Evaluation of the Southwest Alaska Network Nearshore Monitoring Program: synthesis, analysis, and insight from the first 5 years

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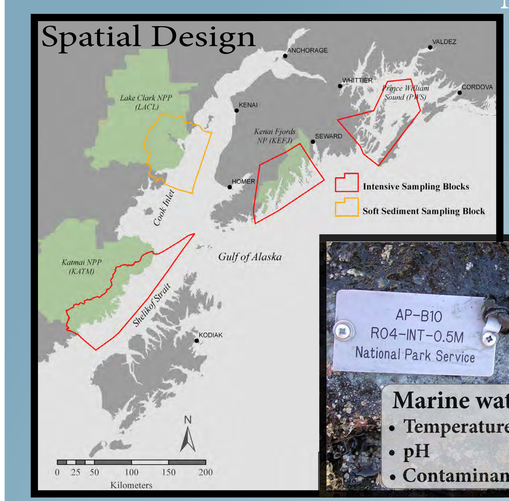
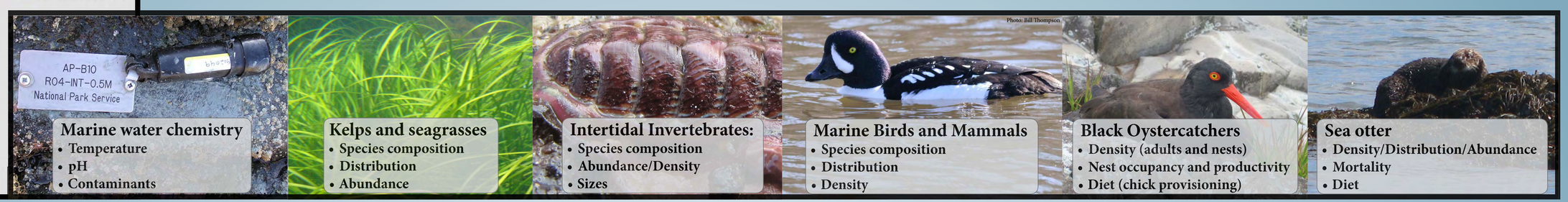


The National Park Service Vital Sign Monitoring Program uses a small set of 'vital signs' or resources to act as indicators for the overall health of a given ecosystem. The Southwest Alaska Network (SWAN) Nearshore Monitoring Program measures over 50 biological, chemical, and physical metrics encompassed within six SWAN I&M designated 'vital signs'. The sampling design incorporates well known ecological interactions and processes primarily within the nearshore food web, at spatially balanced, randomly selected sites within the coastal network of southwestern parks in Alaska. To date, we have complete 4 to 5-year data sets for approximately half of the metrics at both Katmai National Park and Preserve (KATM) and Kenai Fjords National Park (KEFJ), and we can now utilize existing data to evaluate several aspects of the program. While we are interested in what the data are telling us about ecosystem processes, we will also evaluate the functionality of the program. For each metric we will determine whether current sampling intensity and frequency are sufficient to detect change and whether sampling frequency can be reduced, thus allowing us to minimize costs. We will incorporate results in sampling protocols to optimize our ability to detect trends for the nearshore vital signs within the coastal network of Southwest Alaska National Parks.



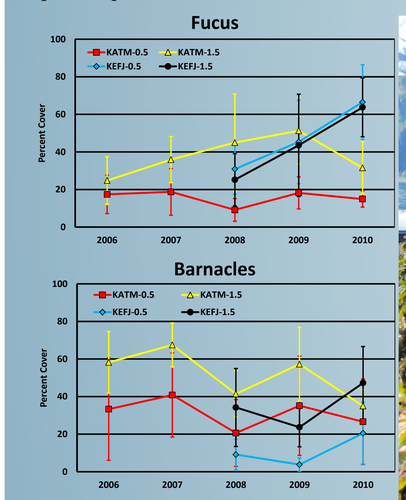
The first 5 years...

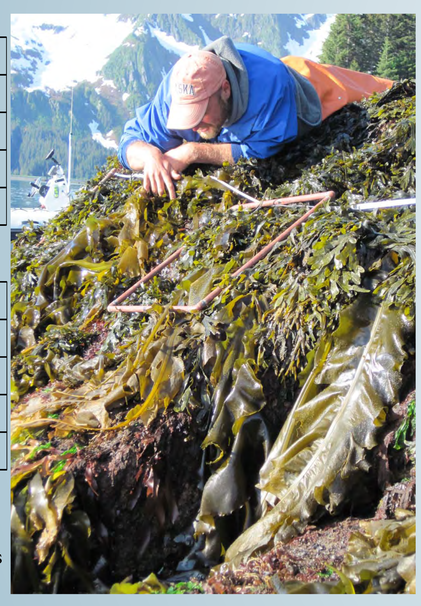
We began exploratory data collection in 2006 in Katmai National Park and Preserve (KATM) and in 2007 in Kenai Fjords National Park (KEFJ). To date, multiple years of data exist for all six of the vital signs. We have loosely and temporarily defined three broad categories to illustrate various aspects of the monitoring program based on field progress and preliminary data analysis at the 5-year mark: (1) protocols that have yielded data ready for further analysis to guide monitoring protocols, (2) protocols that have motivated extension partnerships and studies and (3) protocols generating preliminary data that are thought-provoking and may be suggestive of ecosystem level changes; data that require further examination.

Data ready for further analysis:

Existing data will be used in simulations to estimate sampling intensity required to detect a specified trend or change with some level of confidence for selected metrics. We will begin the simulations with a limited number of vital signs and their corresponding metrics. The metrics associated with rocky intertidal kelps and invertebrates, including those sampled at mussel beds, will be the first assessed. Power analysis through simulations will be conducted next using sea otter aerial survey data. The work proposed here is to assist the National Park Service in the modification of existing protocols to optimize its monitoring program.

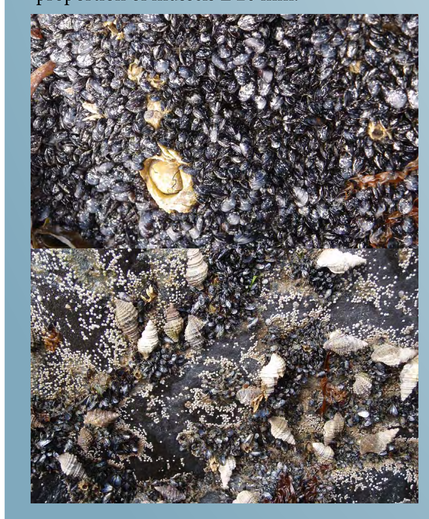
Below is representative data from rocky intertidal sampling of nearshore marine invertebrates and kelps/algae. Each point represents data from 5 randomly selected sites within each Park unit. Each site is sampled at the 0.5 and 1.5 tidal height with 12 random point contact quadrats per elevation.

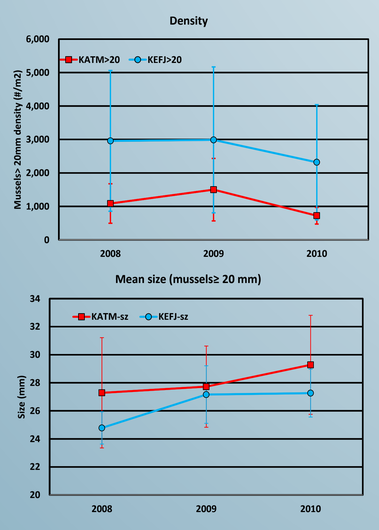




Percent cover of *Fucus* and barnacles at 0.5 and 1.5 m above MLLW in Katmai NPP and Kenai Fjords NP, 2006-2010 (error bars indicate 95% CI)

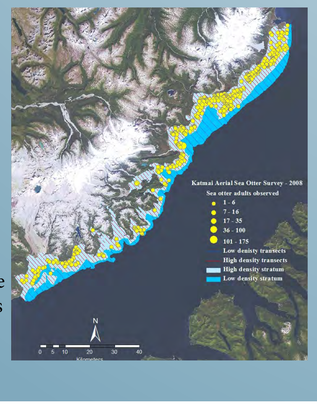
Data here represent three years of sampling at five randomly selected mussels beds within both Katmai NPP and Kenai Fjords NP. Mussel beds are sampled annually for overall density, density of mussels ≥ 20 mm, mean size and size distribution of mussels ≥ 20 mm and proportion of mussels ≥ 20 mm.





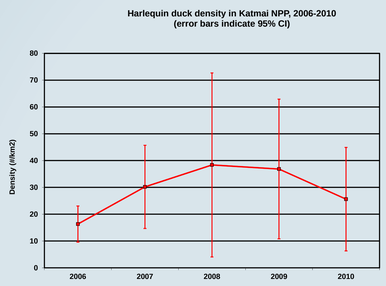
Sea Otter Population Estimates:
KEFJ 2007: 1,511
KATM 2008: 7,095

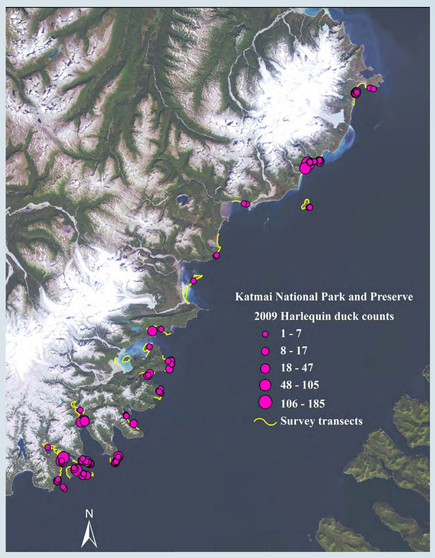
At right is a graphical representation of results of the SWAN 2008 sea otter aerial survey of the Katmai coast. Surveys are important for conservation of sea otters. The Katmai survey helps to define the geographic boundaries of the threatened SW Alaska stock.



Extension partnerships and studies:

Below are two examples of extension studies that we have begun based on preliminary data analysis from the SWAN nearshore monitoring program. The purpose of extension studies and partnerships is to expand and refine current sampling designs as well as to provide further knowledge to assist in the interpretation of monitoring data.

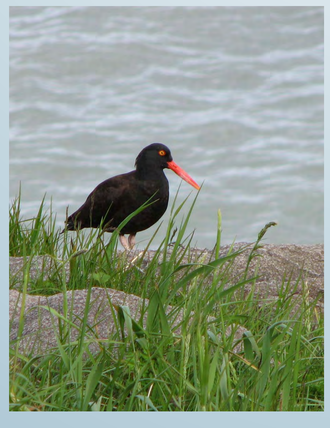


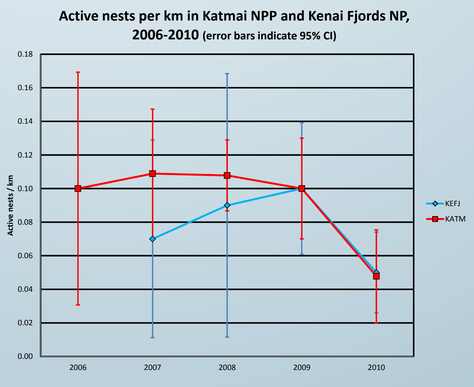


Data shown here are harlequin duck density estimates and distribution along the Katmai NPP coast from 2006-2010. Coefficients of variation and confidence intervals are high, indicating that refinement to the sampling design may be necessary in order to detect a trend within a given time frame. Partnering with other agencies and groups will allow us to build a survey design that is similar across the western GOA, with a primary goal of estimating trends for indicator species across a larger area.

Black oystercatcher (BLOY) results prompted a KEFJ NP-SWAN proposal of BLOY extension studies to address questions regarding nest density, productivity, diet and chick provisioning to ensure robust interpretation of trends observed in long term monitoring data collected for this species. Specific objectives are:

- Estimate productivity at black oystercatcher nest sites
- Determine sources of disturbance and mortality to adults, eggs, and chicks prior to fledging
- Estimate rates of energy delivery to chicks by repeated collections of prey remains and observations of prey deliveries
- Estimate productivity and fledging success as a function of prey provisioning



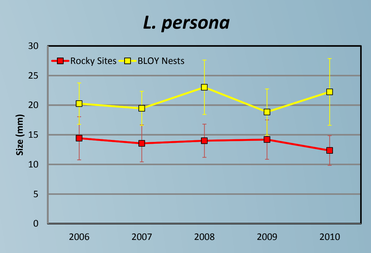


Acknowledgements

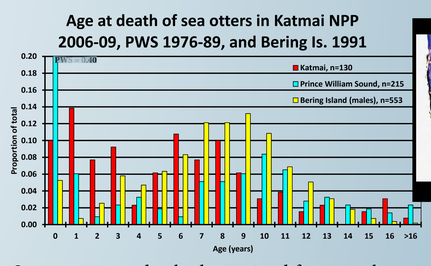
The National Park Service, Southwest Alaska Network, Katmai National Park and Preserve, Kenai Fjords National Park, Lake Clark National Park and Preserve and the USGS Alaska Science Center supported this work. We would like to thank the following (listed in alphabetical order): Leon Alsworth, Brenda Ballachey, Amy Beck, Erik Beever, Alan Bennett, Anne Benolkin, Kelly Bodkin, Bill Choate, Jennifer Coffey, Ashley Coletti, Robin Corcoran, Jeff Cross, Jose deCreeft, Chris Ehrler, George Esslinger, Lee Fink, Allan Fukuyama, Allen Gilliland, Meg Hahr, Shelley Hall, Troy Hamon, Robb Kahler, Pat Kearney, Amy Killshaw, Sharon Kim, Jeff Lewis, Mandy Lindeberg, Brooke McFarland, Dan Monson, Claudette Moore, Ralph Moore, Dorothy Mortenson, Daniel Noon, Jessica Perry, Laura Phillips, John Reed, John Rogers, Angela Romito, Susan Saupe, Michael Shephard, Cuyler Smith, Gary Shigenaka, Greg Snedgen, Tjibbe Stelwagen, Bill Thompson, Declan Troy, Carissa Turner, Kenneth Vicknair, Vanessa VonBiela, John Wetzel and Dan Young. Very special thanks to Hadley Underwood of West High for poster design.

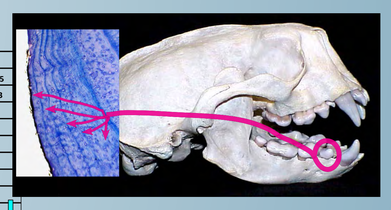
Thought-provoking data:

For these protocols and metrics, in addition to applying standard analysis approaches, we plan to examine further.

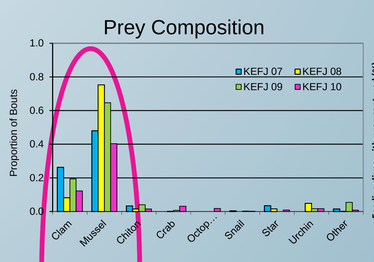


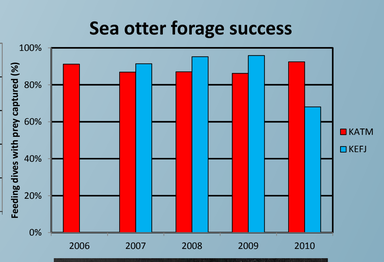
Sampling of black oystercatcher nests includes collection of prey remains brought back to the nest by adults to provision chicks. Prey items are identified to species level when possible and measured. One of the black oystercatcher's primary prey items is the limpet, *Lottia persona*. The graph illustrates that black oystercatchers are consistently targeting the larger size classes of *L. persona* based on our random sample of *L. persona* sizes from our rocky intertidal invertebrate sampling. As black oystercatcher densities change, we may concurrently see changes in size distributions of their prey.

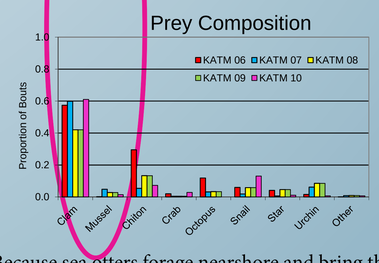




Sea otter age at death, determined from tooth cementum layer analysis, provides useful inference about the status of populations. Here we contrast recent age at death distributions at KATM with comparable data from Bering Island, Russia when the population was equilibrating with food resources and in western PWS (pre-EVOS) when the population was near equilibrium density. We are currently investigating further whether population level mortality is changing at KATM or if there is some other explanation for the high proportion of prime age carcasses in our data.







Because sea otters forage nearshore and bring their prey to the surface, defining foraging success, diet and energy recovery rates is straightforward. In all years, otters are feeding predominantly on clams in KATM and mussels in KEFJ. Contrasts over space and time allow inference to changes in sea otter diet, invertebrate prey populations and sea otter population status relative to food.

Future Directions

- Complete power analysis for all vital signs and their corresponding metrics to optimize sampling design while minimizing costs.
- Continue implementation of monitoring program in Katmai National Park and Preserve, Kenai Fjords National Park, Lake Clark National Park and Preserve and Prince William Sound.
- Utilize partnerships such as the USFWS, universities and other NPS entities to aid in extension studies.
- Expand the nearshore monitoring program to other areas within the Gulf of Alaska, with potential partners including other Park networks, USFWS, EVOSTC, USGS, and NPRB.

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