# Oceans and Ecosystems Research

# Research to support Ecosystem-Based Management

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#### Research to support Ecosystem-Based Management (EBM)

- Major Science Question(s)
  - How do we assess, evaluate, and predict the holistic integrated state of coastal ecosystems to improve management?
- Links to NOAA Strategic Plan
  - A holistic understanding of the Earth system through research
- Links to other authorizing language, statutes, etc. (if appropriate)
  - Water Resources Development Act 2000 (Everglades Restoration), Coastal Zone Management Act, Clean Water Act, Magnuson-Stevens Reauthorization Act, etc.







# How do we assess, evaluate, and predict the holistic integrated state of coastal ecosystems to improve management?



Observations/ Indicators







**Conceptual Models** 



Integrations with Human Dimensions 🔞 🗐

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#### **EBM-DPSER:**

A next generation conceptual ecosystem model

**Ecosystem Services** – the benefits that humans derive from the ecosystem

**State** – quantity and quality of physical phenomena (such as temperature), biological phenomena (such as fish stocks) and chemical phenomena (such as atmospheric  $CO_2$  concentrations)

**Pressure -** release of substances (emissions), physical and biological agents, the use of resources and the use of land

**Drivers -** social, demographic and economic developments

Responses by groups (and individuals) in society, as well as government attempts to prevent, compensate, ameliorate or adapt to changes in the state of the environment



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Kelble et al. (2013)

### Holistic Indicator selection

Drivers, Pressures, Responses	Non-economic HDS Public Health & Safety Education Aesthetics	Economic HDS \$\$ Flood Claims Paid # Recreational Vessels Coastal Park Visits
Ecosystem Services	Recreation Cultural/Historical/ Spiritual	Ornamental Landings Commercial Seafood
State	EnvironmentalSeagrass Coastal wetlands Coral and Hardbottom Oysters Beaches Marine birds Fish and shellfish Water column	

*Ecological Indicators*, Special Issue In Review



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#### **Developing Consistent Indicators for IEAs**





*Loomis et al. (2014)* 



#### **Developing Consistent Indicators for IEAs**





#### Empirical Models to Assess Climate Change Impacts



*Kearney et al. (2014)* 

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Impact of multiple pressures upon Ecosystem Services

*Cook et al. (201* 





#### **Evaluating Management Strategies**

#### % Increase Towards Target over Future Without Project/Management



# Looking Ahead

- In the works:
  - Investigating climate change with coupled climate, physics, & ecosystem models
  - Better integration with Human Dimensions Science by incorporating Human Well-Being
  - Methodology to determine optimal yield for fisheries
  - $_{\circ}~$  Setting reference points for EBM
- Known risks and issues
  - Governance; untested hypothesis; political will;
    accounting for uncertainty in complex systems



#### Recent Publications (2013-2014)

1. Fletcher, P. J., C. R. Kelble, W. K. Nuttle, and G. A. Kiker. 2013. Using the integrated ecosystem assessment process to build consensus and transfer information to managers. Ecological Indicators. *In Review* 

2. Loomis, D. K., P. Ortner, and C. Kelble. 2013. Developing Integrated Ecosystem Indices. Ecological Indicators *In Review* 

3. Kearney, K., M. Butler, R. Glazer, C. Kelble, J.E. Serafy, E. Stabenau. 2014. Quantifying Florida Bay habitat suitability for fishes and invertebrates under climate change scenarios. Environmnetal Management. *Accepted* 

4. Smith, R.H., E.M. Johns, G. J. Goni, J. Trinanes, R. Lumpkin1, A. M. Wood, C. R. Kelble, S. R. Cummings, J. T. Lamkin, S. Privoznik. 2014. Oceanographic conditions in the Gulf of America in July 2010, during the Deepwater Horizon oil. Continental Shelf Research. Accepted

5. Conmy, R., P. Coble, J. Farr, A.M. Wood, K. Lee, W. Pegau, I. Walsh, C. Koch, M. Abercrombie, S. Miles, M. Lewis, S. Ryan, B. Robinson, T. King, C. Kelble, J. Lacoste. 2014. Submersible optical sensors exposed to chemically-dispersed crude oil: wave tank simulations for improved oil spill monitoring. Environmental Science and Technology. Accepted

6. Cook, G. S., Fletcher, P. J., & Kelble, C. R. 2014. Towards marine ecosystem based management in South Florida: Investigating the connections among ecosystem pressures, states, and services in a complex coastal system. Ecological Indicators. doi:10.1016/j.ecolind.2013.10.026

7. Levin, P. S., C. R. Kelble, R. Shuford, C. Ainsworth, Y. de Reynier, R. Dunsmore, M. J. Fogarty, K. Holsman, E. Howell, M. Monaco, S. Oakes, and F. Werner. 2014. Guidance for implementation of integrated ecosystem assessments: a US perspective. Ices Journal of Marine Science *In Press*.

8. Kearney, K.A., C. Stock, and J.L. Sarmiento. 2013. Amplification and attenuation of increased primary production in a marine food web. Marine Ecology Progress Series, 491:1-14, doi:10.3354/meps10484

9. Carson, H.S., P.C. Lopez-Duarte, G.S. Cook, F.J. Fodrie, B.J. Becker, C. DiBacco, and L.A. Levin. 2013. Temporal, spatial, and interspecific variation in geochemical signatures within fish otoliths, bivalve larval shells, and crustacean larvae. Marine Ecology Progress Series, 473:133-148, doi:10.3354/meps10078

10. Kelble, C. R., Loomis, D. K., Lovelace, S., Nuttle, W. K., Ortner, P. B., Fletcher, P., Cook, G.S., Lorenz, J.J., Boyer, J. N. (2013). The EBM-DPSER conceptual model: integrating ecosystem services into the DPSIR framework. PloS one, 8(8), e70766. doi:10.1371/journal.pone.0070766

 Cannizzaro, J. P., C. Hu, K. L. Carder, C. R. Kelble, N. Melo, E. M. Johns, G. A. Vargo, and C. A. Heil. 2013. On the Accuracy of SeaWiFS Ocean Color Data Products on the West Florida Shelf, Journal of Coastal Research 29(6):1257-1272.
 Kelble, C. R. 2013. Low Salinity Predation Refugia Could Cause HAB Initiation. Journal of Phycology 49:18-19.



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# Questions?



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# Back-up slides



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