Monitoring Nearshore Marine Ecosystems in the Gulf of Alaska

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Coastal Resources Associates, Inc.

SWAN Southwest Alaska Network

Timeline of the development of the EVOS and NPS Inventory and Monitoring programs in the nearshore:

2001
EVOS GEM nearshore planning process begins

Planning workshops with academics, agency personnel, researchers, and stakeholders

2002
Conceptual design report completed

Nearshore design begins

2003
Nearshore monitoring design alternatives report completed

2004
Implementation begins

Workshop to review design alternatives

2005
Prince William Sound SOP testing

NPS Southwest Alaska network joins

2006
EVOS nearshore GEM monitoring design completed

Historic georeferenced bibliography completed

Implemented data collection in Katmai NP & P

2007
Implemented data collection in Kenai Fjords NP and Prince William Sound

2008
Continued data collection in Katmai NP & P and Kenai Fjords NP

2009
Sampling to begin in Lake Clark NP & P and continue in Katmai NP & P and Kenai Fjords NP

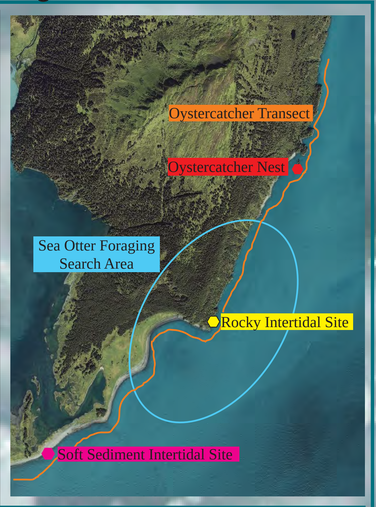
The US Geological Survey, the Exxon Valdez Oil Spill Trustee Council, the National Park Service Southwest Alaska Network Inventory and Monitoring Program, and Coastal Resource Associates, with extensive input and evaluation from the public and academia, designed and tested long-term monitoring programs for marine nearshore ecosystems in the Gulf of Alaska. We have adhered to key guiding principles balanced by relevant constraints to keep the program manageable and focused on our goals. This design is balanced in its ability to detect change, provides latitude for adaptive management, allows hypothesis testing, and includes additional parameters such as water quality measurements and contaminant analysis. The program is designed to monitor at a variety of temporal and spatial scales. The sampling design incorporates well known processes and ecological interactions within the nearshore, from primary production to primary consumers to apex predators at spatially balanced, randomly selected sites within the four regions. The variety of temporal and spatial scales as well as the processes and species interactions inherent to the design will help to evaluate causes of change that are anticipated. Design features include: 1) spatial and temporal components, 2) trophic interactions, 3) environmental variables, 4) species productivity and growth, and 5) species size and age structures.

Goals:
Detect change on varying scales
Inform cause of those changes

Organizing Guidelines:
Focus on trophic interactions
Focus on sentinel habitats and species

Relevant Constraints:
Budgets
Temporal Scale > 1 year
(water quality temporal scale > 1 hr)
Spatial Scale 10^3 > 10^8 m^2

Spatial Design



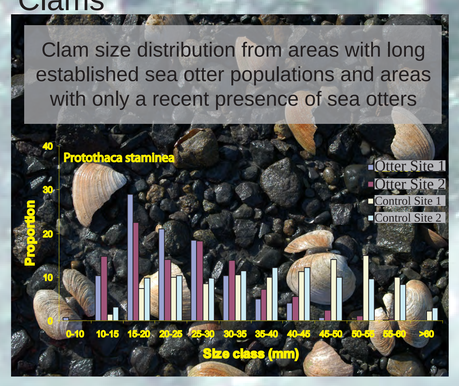
Sampling locations were selected to provide a random, spatially balanced distribution. The design allows for detection of large temporal or spatial-scale changes. The program consists of sampling within 3 blocks of approximately 10,000 km² within each of 4 regions: Kodiak archipelago, Alaska Peninsula, Kenai Peninsula, and Prince William Sound. More frequent and comprehensive sampling is conducted within one intensively sampled block per region (red outline). The plan calls for less frequent sampling at more widely dispersed sites within each of the 12 blocks. Discrete sampling sites were selected using a generalized random tessellation stratified (GRTS) sampling scheme. This design provides a random yet spatially balanced distribution of sites within each block and also allows sampling sites to be added or deleted without compromising the statistical or spatial integrity.

Detecting Trends

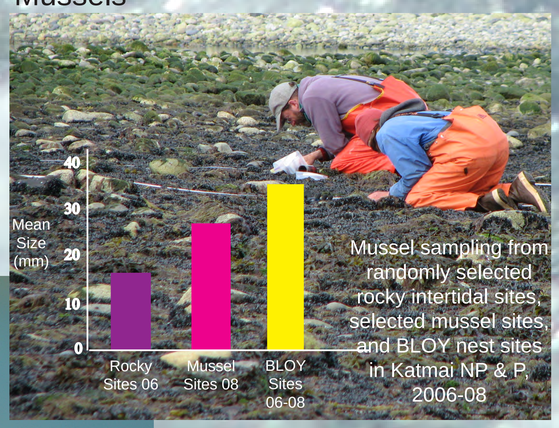
In general, we deem important changes that are likely to have system-wide effects, through predator –prey interactions. Where possible, we will rely on two types of data to help identify trends of ecological importance. The first is the range in natural variation that has been observed in what are considered healthy populations. These variations represent the bounds to be place on any reasonable trigger point. The second is the range in variation, generally expressed as a level of change that has been considered ecologically important in past studies of impacts to nearshore ecosystems, and especially those that have been shown to have larger system-wide effects.

Clams

Clam size distribution from areas with long established sea otter populations and areas with only a recent presence of sea otters

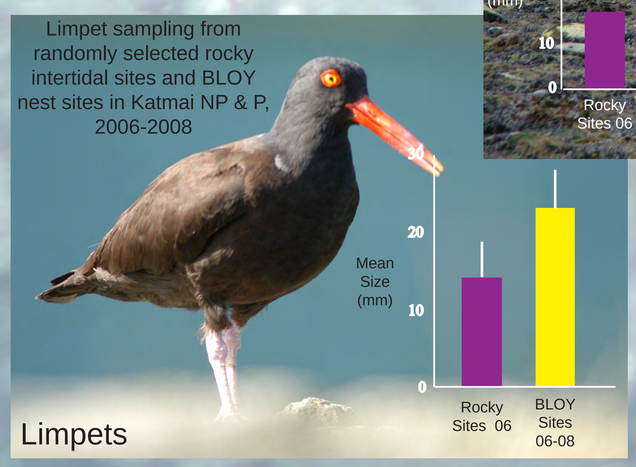


Mussels



Mussel sampling from randomly selected rocky intertidal sites, selected mussel sites, and BLOY nest sites in Katmai NP & P, 2006-08

Limpet sampling from randomly selected rocky intertidal sites and BLOY nest sites in Katmai NP & P, 2006-2008



Limpets

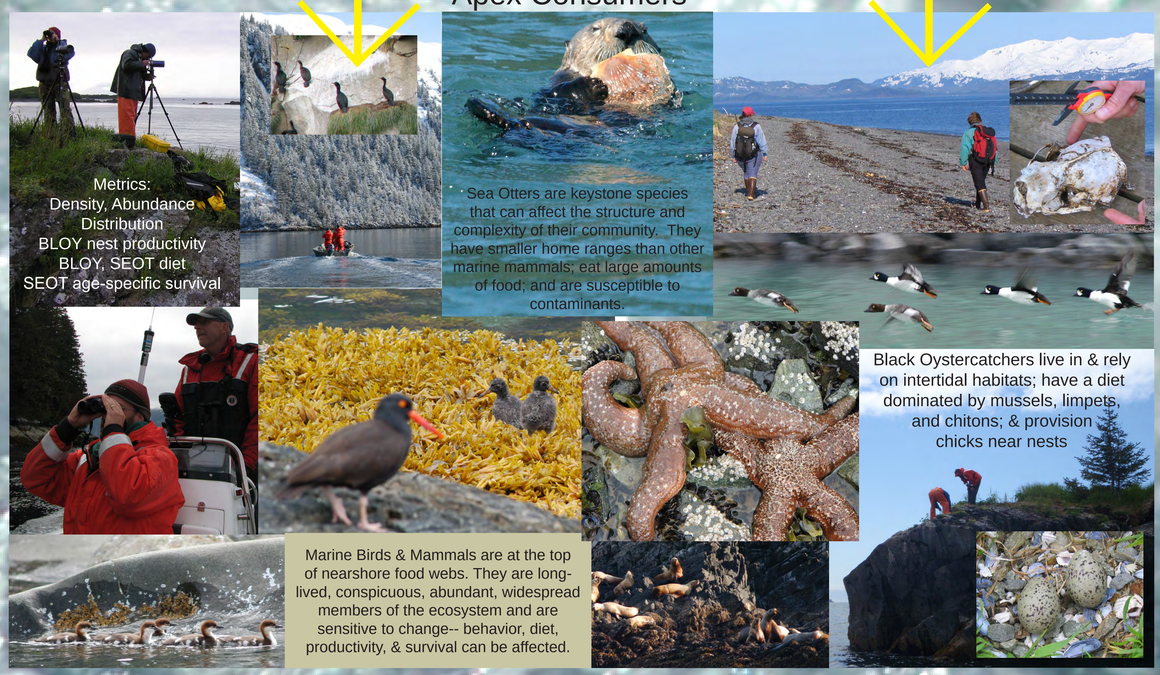
Primary Producers

Kelp and seagrass are the major primary producers, serve as a nutrient filter, provide habitat for fish, clams, & urchins, and are a physical substrate for other invertebrates and algae. Intertidal algae provides food for ducks and fish as well as spawning and nursery habitats for forage fish and juvenile crustaceans.

Primary Consumers

Intertidal grazers and filter feeders provide critical food resources for shorebirds, ducks, fish, bears, sea otters, and invertebrate predators. They serve as conduits for primary productivity across the nearshore food web.

Apex Consumers

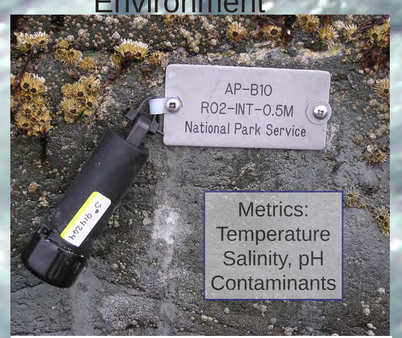


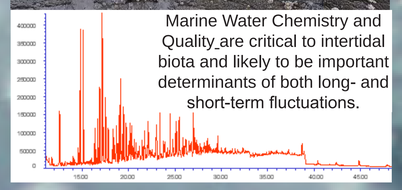
Sea Otters are keystone species that can affect the structure and complexity of their community. They have smaller home ranges than other marine mammals; eat large amounts of food; and are susceptible to contaminants.

Black Oystercatchers live in & rely on intertidal habitats; have a diet dominated by mussels, limpets, and chitons; & provision chicks near nests

Marine Birds & Mammals are at the top of nearshore food webs. They are long-lived, conspicuous, abundant, widespread members of the ecosystem and are sensitive to change-- behavior, diet, productivity, & survival can be affected.

Environment





Marine Water Chemistry and Quality are critical to intertidal biota and likely to be important determinants of both long- and short-term fluctuations.

We expect to add Lake Clark NP & P to our sampling universe in 2009, to continue sampling there and at existing sites indefinitely, and to explore the option of expanding the geographic scope of the program if warranted. As part of the monitoring program, we also advocate hypothesis-driven process studies and more focused studies of events of particular importance. We anticipate that such studies will not be initiated until after the first 5 years or more of monitoring has been completed. This will allow identification of particularly compelling trends and development of hypotheses regarding causes for change, and will allow funding to be built to a sufficient level to support meaningful studies.

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