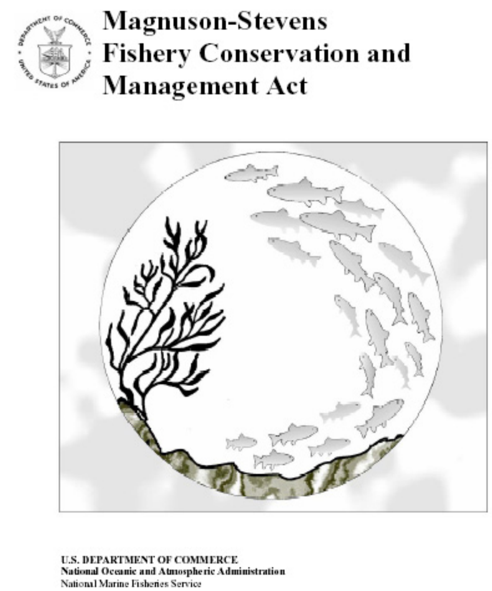
Why an Ecosystem Approach to Management?
Are we allowed to do ecosystem based management?

- Numerous mandates drive how we manage marine ecosystems in the U.S.
- Are able to do EBM under existing mandates.



MSA 2007

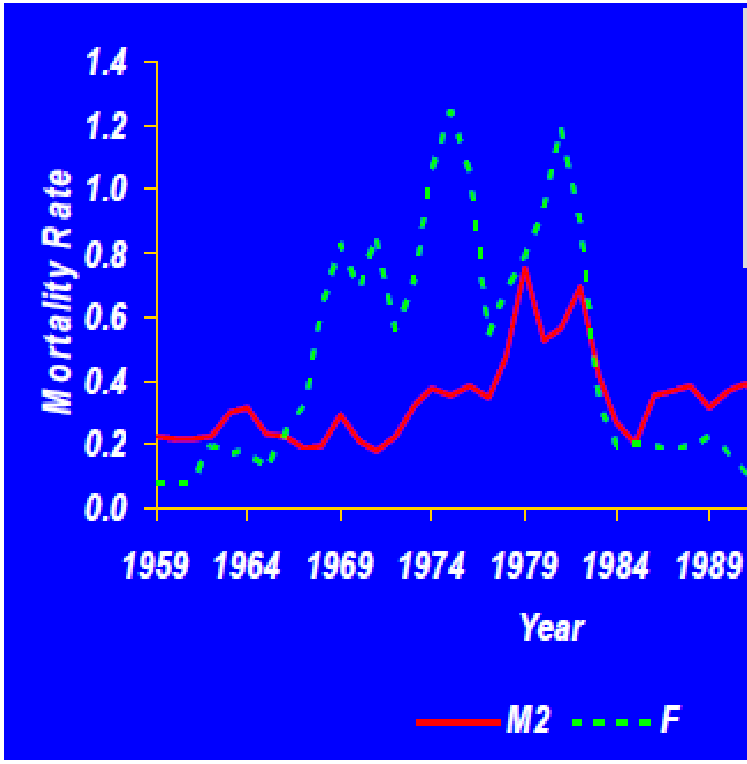


Why an Ecosystem Approach to Management?
Example Interactions

Biological (e.g. predator-prey, competition)
Physical & Chemical (including climate)
Fishing Effects
Regulatory
Other Socio-economic Activities

If manage a stock in a vacuum and don't take linked biological, physical, and chemical components in the system into account, will have "sub-optimal" management results…

Common Observations

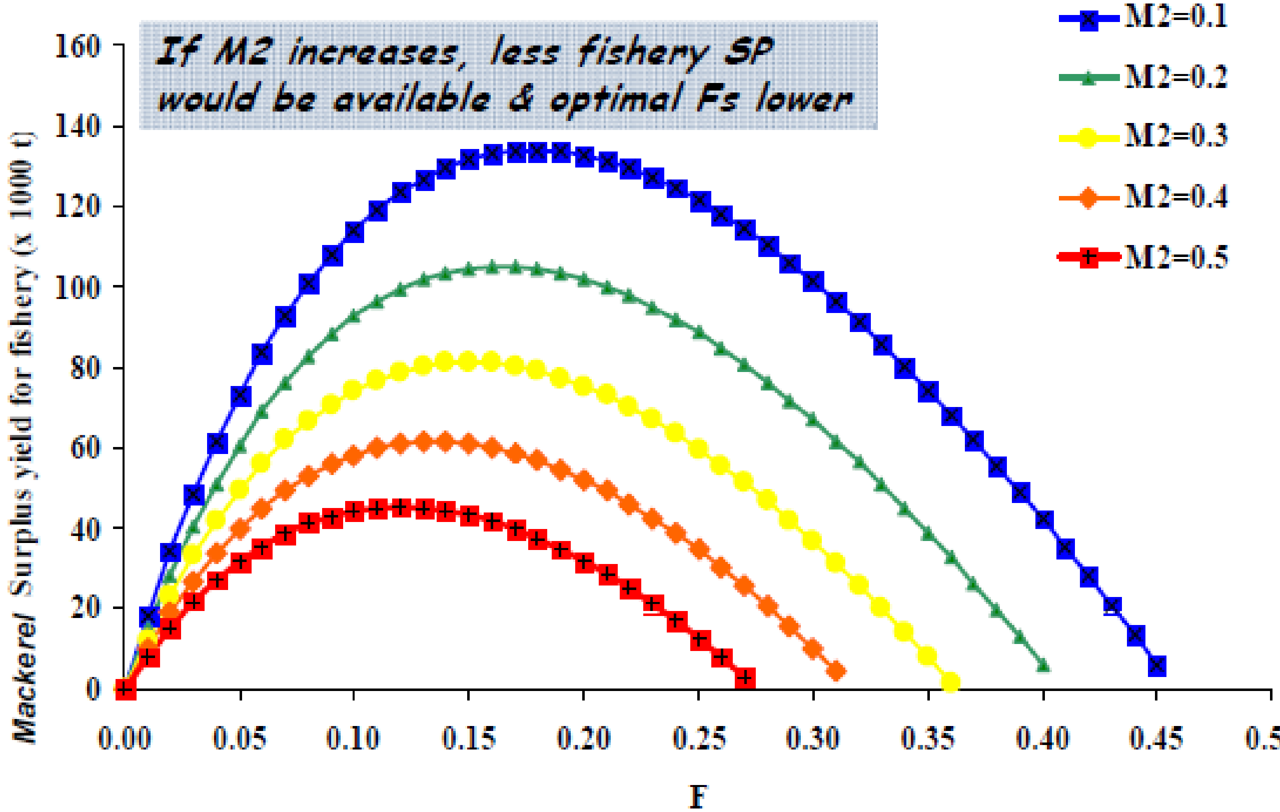


- *M2's are Time Variant*
- *Rates are Prey, Predator, and Fishery Dependent*
- *Recently M2 2-4X F*

Mortality rates (M2 & F) for Atlantic herring

Overholtz & Link. 2007. ICES J. Mar. Sci. 64:83-96.

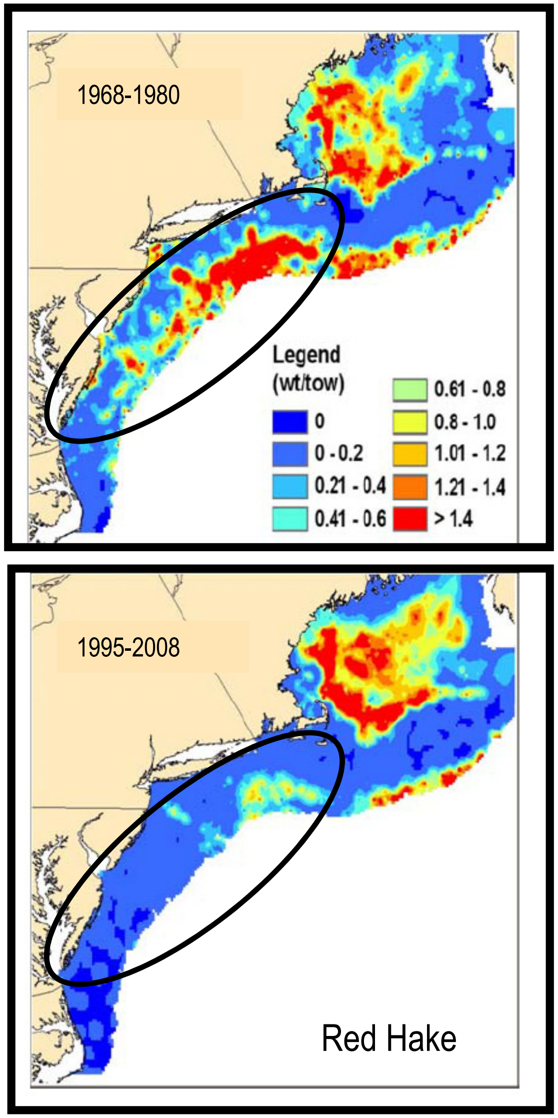
So what difference does it make?



Moustahfid et al. 2009. *ICES J. Mar. Sci. 66: 445-454*

Why We Should Move Forward

- We know marine ecosystems are changing
- These changes are impacting these systems and us
- We have the tools available to move forward with ecosystem-based management



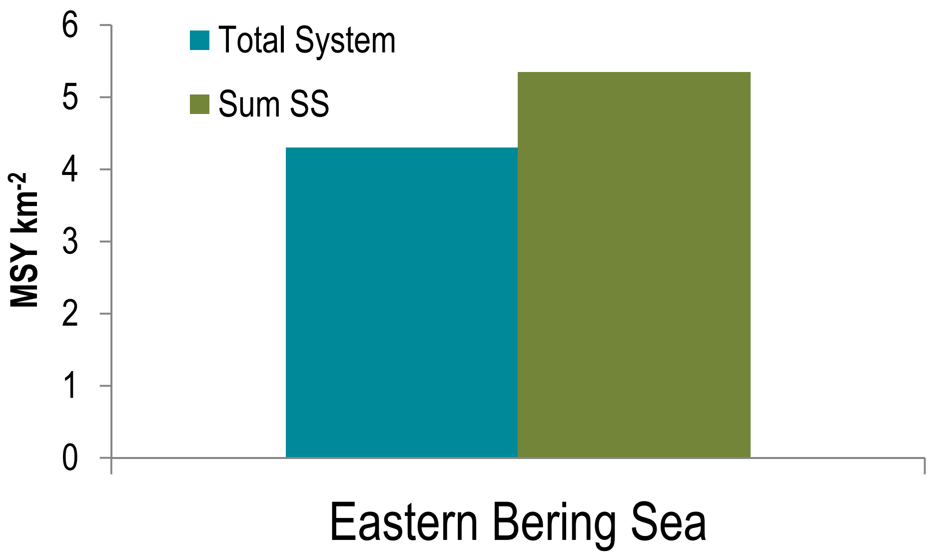
Nye et al. 2009. MEPS 393: 111-139

Why We Should Move Forward

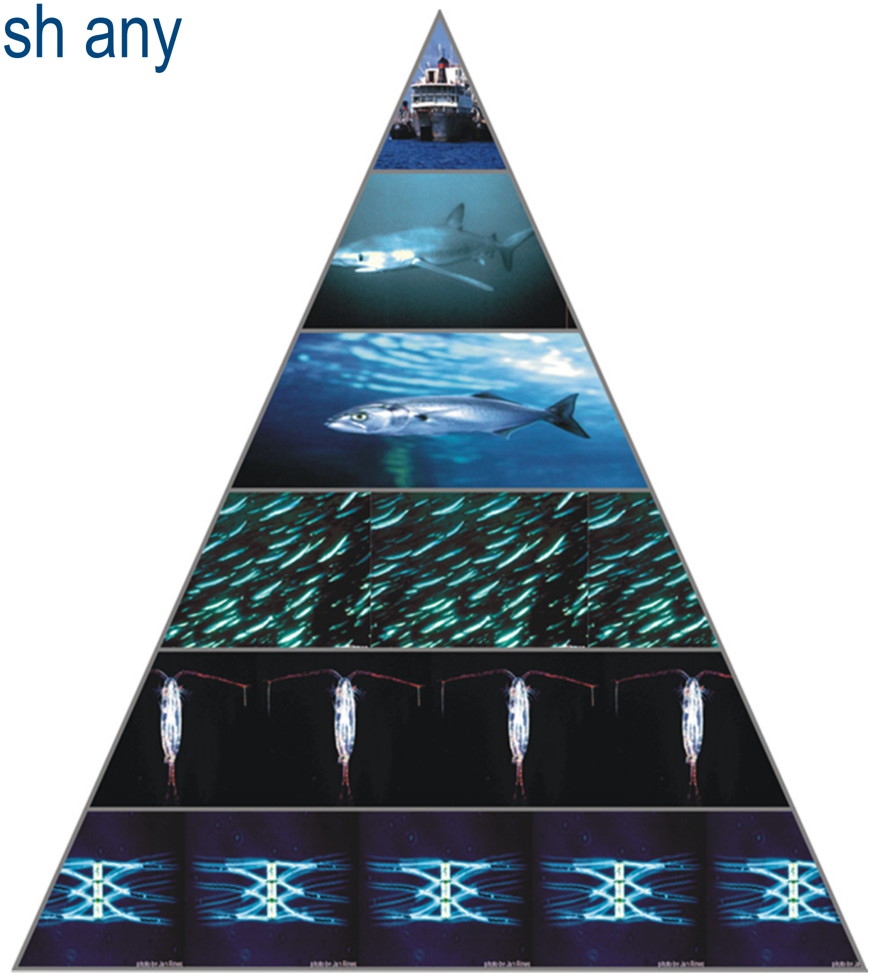
- Critical to our mission to recognize and be able to measure ecosystem changes.
- Changes will affect all of us.

Understanding System Production Limits Is Critical

- There are limits to how much fish any ecosystem can produce
- The challenge of energy flow



Data from S. K. Gaichas et al.



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Evolution in Approach to Science and Management: An Ecosystem-Based Approach

Focus on Managing Ecosystem Parts	Focus on Ecosystem Relationships, Processes, and Tradeoffs
FROM	TO
Individual species	**Ecosystems**
Short-term perspective	**Long-term perspective**
Humans: independent of ecosystems	**Humans: integral part of ecosystems**
Resolute management	**Adaptive management**
Managing commodities	**Sustaining production potential for goods and services**

Some Benefits of EB(F)M

- Brings more information to bear on management decisions, which should improve our ability to sustainably manage fisheries
  - There will be fewer and smaller gaps between what occurs and what we expected to occur, and better understanding of the factors with the most impact on our fisheries
  - In short, fewer surprises, fewer mistakes
- We will have increased ability to predict likely outcomes of management actions
  - Forecasts pressures and impacts on both single and aggregated components of a marine ecosystem
  - Better understanding of how ecosystems respond to multiple stressors
- More stability of ecosystem level measures, translates into better regulatory stability and business plans
  - Is cost-effective
  - Provides a more effective management framework
  - Is designed to be adaptive
- Facilitates trade-offs between different stakeholder priorities, balancing social and ecological needs
  - Addresses multiple legal mandates simultaneously
  - Maintaining ecosystem goods and services for delivering social, economic and cultural benefits to society
  - Addresses cumulative impacts
  - Increased stakeholder participation

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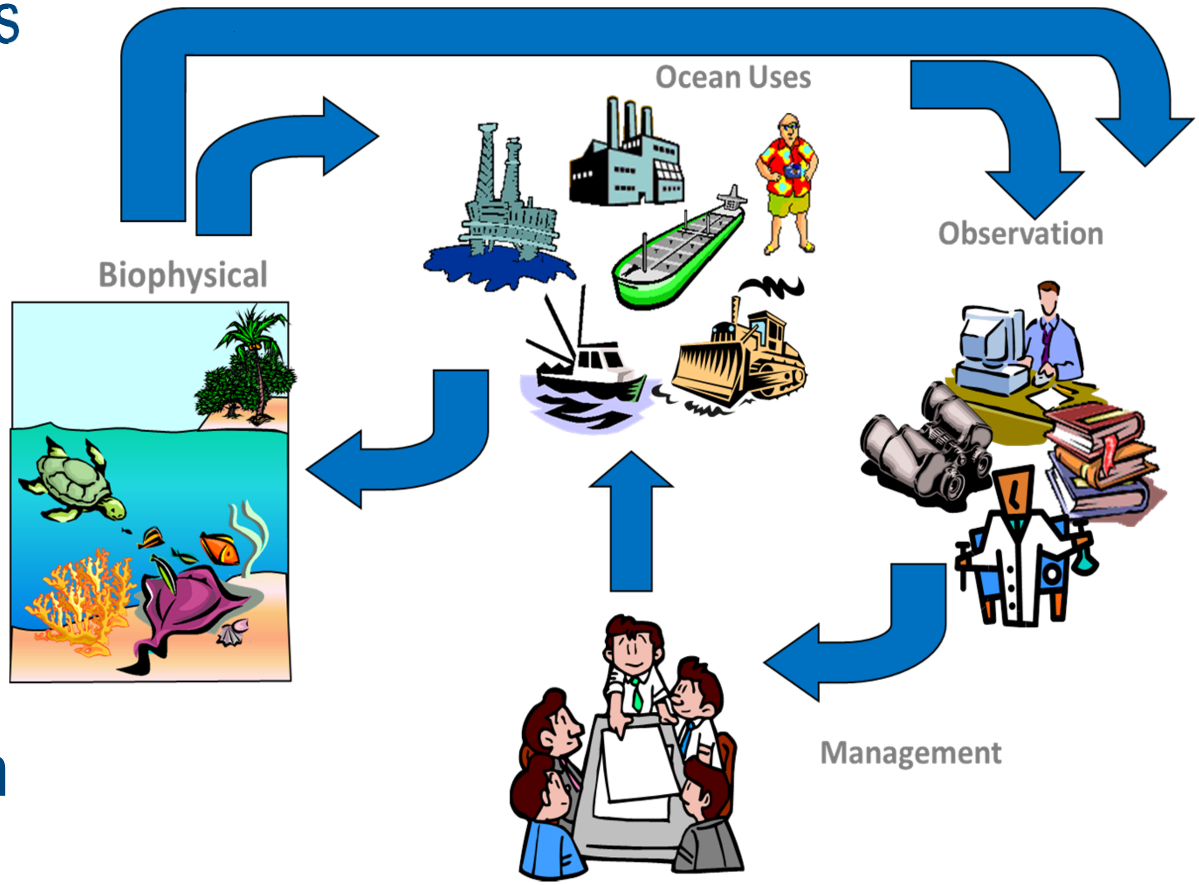
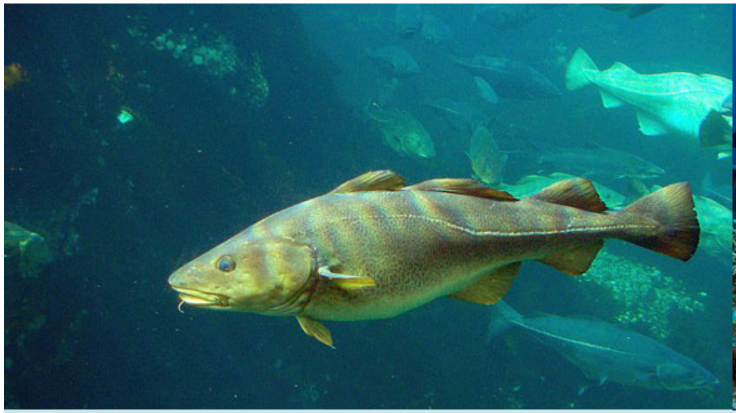
How Do We Move Forward?

- Develop and use tools to make connections.
  - Need to link climate and habitat with fish production
- We must move forward or we run the risk of doing things incorrectly with impacts to the system and our livelihoods.



How Do We Move Forward?

- EAF
  - Develop reference points (e.g. overfishing limits, population targets and thresholds) that are calculated with inclusion of ecosystem considerations - e.g. inclusion of predation, environmental (e.g. T), or habitat variables into stock assessments
- EBFM
  - Develop reference points at the ecosystem level - e.g. ecosystem productivity thresholds, habitat thresholds
  - Area and seasonal closures, gear restrictions to protect sensitive areas, species, or life stages

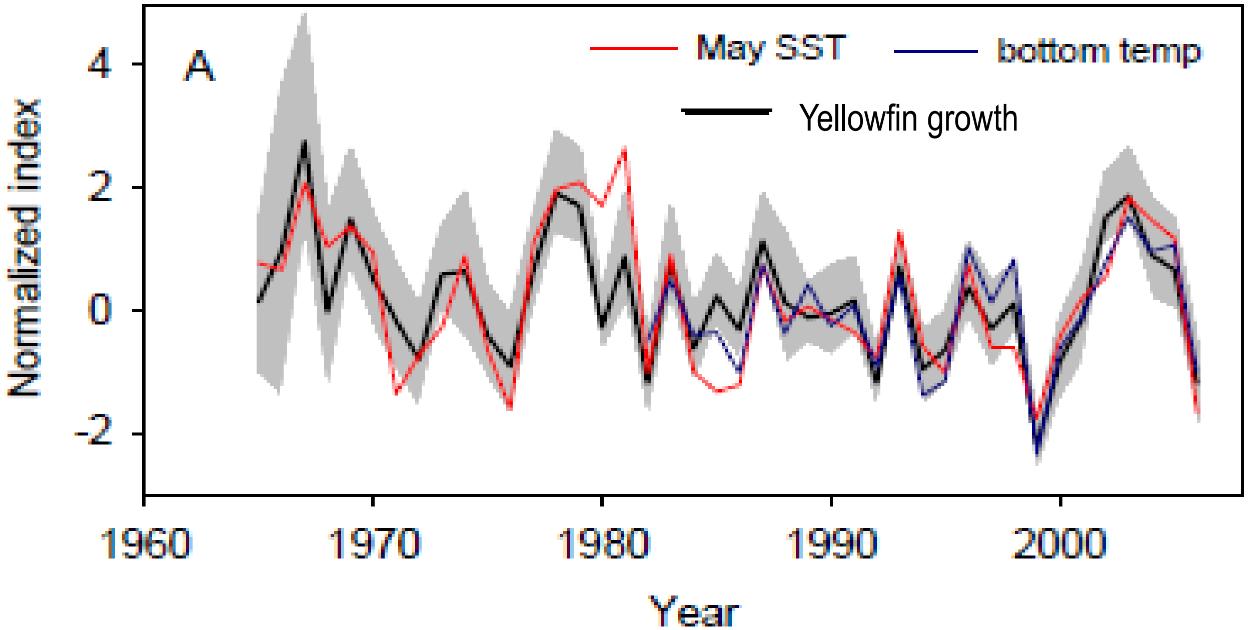


Fisheries and the Environment (FATE)

Ecosystem Indicators	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
PDO (December-March)	14	6	3	10	7	15	9	13	11	8	5	1	12	4	2
PDO (May-September)	9	4	6	5	10	14	13	15	11	12	2	8	7	3	1
ONI Jan-June	15	1	1	6	11	12	10	13	7	9	3	8	14	4	5
46050 SST (May-Sept)	13	8	3	4	1	7	15	12	5	14	2	9	6	10	11
NH 05 Upper 20 m T winter prior (Nov-Mar)	15	9	6	8	5	12	13	10	11	4	1	7	14	3	2
NH 05 Upper 20 m T (May-Sept)	13	10	12	4	1	3	15	14	7	8	2	5	11	9	6
NH 05 Deep Temperature	15	4	8	3	1	11	12	13	14	5	2	10	9	6	7
NH 05 Deep Salinity	15	3	6	2	5	13	14	9	7	1	4	11	12	8	10
Copepod Richness Anomaly	15	2	1	6	5	11	10	14	12	9	7	8	13	3	4
N. Copepod Biomass Anomaly	14	10	6	7	4	13	12	15	11	9	3	8	5	1	2
S. Copepod Biomass Anomaly	15	3	5	4	2	10	12	14	11	9	1	7	13	8	6
Biological Transition	14	10	6	5	7	13	9	15	12	2	1	4	11	3	8
Winter Ichthyoplankton	15	7	2	4	5	14	13	9	12	11	1	8	3	10	6
Chinook Juv Catches (June)	14	3	4	12	8	10	13	15	9	7	1	5	6	11	2
Coho Juv Catches (Sept)	11	2	1	4	3	6	12	14	8	9	7	15	13	5	10
Mean of Ranks	13.8	5.5	4.7	5.6	5.0	10.9	12.1	13.0	9.9	7.8	2.8	7.6	9.9	5.9	5.5
RANK of the Mean Rank	15	4	2	6	3	12	13	14	10	9	1	8	11	7	4
Principle Component Scores (PC1)	6.56	-2.22	-2.95	-1.60	-2.12	2.08	3.12	4.21	1.10	-0.30	-4.39	-0.91	1.13	-1.76	-1.96
Principle Component Scores (PC2)	-0.51	0.04	-0.24	-0.76	-1.96	-1.53	2.55	-0.43	-0.66	1.07	-0.50	0.96	-0.74	1.36	1.35
Ecosystem Indicators not included in the mean of ranks or statistical analyses															
Physical Spring Trans (UI Based)	3	6	14	12	4	9	11	15	9	1	5	2	7	8	13
Upwelling Anomaly (Apr-May)	7	1	13	3	6	10	9	15	7	2	4	5	11	13	11
Length of Upwelling Season (UI Based)	6	2	14	9	1	10	8	15	5	3	7	3	11	13	11
NH 05 SST (May-Sept)	10	6	5	4	1	3	15	13	8	12	2	14	9	7	11
Copepod Community Structure	15	3	5	7	2	12	11	14	13	8	1	6	10	9	4

Assembling relationships between oceanography and plankton with salmon provide yearly assessments of the conditions surrounding salmon. (W. T. Peterson et al. 2012, NWFSC Ocean Ecosystem Indicators of Salmon Marine Survival in the Northern California Current) http://www.nwfsc.noaa.gov/research/divisions/fe/estuarine/oeip/index.cfm

Fisheries and the Environment (FATE)



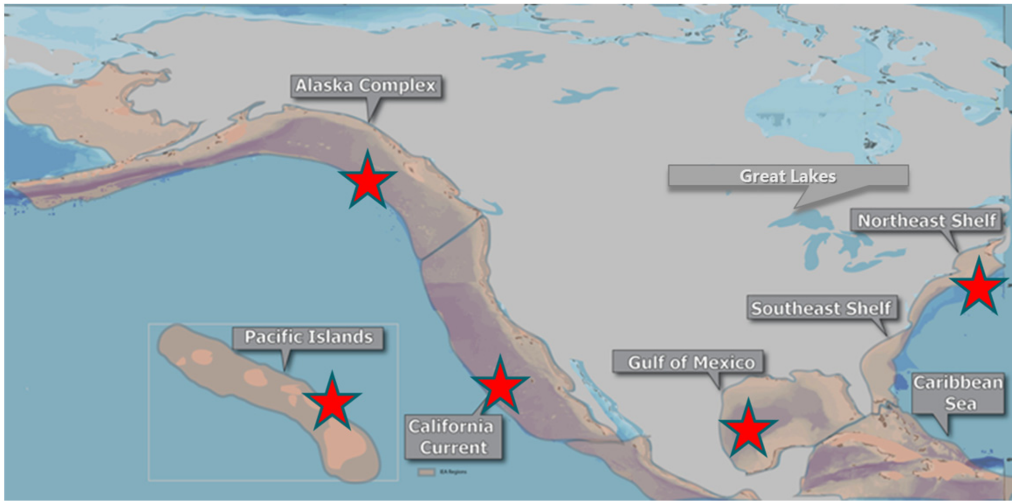
40-year time series of yellowfin sole (Eastern Bering Sea) data allows analysis of the effects of climate.

Trend closely follows bottom and surface temperature, which suggests growth is susceptible to changes in climate.

Bryan Black et al. 2012, OSU and AFSC

NOAA's Integrated Ecosystem Assessment (IEA) Program

www.noaa.gov/iea



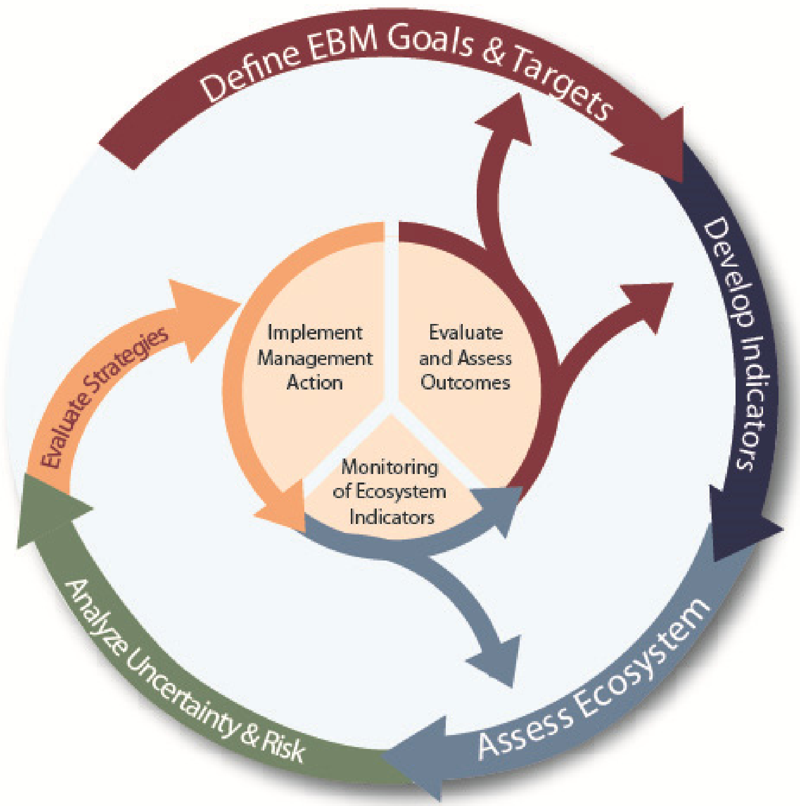
- NOAA's approach to IEAs offers a way to better manage resources to achieve ecologic, economic, and societal objectives.
- IEAs provide a sound scientific basis for EB(F)M.
- They provide a framework for organizing & synthesizing science to inform multi-scale, multi-sector EB(F)M.
- Their primary objective is to make comprehensive information available to inform management decisions.
- IEAs are "a synthesis and quantitative analysis of information on relevant physical, chemical, ecological, and human processes in relation to specified management objectives"
- The resulting analyses, done at scales relevant to management questions, provide resource managers with information to make more informed and effective management decisions.
- NOAA's IEA approach defines a national framework that provides IEA practitioners a consistent, yet flexible, architecture to tailor the process for regional needs.

NOAA's Integrated Ecosystem Assessment (IEA) Program

Integrated Ecosystem Assessments Provide the Analytical Toolbox to Support EB(F)M

- It is an iterative decision-support process that uses diverse data and ecosystem models.
- Once EB(F)M objectives and targets are defined by resource managers and stakeholders**, models are used to simulate the future outcome of potential management actions.
- These outcomes allow a comparison of the possible economic and ecological trade-offs to guide management decisions.
- Results of the analysis are provided to managers who decide which management action to implement.
- After a management plan has been implemented, the process can be repeated in the future to evaluate the effectiveness of the plan (adaptive management).
- Each step of the IEA contributes to this process to provide for better management of ocean and coastal resources through an ecosystem-based approach.

www.noaa.gov/iea



**Participation and communication with managers and stakeholders is meant to be ongoing through the IEA process

Examples of interim products of an IEA

- Conceptual models that synthesize our knowledge about how the ecosystem functions, produces ecosystem services, and responds to anthropogenic changes

- Assessments of status and trends in ecosystem pressures, states, and services

- Risk Analysis for key ecosystem indicators and services

- Forecast of the future condition of the ecosystem and its services under a range of likely policies and management strategies to evaluate the relative success of management actions in achieving the desired target conditions

- ULTIMATE PRODUCT: Comprehensive/holistic information provided to managers to support and inform management decisions in a dynamic, multi-sectoral ecosystem context

Examples of interim products of an IEA

Region		Select examples of implementation progress	Key Management Topics
California Current		• Two IEA reports, including all steps within IEA process (2011, 2013) • Ecosystem considerations report delivered to PFMC (2011) • Integration of IEA science into management discussions (e.g. Sanctuaries, Puget Sound, Sacramento River) • IEA "toolkit" for CC • Next steps: habitats, highly migratory species	• Climate • Fisheries • Energy
Northeast US Shelf		• Development of multi-species and ecosystem models • Indicator development using DPSIR • Development of spatial tools for EBFM • Semi-annual production of Ecosystem Advisory report • Bi-annual Ecosystem Status report	• Fisheries • Wind energy • Protected species • Climate • Recreation and Tourism • Shipping
Gulf of Mexico		• Demonstration project with GMFMC SEDAR process to provide ecosystem considerations • Development of ensemble set of ecosystem models • Ecosystem Assessment Management Report for 4 estuarine ecosystems • Development of digital trophic database and Data Atlas • Next: Ecosystem Status report for 2013	• Commercial Fishing • Energy • Population • Recreation and Tourism • Shipping
Alaska Complex		• Annual ecosystem considerations chapter provided to NPFMC • Ecosystem indicator selection process through multi-stakeholder workshops • Development of metrics to represent condition of ecosystems; help establish reference points and comparisons across ecosystems (part of Risk Assessment)	• Fisheries • Climate • Energy
Pacific Islands		• Studies on effects of ocean circulation on larval retention • Development of "reef" and "coastal" ecosystem model to understand energy flows and interactions • Studies on human dimensions in ecosystem functions in Kona Coast (incl. Indicator development, Identification of drivers and pressures, communication and networking with managers) • Cetacean habitat modeling • Annual Kona IEA research cruise	• Shared use resources • Aquaculture • Climate change and Kona Sentinel Site

NOAA FISHERIES
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Ecosystem Advisory
for the Northeast Shelf Large Marine Ecosystem

Summary of Conditions for the Northeast Shelf Ecosystem

- Sea surface temperature (SST) in the Northeast Shelf Large Marine Ecosystem during the first half of 2013 moderated compared to the record high temperatures that occurred in 2012; however, temperatures remain above the long-term mean based on both contemporary satellites remote sensing data and ship-board measurements.
- This moderating effect was not uniform over the ecosystem. The northern ecoregions of the Gulf of Maine and Georges Bank remained relatively warm whereas the Middle Atlantic Bight cooled to a greater extent.
- Spring survey hydrocast data shows that surface and bottom temperatures have moderated since 2012, but remain above average with bottom temperatures being influenced by water entering the ecosystem.
- In contrast to the 2012 Gulf of Maine spring bloom which was a long duration, intense bloom that started at the earliest recorded start date, the 2013 was the latest recorded bloom that was so poorly developed its extent was below detection limits. The bloom on Georges Bank was also relatively late and though it could be detected, it was a small bloom in terms of duration and intensity.
- Though not a regular feature in the Middle Atlantic Bight, a distinct spring bloom could be measured in 2013.
- An analysis of spring transition temperatures shows that there has been an abrupt shift in spring thermal phenology.
- 2013 spring zooplankton biomass on the Northeast Shelf was the lowest on record for the monitoring time series; the biomasses were lowest for the northern segments of the ecosystem and would appear to be related to the poorly developed spring bloom in the Gulf of Maine area
- The Northeast Shelf ecosystem continues to experience wide swings in physical conditions and biological responses that would appear to reflect great variation in the climate system impacting the ecosystem.

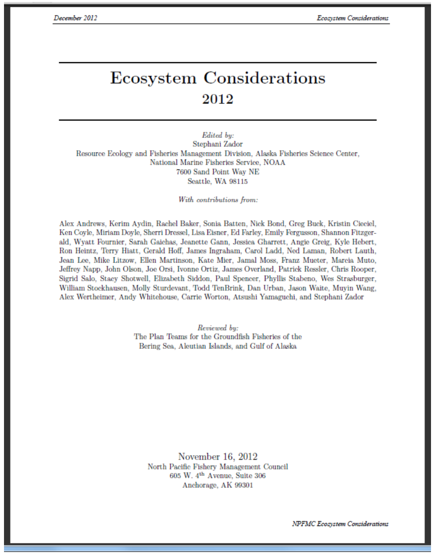
http://www.nefsc.noaa.gov/ecosys/advisory/current/

AFSC

http://access.afsc.noaa.gov/reem/ecoweb/Index.cfm

Resource Ecology and Ecosystem Management: Ecosystems Considerations Report

- Ultimate goal is to have quantitative predictions from this research to guide management.
- However, these efforts already serve as indicators of ecosystem status and trends.
- These indicators can provide an early warning system for managers, signaling human or environmentally-induced changes that may warrant management action.
- They can also serve to track the success of previous ecosystem-oriented management efforts.



December 2012 *Ecosystem Considerations*

Ecosystem Considerations
2012

Edited by:
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Reviewed by:
The Plan Teams for the Groundfish Fisheries of the
Bering Sea, Aleutian Islands, and Gulf of Alaska

November 16, 2012
North Pacific Fishery Management Council
605 W. 4th Avenue, Suite 306
Anchorage, AK 99301

NPFMC Ecosystem Considerations

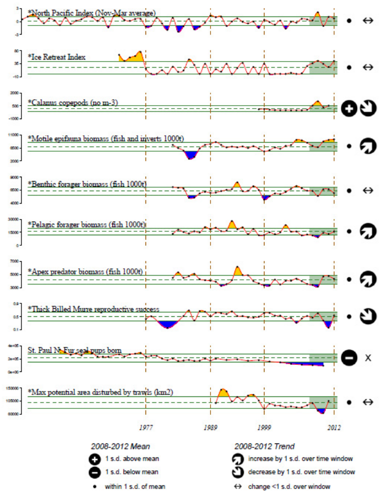

Figure 1: Eastern Bering Sea ecosystem assessment indicators; see text for descriptions. * indicates time series updated in 2012.

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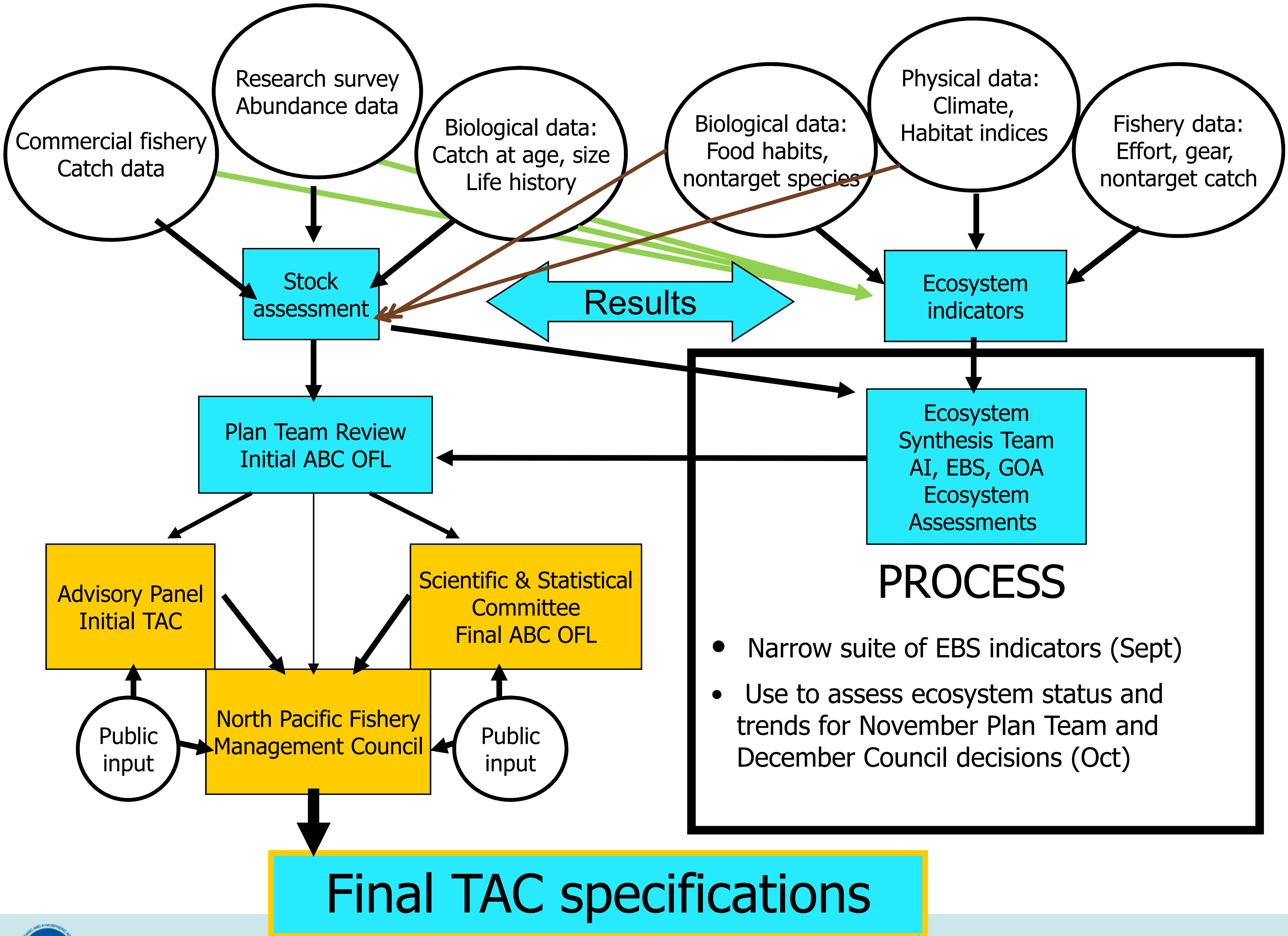
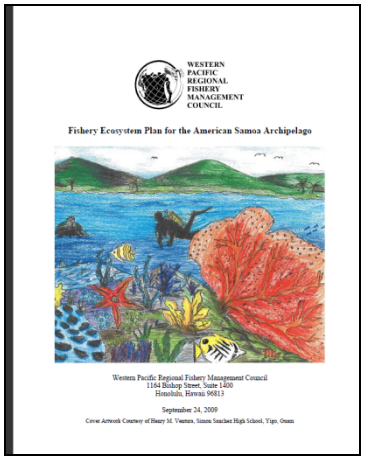

Research survey Abundance data
Commercial fishery Catch data
Biological data: Catch at age, size Life history
Biological data: Food habits, nontarget species
Physical data: Climate, Habitat indices
Fishery data: Effort, gear, nontarget catch
Stock assessment
Results
Ecosystem indicators
Plan Team Review Initial ABC OFL
Ecosystem Synthesis Team AI, EBS, GOA Ecosystem Assessments
Advisory Panel Initial TAC
Scientific & Statistical Committee Final ABC OFL
Public input
North Pacific Fishery Management Council
Public input
PROCESS
• Narrow suite of EBS indicators (Sept)
• Use to assess ecosystem status and trends for November Plan Team and December Council decisions (Oct)
Final TAC specifications

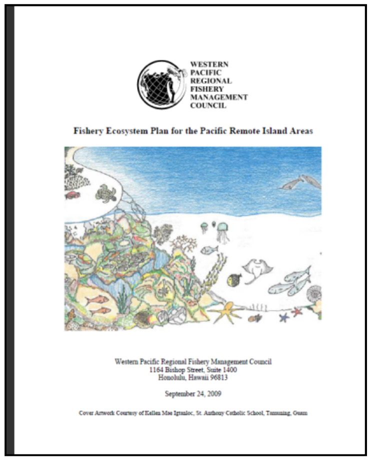
WPFMC: An Ecosystem-Based Approach to Fisheries Management in the US Pacific Islands


WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Fishery Ecosystem Plan for the American Samoa Archipelago

Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1400
Honolulu, Hawaii 96813

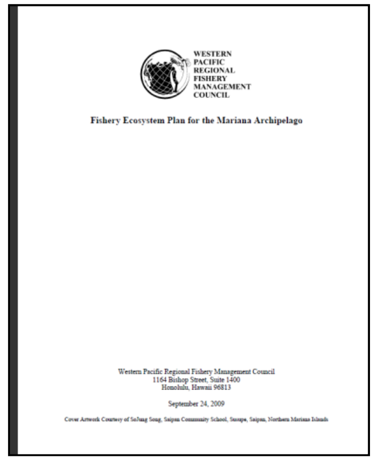
September 24, 2009


WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Fishery Ecosystem Plan for the Pacific Remote Island Areas

Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1400
Honolulu, Hawaii 96813

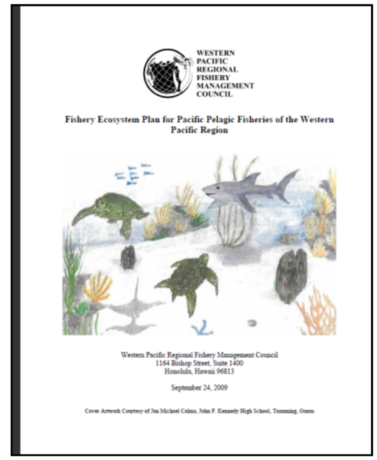
September 24, 2009


WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Fishery Ecosystem Plan for the Mariana Archipelago

Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1400
Honolulu, Hawaii 96813

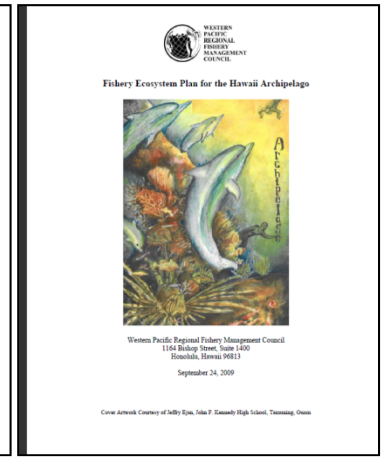
September 24, 2009


WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Fishery Ecosystem Plan for Pacific Pelagic Fisheries of the Western Pacific Region

Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1400
Honolulu, Hawaii 96813

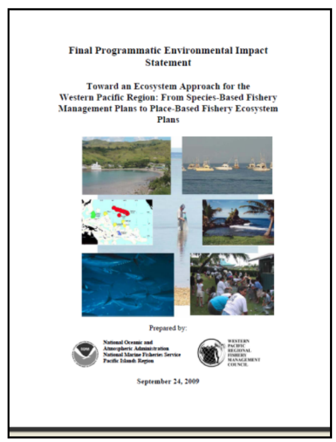
September 24, 2009


WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Fishery Ecosystem Plan for the Hawaii Archipelago

Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1400
Honolulu, Hawaii 96813

September 24, 2009


Final Programmatic Environmental Impact Statement

Toward an Ecosystem Approach for the Western Pacific Region: From Species-Based Fishery Management Plans to Place-Based Fishery Ecosystem Plans

Prepared by:

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Pacific Islands Region

WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

September 24, 2009

Fishery Management Council Activities

- "Ecosystem" Committees
- Fishery Ecosystem Plans

  Pacific Council purpose statement for FEP:

  ". . . to enhance the Council's species-specific management programs with more ecosystem science, broader ecosystem considerations and management policies that coordinate Council management across its FMPs and the California Current Ecosystem (CCE). A FEP should provide a framework for considering policy choices and tradeoffs as they affect FMP species and the broader CCE."

- Doing many things generally regarded as EBFM
  - ► Forage Fish – limit or prohibit fisheries on these species
  - ► Area and seasonal closures, gear restrictions
  - ► Use environmentally-based run size forecasts and harvest control rules
  - ► Implement bycatch restrictions

Implementing Marine Ecosystem-Based Management

- Ecosystem-Based Management is feasible now and we cannot afford not to adopt it. Ignoring interactions among system components can only lead to sub-optimal results.

- Ecosystem-Based Management requires that we directly confront tradeoffs among competing objectives within and among ocean use sectors. Tradeoffs do not go away if they are ignored.