

# Ecosystem and climate indicators for science based decision making



Kelly Montenero and Willem Klajbor  
University of Miami CIMAS/ NOAA Research  
Atlantic Oceanographic and Meteorological Laboratory  
[Kelly.Montenero@noaa.gov](mailto:Kelly.Montenero@noaa.gov) and  
[Willem.Klajbor@noaa.gov](mailto:Willem.Klajbor@noaa.gov)

# Takeaways

- NOAA Uses Indicators at Multiple Scales
- Based on:
  - Intended Audience
  - Purpose
  - Scale
  - Utility
- Consistent, Simple, and Accurate
- Conservation and Management Goals

# What is an Ecosystem Indicator?

**Quantitative and/or qualitative measures of key components of the ecosystem**

- Provide insight into general status of ecosystem
- All are interconnected - Ecosystem-Based Approach
  - The full suite of indicators assesses holistic ecosystem status
- Includes human dimensions

# What Makes a “Good” Indicator?

- Relevant and Easily Understood
- Spatial and Temporal Resolution
- Consistent
  - Long Term
  - Updated Regularly
- Signal to Noise
  - What are you demonstrating?



# NOAA's Indicator Programs



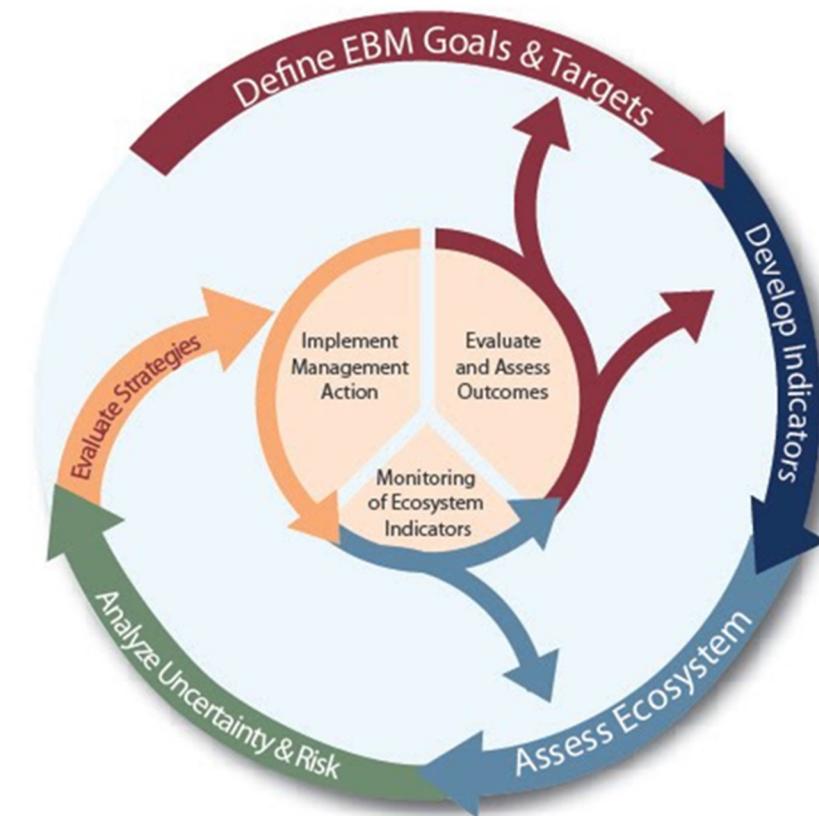
# Scaling Ecosystem Indicators

<u>Geographic Scale</u>	<u>Assessment Type(s)</u>	<u>Complexity</u>
1) National	1) <i>National Marine Ecosystem Status</i> <u>(<a href="http://www.ecowatch.noaa.gov">www.ecowatch.noaa.gov</a>)</u>	1) Low
2) Regional	2) <i>Ecosystem Status Reports</i>	2) Medium
3) Local (Marine sanctuary, Bay, Estuary, etc.)	3) <i>Condition Reports, Stoplight Reports, Report Cards</i>	3) High

# NOAA's IEAs provide an analytical framework to implement ecosystem based management

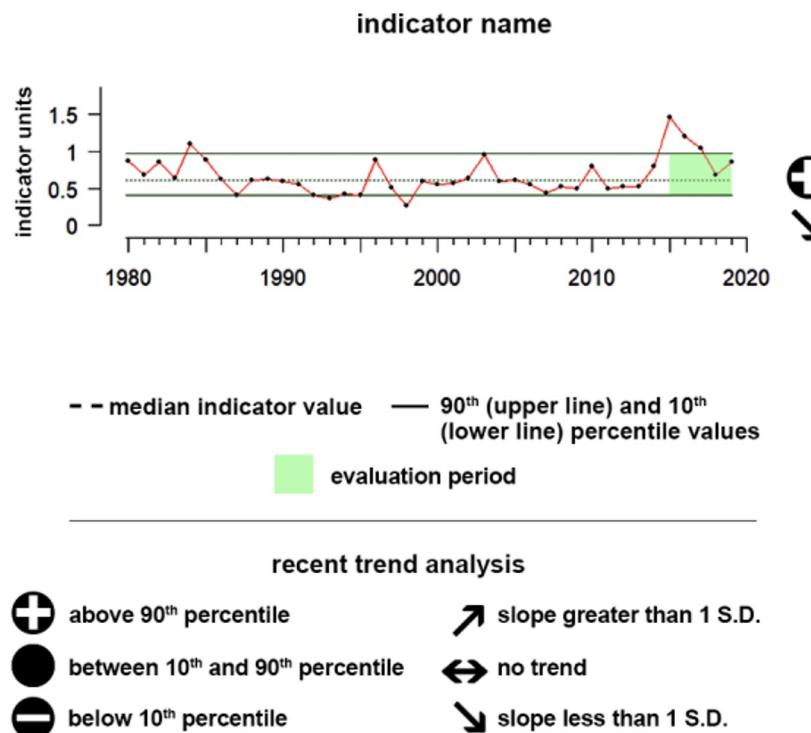
## Integrated Ecosystem Assessments:

- Synthesize and analyze diverse data and ecosystem model outputs
- Share common national framework with regional variation
- Are modular, iterative, scale-able, and adaptable
- Provide assessments for multiple ocean-use sectors, including NMS, FMC and state agencies





# Intro to NaMES



# Indicator Selection

# How do we select indicators?

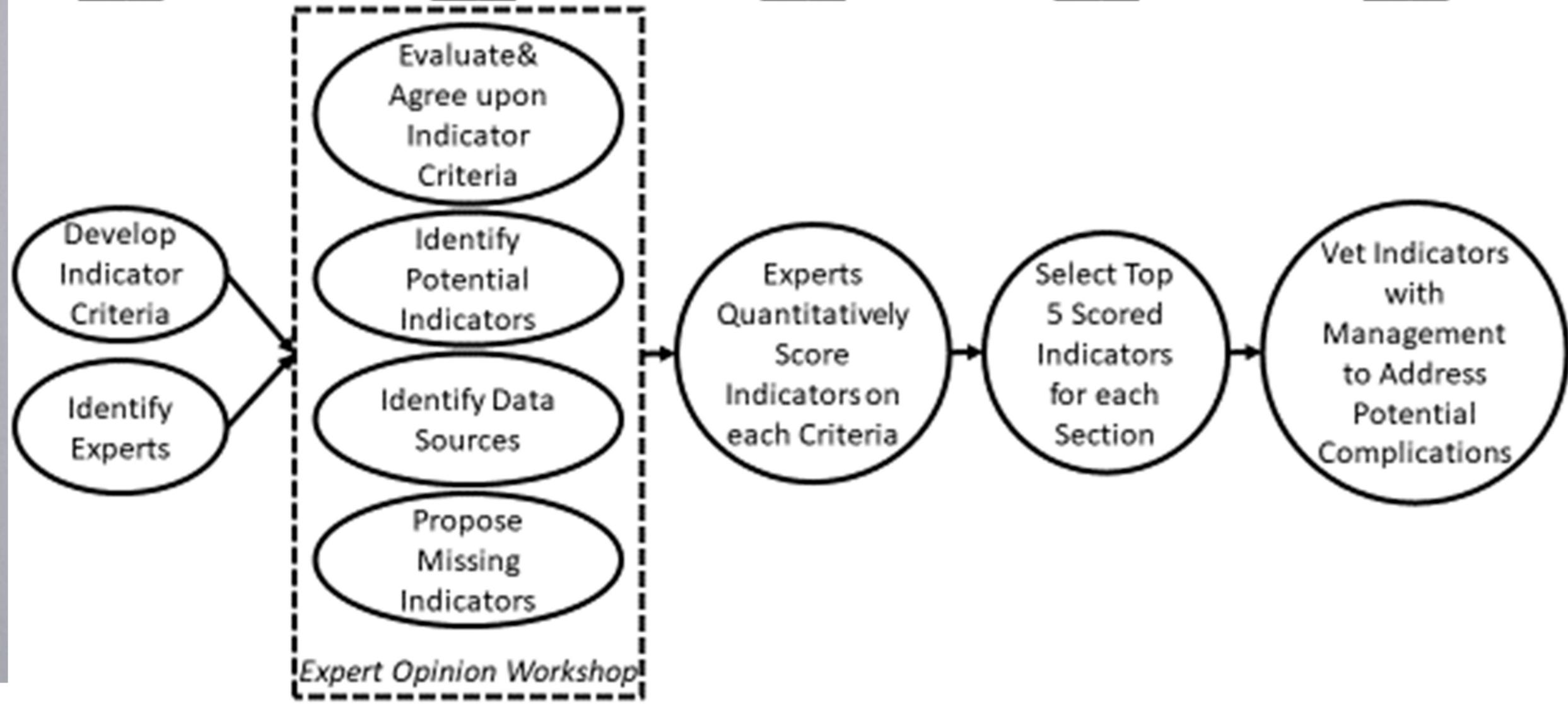
Step 1

Step 2

Step 3

Step 4

Step 5





# Indicator Selection for NaMES

	Available in most regions	Quantitative	Updated on a regular basis	Long-term time series (>10-years preferred)
chl a				
zooplankton				
Forage fish (small pelagic)				
Coral reef				
overfished stocks				
Seabirds				
threatened and endangered				
marine mammals				



# Indicator Vetting

## Condition + Ecosystem Status Reports

- One day workshops with invited subject matter experts
- Individual “Decision matrix” to score proposed indicators according to established criteria

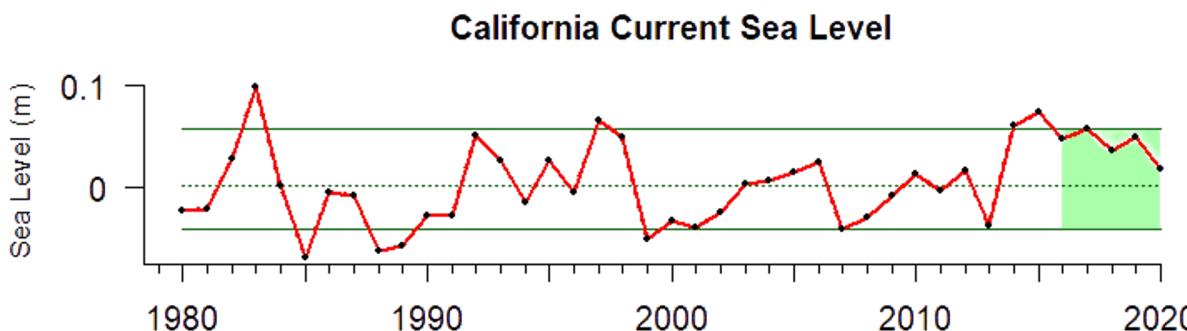
## National Marine Ecosystem Status

- One-on-one consultation with “subject matter experts”
- End user feedback
  - Surveys
  - Presentations

# Applications of Indicators

# Example: Applications of NaMES Indicators

- **Broad Temporal and Spatial Scales =**
  - Education
  - Science Communication
  - High-level reporting



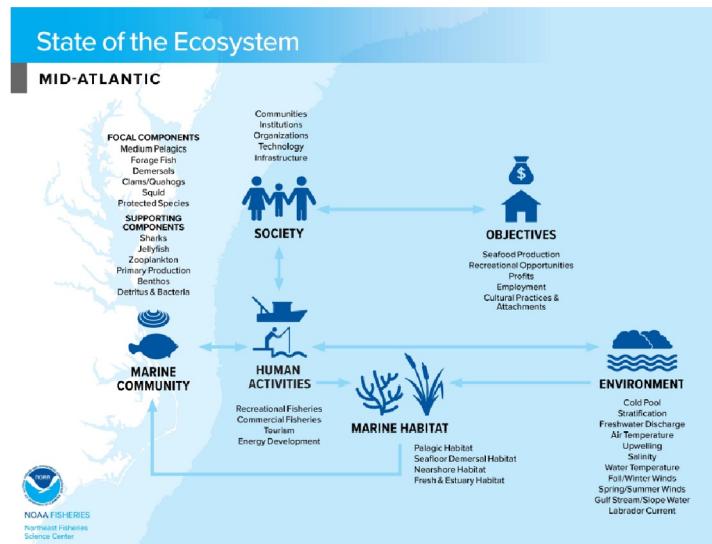
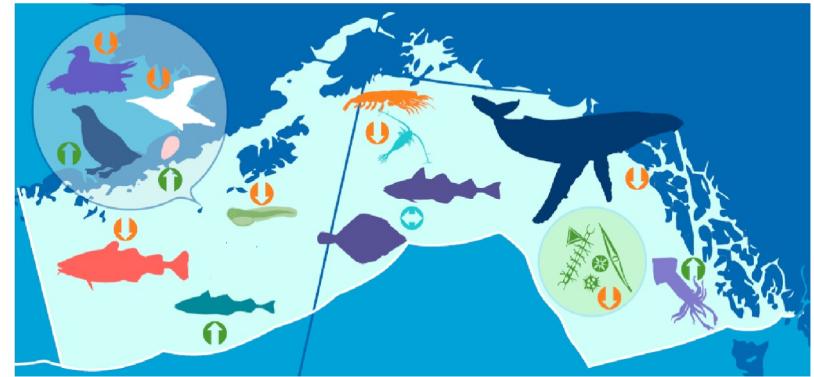


# Example: Indicators for Ecosystem Status Reports used in management



PFMC: Fishery Ecosystem Plan requires an ESR describing status and trends, as context for decision-making

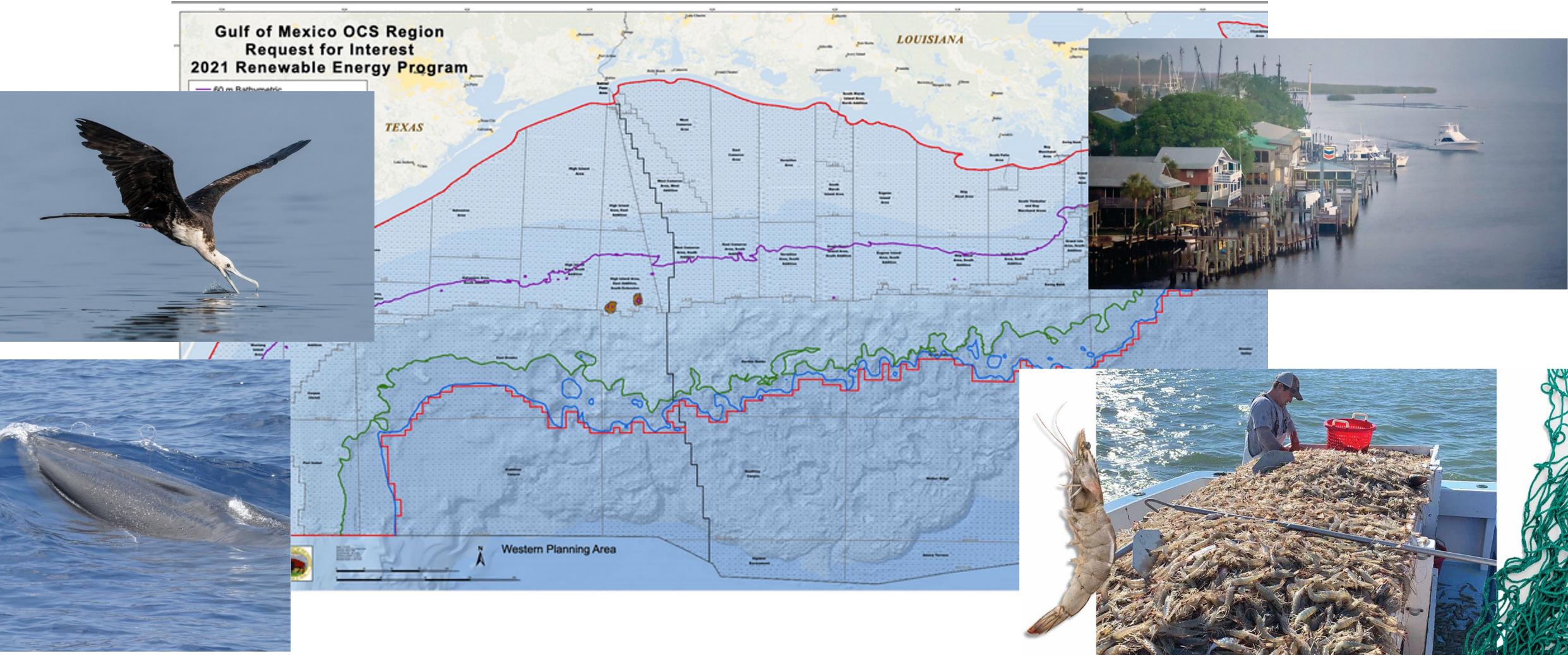
NPFMC: single-species quotas set in context of ecosystem information



MAFMC, NEFMC and CFMC: Indicators linked to specific management objectives, risk assessment



# Example: Indicators for wind energy siting



# Example: Indicators and National Marine Sanctuaries

- ONMS manages federal activities with the goal of conservation of marine resources; engagement with local communities
- Condition reports, management plan reviews, policy development, partnership development are some of the tools and tasks done in each sanctuary.
- Leads to updating sanctuaries' management plans, which contain regulations on no take zoning and marine reserve management
- Specifically, indicator suite development, information adaptation and analysis, and considering effective management are areas of overlap



# Example: Florida Keys NMS web tool



[https://www.integratedecosystemassessment.noaa.gov/infographic/gulf\\_of\\_mexico/fk-esr-info-main/fk\\_infographic\\_drupal.html](https://www.integratedecosystemassessment.noaa.gov/infographic/gulf_of_mexico/fk-esr-info-main/fk_infographic_drupal.html)

# The Need for Indicator Consistency



## CATEGORICAL CONSISTENCY

Marine Species Distribution

Species Richness, Diversity, Mean Trophic Level, Abundance of Economically Important Species

Black Grouper, Hogfish, Red Grouper, and Yellowtail abundance, species diversity

Coral Reef Overall Index

Coral Reef Overall Index

Stony Coral Living Tissue Area, Species Richness

## 1-TO-1 CONSISTENCY

SST

SST

SST

Chlorophyll *a*

Chlorophyll *a*, NPP

Chlorophyll *a*, DIN, DIP



# Recommendations

**Scale**

**Maintenance and updates**

**Management partners**

**Criteria and sensitivity**

# Summary

- NOAA uses ecosystem indicators to track the status and trends of ecosystems
- Ecosystem indicators are developed based on the intended audience and purpose of the assessment
  - Scale
  - Management utility
  - Communication
- Ecosystem indicators need to be consistent and need to accurately convey the status of the system to allow you to tell the story
- Indicator suites should be developed and applied to tracking progress towards project goals- we can help

# Thank you!

[Kelly.Montenero@noaa.gov](mailto:Kelly.Montenero@noaa.gov) and  
[Willem.Klajbor@noaa.gov](mailto:Willem.Klajbor@noaa.gov)

# Questions and discussion

- How do you see indicators being used for your projects?
- Do you have defined management goals and objectives?
- What kinds of indicators could be used in LTER?
- What kind of data do you have and why is it collected?
- How can we help?

# Extra slide: Indicator suite selection takeaways across projects relevant for marine reserve management

- **Environmental indicators relevant to water quality and changing climate**
  - dissolved oxygen, storm frequency and intensity, harmful algal blooms, SST, fecal coliform from LBSP, carbonate production, turbidity, primary productivity
- **Human dimensions relevant to stakeholders**
  - Population change, reliance and engagement, housing disruption, disturbance events, coastal development, tourism pressure, enforcement and resource awareness, total registered vessels

# Extra slide: Indicator suite selection takeaways across projects relevant for marine reserve management

- **Ecological and biological indicators relevant to living resources**
  - Benthic cover, target fish species abundance, condition of habitat, species diversity
- **Ecosystem services relevant to management goals**
  - Commercial fishing total trips, revenue and engagement, recreational fishing reliance and engagement, employment in ocean economy, total tourism value
- **National Status Indicators relevant to long-term monitoring and high-level reporting**
  - SST, chl-a, forage biomass, coastal population, coastal employment, coastal tourism, fishing effort and harvest, marine heatwaves, marine protected area cover