Nearshore Marine Ecosystems in the Gulf of Alaska: Detecting Change and Understanding Cause

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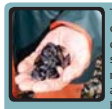
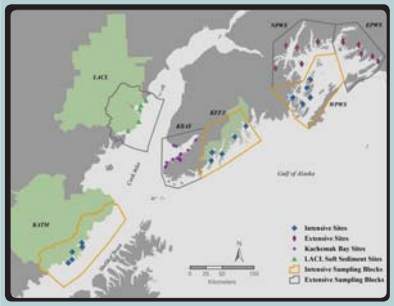


This poster presents data from our Gulf Watch Alaska program, nearshore benthic component. The data are from several types of sampling sites and methods but all focus on the mussel (*Mytilus trossulus*). In our study regions, mussels are ubiquitous. They serve as an important link in the intertidal trophic web by filtering detrital and planktonic material from the water and providing a food resource for other invertebrates as well as avian and mammalian predators. Additionally, by forming large mats, they provide habitat for other intertidal denizens that reside within or subsurface to mussel beds.

We chose to display these particular data because they:
-illustrate the interconnectedness of different aspects of our monitoring program
-demonstrate areas where process studies will easily and effectively complement the primary monitoring
-could be used in larger scale meta-analyses crossing large latitudinal gradients or even oceanic boundaries

Study Area



The current extent of our program, includes 5 sets of sites in each of 3 intensive blocks spanning 3 regions (bordered in yellow).
KATM = Katmai Nat'l Park & Preserve
KEFJ = Kenai Fjords Nat'l Park
WPWS = west Prince William Sound

Additional sites are located in extensive blocks in the same regions as illustrated by the gray outlines in Prince William Sound.

Randomly chosen rocky intertidal sites (blue cross) are paired with nearby soft sediment, mussel, and eelgrass sites. Marine bird and mammal & black oystercatcher transects, and sea otter forage and carcass recovery areas are also associated with the rocky sites. A similar monitoring program is being implemented in Kachemak Bay (purple diamonds). Since it lacks rocky habitat, the Lake Clark region only has the soft sediment monitoring portion of the program.

Program Overview

Below is a list of our vital signs and metrics. Vital signs monitoring tracks a set of physical, chemical, and biological elements of an ecosystem chosen to show the condition of resources, indicate change, or because they have human value. For each vital sign, we study a set of metrics and have proposed levels of ecologically significant change that would cause management action. The program is designed to give both site-specific and regional information needed to identify and understand change. The information helps determine whether changes are within natural levels of variability or if they may be the result of human influences. Highlighted cells indicate metrics with results in this poster.

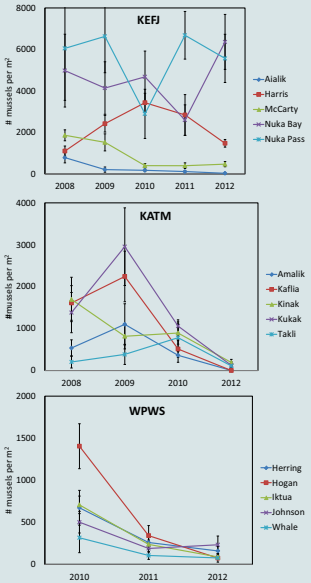
Vital sign	Metric	Degree of change deemed ecologically important*
Kelps and seagrass	Km of coastline with canopy forming kelp	80% reduction
	Proportion of beds with kelp canopy present	30% reduction
	Km of coastline with eelgrass	25% reduction
	Area with eelgrass present	25% reduction
Intertidal community -rocky substrate	Number of algal and invertebrate species	30% change
	Percent cover bare substrate, barnacles, mussels, Fucus, Alaria, Neorhodomela/Odonthalia	80% change
	Density of Nucella, Katharina, various stars	80% change
	Size distribution of Tectura persona	50% change
Intertidal community - soft sediment	Number of clam species	
	Total clam biomass	
	Density & size dist of Leucoma staminea, Saxidomus gigantea, Macoma spp.	
Intertidal Community – mussel beds	Density of Mytilus trossulus >20 mm	80% change
	Biomass of Mytilus trossulus >20 mm mussels	50% change
Marine birds	Number of bird species - summer	
	Number of bird species – winter	
	Abundance of harlequin ducks & Barrow's goldeneye in winter	
	Abundance of black-legged kittiwakes, glaucous-winged gulls, pigeon guillemots, cormorants, scoters, and harlequin ducks in summer	
Black oyster catcher	Density of active nest sites	
	Number of chicks or eggs per nest site	
	Species composition of prey remains	
	Size distribution of dominant prey	
Sea otter	Abundance	40% reduction
	Proportion of dominant prey in diet	
	Hours required to meet energetic needs	20% increase
	Carcass: age at death	
Water quality	Mean yearly air temperature	NA
	Mean yearly water temperature & salinity	NA
	Average daily range in water temperature & salinity	NA
	Min & max air temp, water temp, & salinity	NA
	Concentration of PAHs, PCBs, DDTs, Chlordanes, organopesticides, and heavy metals in mussels	Concentrations > the mean of sites sampled in mussel watch

*based on current ability to detect change and will be modified as the program and analyses are refined

Number of mussels (>20 mm) at mussel sites

Sampling a WPWS mussel site.

One of our KATM mussel sites in 2009 (top photo) and the same Katmai site in 2012 (bottom photo).

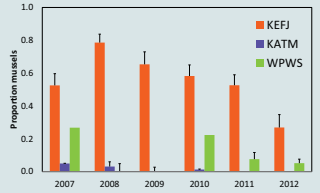


Percent cover of mussels from rocky intertidal sites, 5 sites per region

Percent cover data are from random point contact quads at the 1.5m tide height.

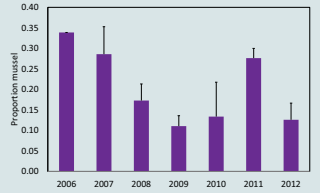
Proportion mussels in sea otter diet

Using high powered spotting scopes to watch sea otters, we can determine the proportion of different items in their diet.



Proportion mussels in black oystercatcher chick diet

We collect litter from oystercatcher nests and calculate proportion of prey types provided to chicks.



Results Summary

- Reductions in numbers of mussels at mussel sampling sites in KATM (2008-2012) and WPWS (2010-2012), however results vary more for KEFJ sites (2008-2012).
- An apparent decrease in percent cover of mussels at the majority of the rocky intertidal sites over the course of our sampling (2006-2012).
- The proportion of mussels observed in sea otter diets declined in KEFJ & WPWS during our study period, while it has remained low at KATM during our study.
- The proportion of mussels in black oystercatcher chick diets varied from 2006-2012, combining data from all sites, all areas.
- Decrease in total numbers of black oystercatchers observed on bird survey transects in both KATM and KEFJ over the course of this monitoring period (results not shown on this poster).

Challenges & Future Plans

- Mussel trends suggest decreases in all areas studied, possibly affecting population density and consumption by sea otters & oystercatchers. A challenge is how to analyze multiple metrics to understand linkages among species in the ecosystem.
- Maintain consistency of data collection across individuals, areas, and time to insure reliable comparability.
- Assess methods to determine our power to detect change.
- Continue working to evaluate the extent of natural variation compared to human induced change.
- Link & interact with other long term monitoring programs to see where collaborations exist.
- Enhance mussel component to address additional metrics such as mussel bed thickness, and continue recently implemented research on gene expression, physiology, and stable isotopes across regions.
- More intense monitoring of sea otter foraging in KEFJ to better understand the importance of mussels in sea otter diets and examination of seasonal effects.
- Initiated a study in KEFJ about how variation in oystercatcher chick provisioning affects productivity & fleding success.

Acknowledgements

Since the start of this program, the Exxon Valdez Oil Spill Trustees Council, the National Park Service (Southwest Alaska Network, KEFJ, LACL, & KATM) and the USGS Alaska Science Center have supported this work. We would like to recognize the exceptional cooperation and technical assistance by NPS staff, A. Bennett, B. Chilcott, M. Hahr, S. Hall, T. Hamon, M. Kansteiner, M. Knight, C. Moore, R. Moore, D. Mortenson, D. Noon, L. Phillips, M. Shephard, C. Smith, B. Thompson, J. Thompton, and C. Turner. This work could not have been completed without the field and technical assistance of A. Doroff (NERR), G. Esslinger (USGS), A. Fukuyama (AKF, Inc), S. Saupe (CIRCAC), G. Snedgen (USGS), K. Vicknair (ADF&G), V. VonBiela (USGS), B. Weitzman (USGS) and a fantastic and dedicated group of volunteers & contractors, A. Benolkin, K. Bodkin, B. Choate, M. Cody (BOEM), J. Coffey, A. Coletti, G. Cox, C. Ehrler, J. Paszalek, J. Perry, and S. Speckman (FWS).

We want to extend a special "Thank You" to Kathleen Gill, a senior at Chugiak High School who is participating in the Anchorage School District's mentoring program and who created this poster as part of her mentorship with USGS.

THE LONG-TERM MONITORING PROGRAM OF THE EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
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