

Assessing Ecological Conditions in U.S. Coastal Ocean Waters: Expansion of EMAP from Estuaries to the Offshore Environment

Jeff Hyland¹, Walt Nelson², John Macauley³



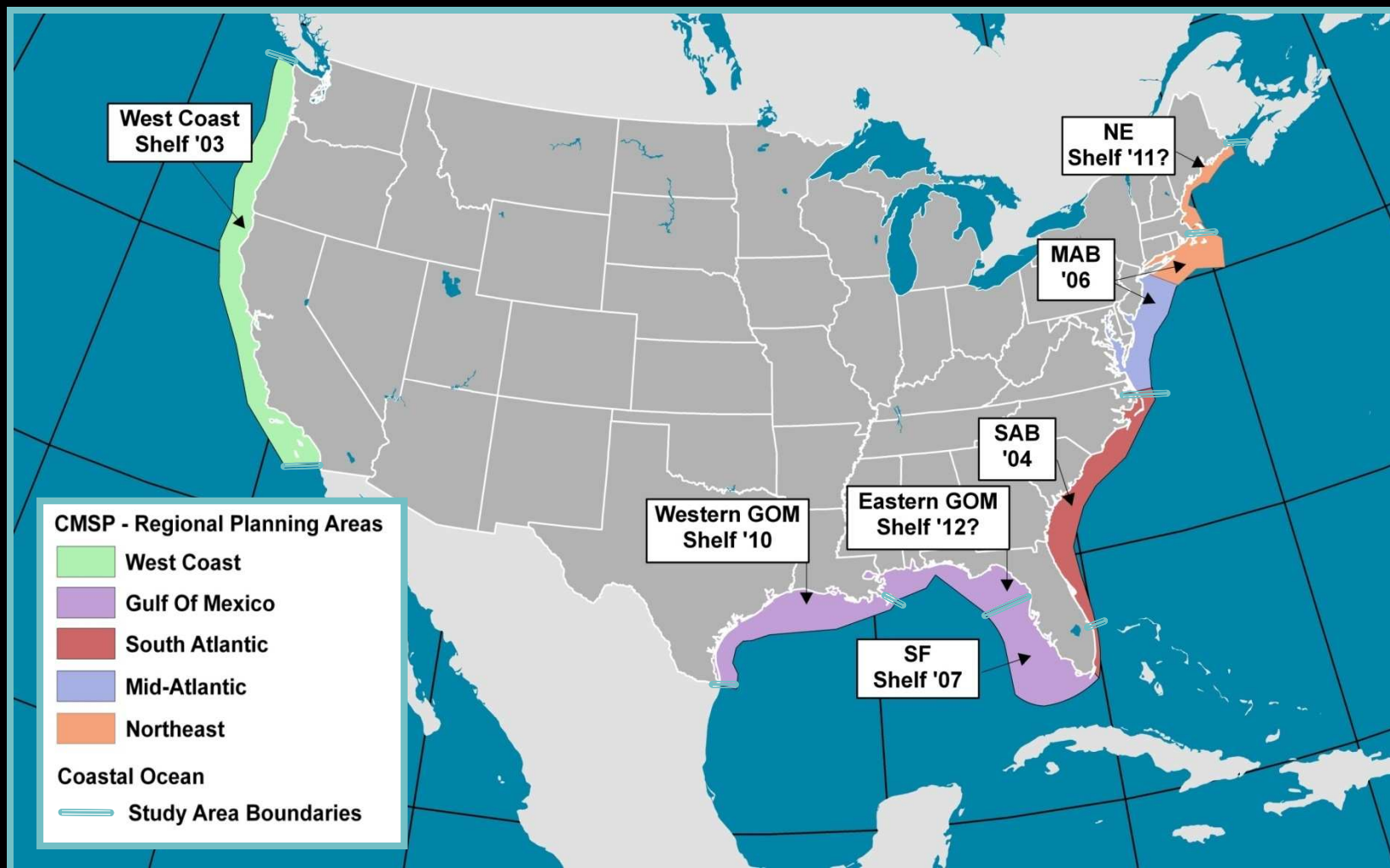
¹NOAA, Charleston SC

²U.S. EPA, Newport OR

³U.S. EPA, Gulf Breeze FL



Regional Assessments of Ecological Condition Throughout Coastal-Ocean Waters of the U.S.



Purpose

- To assess status of ecological condition and stressor impacts in coastal-ocean waters of the U.S. continental shelf (where prior EMAP-type assessments have been lacking).
- To provide quantitative benchmarks for comparisons with any future follow-up monitoring in these waters to determine long-term trends and how environmental conditions may be changing with time.
- To provide baseline information to support evolving coastal management priorities (e.g., MSP, EBM, NCCRs).

Approach

- **Extension of previous EMAP/NCA efforts in estuaries and inland waters to near-coastal shelf waters**
- **Use of probabilistic sampling approach of EMAP to support statistical estimation of spatial extent of condition with respect to measured indicators**
- **Multiple indicators measured synoptically at each station to support “weight-of-evidence” assessments of condition, and examination of potential linkages between presence of stressors and biological responses**

Indicators

Habitat Conditions

- DO, T, Sal, pH, depth
- Sediment grain-size, TOC
- Nutrients, Chlorophyll

Exposure Conditions

- Hypoxia / Anoxia
- Sediment Contaminants
- High TOC
- Sediment toxicity

Biotic Response Conditions

- Benthic Infauna
- Demersal Fish

Aesthetics & Human Health Risks

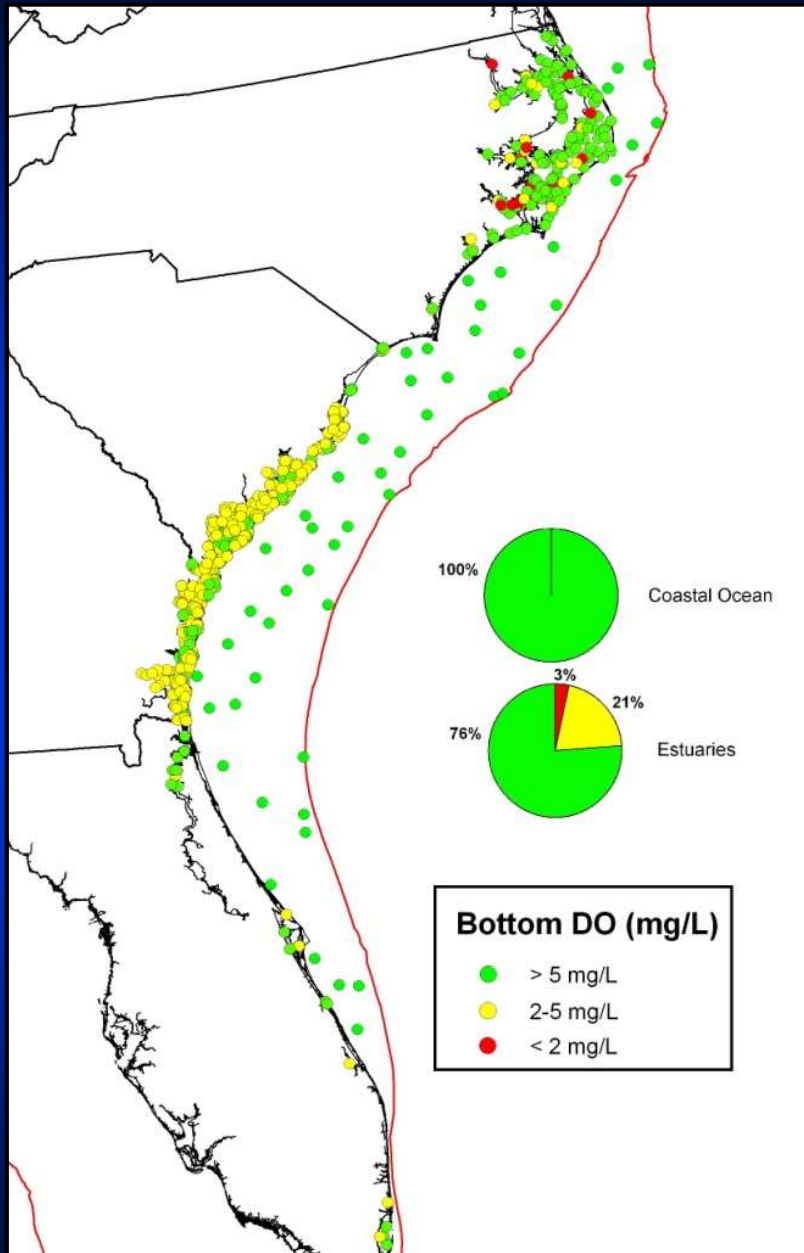
- Low Water Clarity
- Noxious Sediment Odor
- Oily Sediment
- Trash
- High Fish Tissue Contaminants (relative to human-health guidelines)

Approach - continued

- **Stratifying sampling sites across varying spatial scales to enable assessment of condition at state, regional, and national levels**
- **Sites included in NMSs where applicable, thus allowing comparison of condition in sanctuaries vs. surrounding shelf waters.**
- **Use of methods consistent with prior estuarine monitoring efforts enable comparison of condition between offshore & estuarine resource categories.**

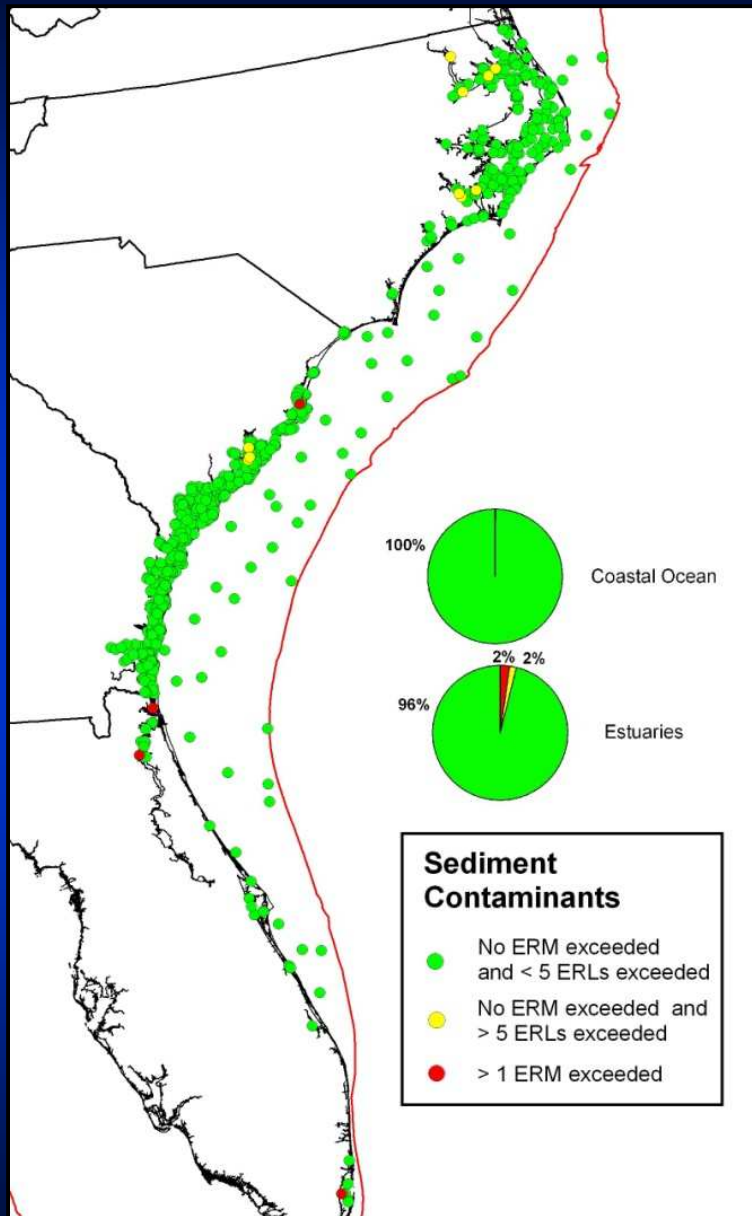
What have we learned?

Some examples of results thus far



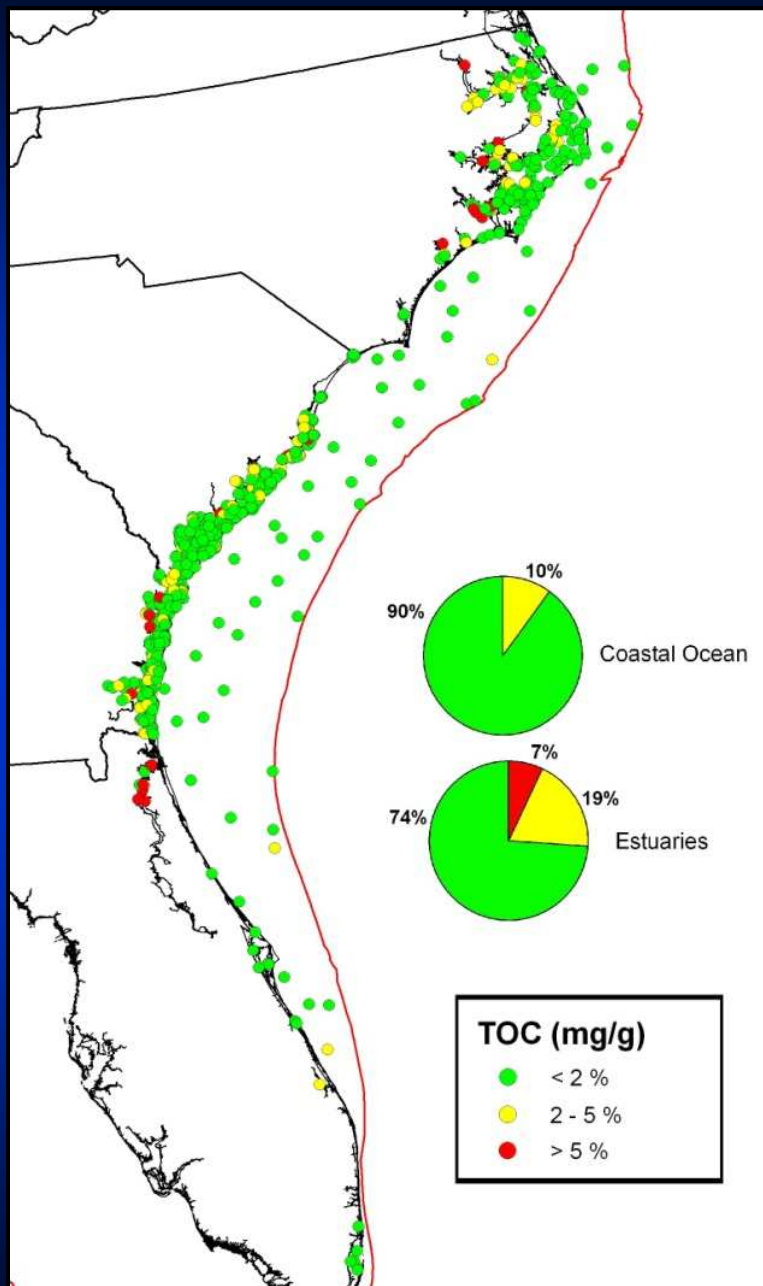
DO concentrations in near-bottom waters of the SAB

- Estuarine sites: 2000-2004, n = 697 (from EPA's EMAP/NCA program)
- Offshore sites: 2004, n = 50 (from NOAA's SAB-04 survey)
- See Cooksey et al. (In press)



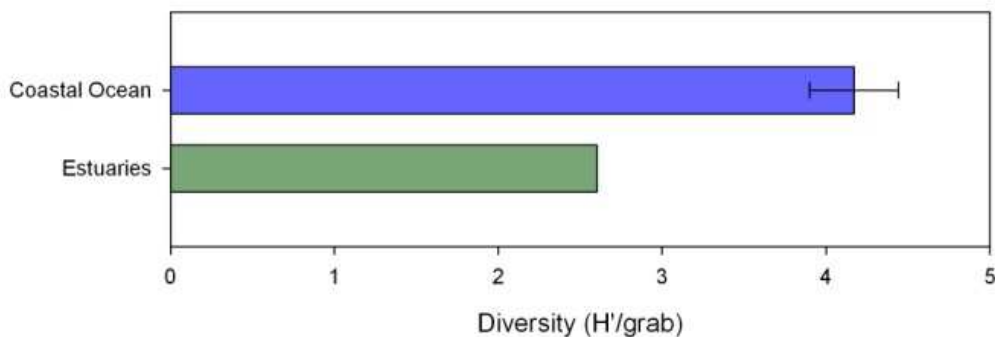
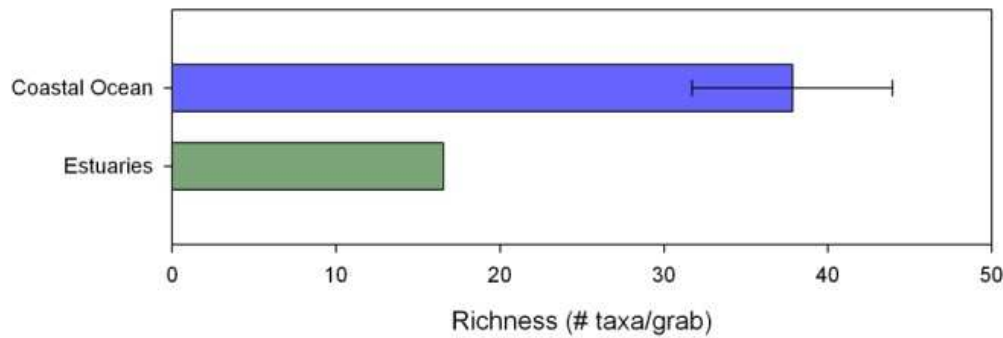
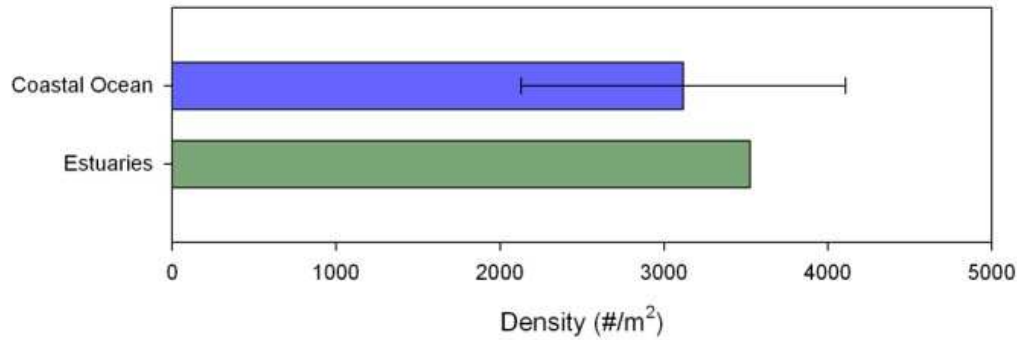
Extent of chemical contamination of sediments along the SAB

- Estuarine sites: 2000-2004, n = 697 (from EPA's EMAP/NCA program)
- Offshore sites: 2004, n = 50 (from NOAA's SAB-04 survey)
- See Cooksey et al. (In press)

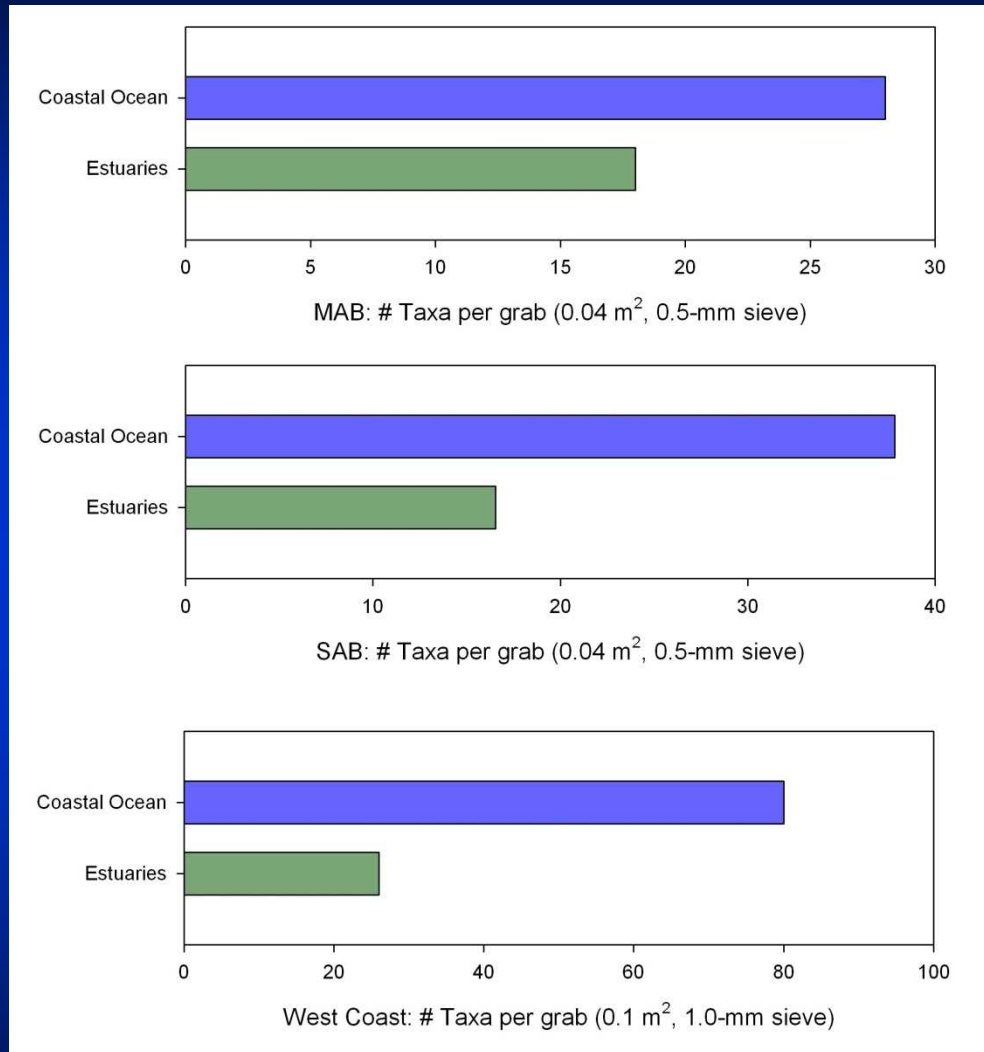


Ranges of TOC concentrations in sediments throughout the SAB

- Estuarine sites: 2000-2004, n = 697 (from EPA's EMAP/NCA program)
- Offshore sites: 2004, n = 50 (from NOAA's SAB-04 survey)
- See Cooksey et al. (In press)



Comparison of benthic species abundances, richness, and diversity in offshore vs. estuarine sediments of the SAB



Pattern of higher benthic species richness in offshore waters compared to estuaries is consistent across regions (SAB, MAB, and western U.S. Shelf)

Potential Benthic-Stressor Linkages

- No multi-metric/B-IBI type index available for most offshore regions.
- Potential stressor impacts were assessed by looking for obvious linkages between reduced values of key biological attributes (# of taxa, diversity, abundance) and synoptically measured indicators of poor sediment or water quality.
- Low values of species richness, H' , and density were defined as the lower 10th percentile of all observed values.
- Evidence of poor sediment or water quality was defined as: ≥ 1 chemical in excess of ERMs, $TOC > 5\%$, or $DO < 2$ mg/L.
- For all 3 offshore assessments (west coast, SAB, and MAB), we have found very little to no association of low values of biological attributes with indicators of poor sediment or water quality.
- Such lack of concordance suggests that these offshore waters are currently in good condition, with lower-end values of biological attributes representing parts of a normal reference range controlled by natural factors (e.g., latitude, depth, sediment type).



Olympic Coast National Marine Sanctuary

Products

- **Final Report: West coast shelf survey – Nelson et al. 2008**
- **Final Report: MAB survey – Balthis et al. 2009**
- **Final Report: SAB survey – Cooksey et al. (in press)**
- **NCCR4: Data from west-coast shelf, MAB, and SAB offshore surveys are being incorporated into the next National Coastal Condition Report (NCCR4 in prep)**

Contact: jeff.hyland@noaa.gov

Summary

- Studies provide probability-based estimates of condition in coastal-ocean (shelf) waters and at varying spatial scales
- Synoptic sampling of various biological & environmental indicators provides a basis for evaluating biotic condition in relation to stressor levels & other controlling factors
- Sampling design provides an opportunity for evaluating condition of NOAA NMSs in comparison to surrounding shelf waters
- Sampling scales provide an opportunity to enhance understanding of broad-scale oceanographic patterns and processes

Summary - continued

- Results serve as benchmarks to track any future changes with time
- Results provide support for key coastal management products & priorities (e.g, National Coastal Condition Reports, CMSP actions, EBM)
- Results of assessments conducted thus far in offshore waters along the U.S. west coast, SAB, & MAB have indicated generally good conditions, with little to no evidence of biological impacts linked to poor sediment or water quality
- However, future efforts should perhaps include additional stressor indicators of importance in offshore waters.

A photograph of a sunset over the ocean. The sun is a bright yellow-orange circle on the horizon, partially obscured by dark, heavy clouds. The sky is a mix of deep blue and orange, with the clouds catching the low light of the setting sun. The ocean is dark and textured with small waves. The text "The End" is written in a bold, yellow, sans-serif font in the center of the image.

The End