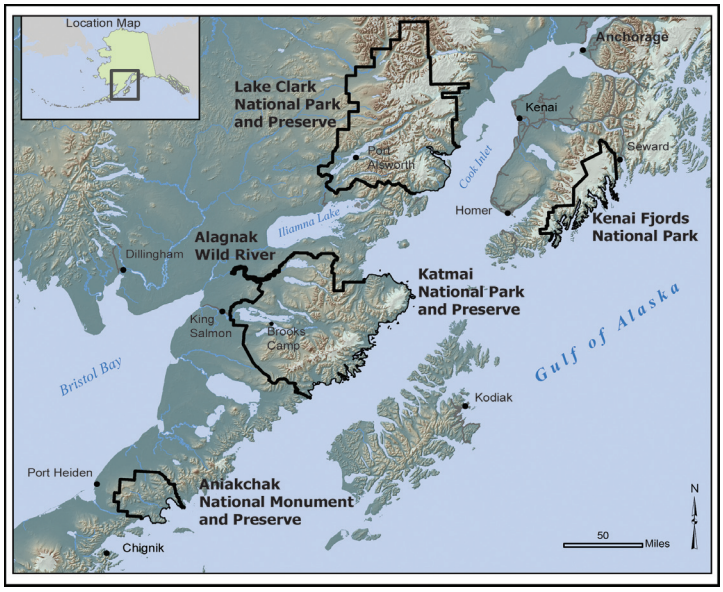
National Park Service - Southwest Alaska Network

Inventory & Monitoring Program

INVENTORY AND MONITORING- WHAT IS IT, AND WHY ARE WE DOING IT?

The National Park Service's primary mission is to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations. Preservation of healthy parks depends on acquiring accurate and timely information about the condition of natural resources, monitoring the change of conditions over time, and acting on that information with confidence. Because of a lack of resource knowledge in many parks, the 1998 National Parks Omnibus Management Act mandated a program to collect baseline information and to monitor long-term trends in the condition of the Parks' natural resources.



Why Networks?

It's not economically feasible to provide every park with a staff of scientists. Therefore, the 270 parks with significant natural resources have been organized into 32 networks based on geographic proximity and ecological similarity, sharing staff and resources. The Southwest Alaska Network (SWAN) is one of 4 Alaska Networks and consists of five park units: Aniakchak National Monument and Preserve (ANIA), Alagnak Wild River (ALAG), Katmai National Park and Preserve (KATM), Kenai Fjords National Park (KEFJ), and Lake Clark National Park and Preserve (LACL).

The intent of the SWAN monitoring program is to track a subset of park resources and processes, known as "vital signs", that are considered to be the most significant indicators of ecological condition of those specific resources that are of the greatest concern to each park. Currently, the network has completed biological inventories and is developing the most efficient and cost-effective techniques for monitoring vital signs.

SWAN Accomplishments - General Overview

In 2006, the Network's vital signs monitoring plan was finalized and approved. Network staff and cooperators continued writing and field testing protocols and initiated pilot monitoring for several vital signs including landscape processes, glacial extent, freshwater flow systems, and marine nearshore. Final drafts of these protocols will be submitted to the Alaska Regional I&M Coordinator for peer review by other scientists during 2007. Several ecological history studies initiated in 2003-2004 were completed this year including repeat photography, palaeolimnology of lake productivity and salmon abundance, and paleoenvironmental reconstruction of SWAN lake systems. Final field work was completed for the montane landbird and coastal river otter inventories and final inventory reports were completed for small mammals, vascular plants, forest landbirds, and marine invertebrates. SWAN staff gave public lectures in gateway communities on the importance of long-term monitoring in national parks, technical presentations at professional meetings, and produced educational products for distribution at visitor centers and commercial lodges that serve park visitors. Accomplishments in 2006 represent the dedicated work of Anchorage-based SWAN staff, park staff in Seward, Homer, King Salmon, and Port Alsworth; NPS Alaska Regional Office Staff; and 42 cooperators and contractors affiliated with federal and state agencies, universities, non-government organizations, and private science consultants.

Education and Outreach

SWAN staff have been working collaboratively with the NPS Office of Education and Outreach to develop educational materials for a broader audience. Initial products will include a brochure handout that provides an overview message of the SWAN and its mission and a logo to provide recognition of SWAN-related products. In addition, Jim Pfeiffenberger, Ocean Alaska Science and Learning Center (OASLC), Seward, AK recently completed a 22-minute film on the SWAN Inventory and Monitoring Program. The film will air on Alaska Public Television-KAKM and made available to other PBS affiliates. A DVD can be requested from the SWAN or OASLC.

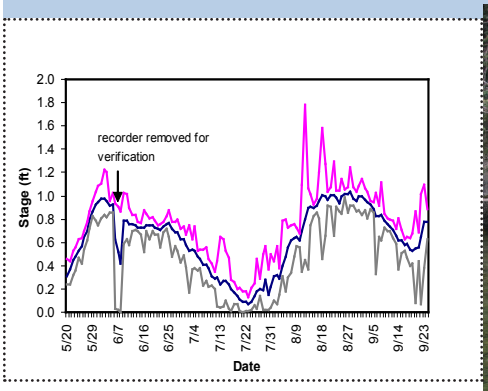
SWAN
Southwest Alaska Network

Surface Hydrology

- Protocol development for surface hydrology was initiated through a cooperative agreement with USGS – WRD to establish stage and crest gages at four SWAN rivers: the Naknek and Brooks Rivers in KATM, and the Chilikadrotna and Telaquana Rivers in LACL.

- SWAN staff deployed water level recorders and corresponding barometers at all sites except the Telaquana River, where volunteers record the daily gage height.

- Preliminary stage rating curves will be available in early 2007. These rating curves will be used to quantify streamflow volume.



Upper right: Kokanee fish sample (KEFJ). Lower center: USGS hydrologist installing stage gage at Lake Brooks outflow (KATM). Lower left: Lake Brooks outflow stage readings.

Resident Lake Fish

- Protocol development and testing continued for a second year during 2006 in LACL.

- Field crews captured 120 adult resident lake fish of nine species, and 2815 juveniles or fry, the majority of which were young of the year sockeye salmon (*Oncorhynchus nerka*).

- Several types of nets were tested and evaluated. Surface and sinking gill nets yielded the highest catch and had the lowest mortality. Sinking gill nets, pelagic gill nets and oversize minnow traps resulted in poor yield and high mortality.

- Two years of protocol testing have revealed habitat differences for some species and reiterated the difficulty in capturing uncommon species or habitat specialists without focused sampling. The final protocol will address these issues.

Black Bear Genetics

- Investigations in KEFJ and adjacent areas of the Kenai Peninsula by Stacie Robinson, University of Idaho, indicate restricted gene flow in current generations of black bears and evidence for past barriers between the Kenai Peninsula and mainland.

- Three genetically distinct groups were clustered geographically in the Kenai Peninsula, Alaskan mainland, and Prince William Sound.

- Park managers can use this information to monitor changes in black bear populations that could result if population connectivity were disrupted by humans or habitat loss.

Lower center: Black bear in Kenai Fjords National Park. Upper right: Scientist preparing bear hair samples for DNA analysis.

Completed SWAN Plans

- Vital Signs Monitoring Plan - Completed and approved by the SWAN Board of Directors and NPS National Monitoring Program Leader, September, 2006.

- Data Management Plan - Completed in September, 2006.

- Plans are available for viewing or downloading at the SWAN website: http://www.nature.nps.gov/im/units/swan/index.cfm?theme=monitoring_plan

Glacial Ice Extent

- Dr. Dorothy Hall and Janet Chen (NASA-Goddard Space Flight Center) are using Landsat satellite imagery to map glacial ice extent and decadal changes in ice cover (1970s - 2000).

- Preliminary results indicate that glacier extent in KATM has decreased by approximately 6.7% since 1974. Volcanic ash and moraine material covering glacier ice in KATM present challenges in the interpretation of satellite imagery.

- Monitoring of glacial extent may enable us to predict where rapid ice loss, accompanied by increased sedimentation, increased discharge, and/or rapid establishment of vegetation could occur.

Vegetation Composition and Structure

Vegetation composition and structure was identified as a SWAN vital sign because of its importance to ecosystem function. Changes in vegetation affect wildlife habitat, and can also reflect long term trends in climate, biotic interactions, or human uses. For example, a warming climate might accelerate the rate at which trees advance into the subalpine, down the Alaska Peninsula, or into drying wetlands. In 2006, Drs. Robert Kennedy and Warren Cohen, USFS-Pacific Northwest Research Station, worked with SWAN staff to adapt an existing protocol developed for the North Coast and Cascades Network (NCCN) for use in the landscapes of the SWAN. Monitoring objectives include:

- detect changes in shrub cover (e.g., shrub expansion and infilling)
- quantify changes in coniferous and lichen cover
- monitor establishment of vegetation following glacial retreat and/or channel abandonment
- track changes in surface hydrology, including infilling of ponds by vegetation and creation of new water bodies.

Left: Principal Investigator Dr. Rosemary Sherriff cores a mature white spruce (LACL). Upper: Recent spruce bark beetle-induced mortality, Bay of Isles, Naknek Lake (KATM).

Harding Icefield Weather Station

Located at 4,200 ft., this station is beginning its third year of continuous operation. Despite extremes in weather, the weather station tower and all sensors are functioning as designed. The station records and transmits weather observations hourly. Current weather conditions and summary reports can be viewed on the Western Regional Climatic Center's web site at: http://www.wrcc.dri.edu/cgi-bin/rawMAIN.pl?akAHAR. With two years of data in archive, some interesting observations are noted below:

Date	Observation	Comment
1/27/06	-17 F	record low to date
8/11/05	72 F	record high to date
8/1/04 – 7/31/05	28.7 F	avg. annual temp.
8/1/05 – 7/31/06	25.9 F	avg. annual temp.
2/9/06	100.2 mph	highest wind gust to date

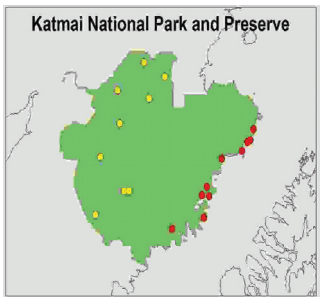
Left: Alder establishment on glacial outwash (LACL). Bottom: Shrub encroachment into lichen-dominated heath and infilling of pond (KATM).

The protocol uses paired Landsat TM/ETM+ images to identify changes through time. Overflights conducted in 2006 showed that existing spectral classes need to be better defined, and that interannual variation in phenology may confound interpretation of change in some parts of the landscape. However, the different images clearly reveal a number of changes that have occurred over a short time frame including:

- tree and shrub mortality due to recent insect outbreaks
- establishment of vegetation on glacial outwash
- significant re-routing of stream channels

More subtle increases in the cover of dwarf birch (*Betula nana*), willows (*Salix* spp.) and birch hybrids appear to be associated with a concomitant decrease in lichen cover in many of the drier dwarf shrub and open spruce communities. A draft protocol and SOPs for acquisition, preprocessing, and interpretation of difference images is due in December 2006.

A second project, looking at historic spruce bark beetle disturbance, is being conducted in Lake Clark and Katmai NPP by Dr. Rosemary Sherriff, University of Hawaii, and Dr. Ed Berg, USFWS. Tree-ring data from the two parks will provide an indication as to whether widespread insect disturbance has occurred in these forests in the past.



Left: Harding Icefield weather station. Right: Surveyed sites for potential weather station deployment in KATM.

On-the-ground surveys for potential weather station deployment sites were conducted in KATM (9 sites) and KEFJ (7 sites). Physical conditions at each site were documented and a full set of digital photographs were captured. Over-flights of 11 more sites were conducted in KATM. Staff from the Alaska Regional Office, KATM and KEFJ participated in documenting each of these sites.

Climate Change and Permafrost in KATM

Loss of permafrost associated with climate warming is a major disturbance in boreal regions. In KATM, thawing of discontinuous permafrost has resulted in the development of thermokarst terrain, or uneven surface topography consisting of collapse features (pits, troughs, thaw slumps and other depressions) that are filling with water and converting ericaceous heath tundra to wetland. Through its effects on SWAN vital signs, surface hydrology and vegetation composition and structure, permafrost degradation has the potential to dramatically alter the landscape of the SWAN parks. In cooperation with Torre Jorgenson, ABR, Inc., and Dr. Vlad Tumskoy, visiting scientist from Russia, SWAN staff used a protocol using procedures similar to those adopted by the Central Alaska Network to establish a permafrost monitoring station in KATM. Two ice cores were collected in the study area, one of which contained unusually high quality ice lenses in lacustrine sediments. The presence of this lacustrine ice between 2-2.5 m in the soil profile suggests ancient lake drainage and re-freezing of lake sediments, and/or intervals of freezing and thermokarsting separated by deposition of fine sediments. Carbon-14 analysis of organic matter in the ice cores will enable the PIs to fine-tune their estimate of how long ago the permafrost layer established and when it began to break down. To evaluate the effect that present-day permafrost degradation is having on plant communities in the area, SWAN staff assisted in documenting species composition surveyed along 400 m transects. In addition to describing successional changes in vegetation along the transects, soil cores were used to examine the shifts in community composition associated with changes in surface hydrology. For example, some stratigraphic sequences showed an older lacustrine layer supporting aquatic vegetation overlain by a younger peat layer, suggesting the rapid in-filling of pond margins by *Sphagnum* moss. Soil pH and electrical conductivity measurements associated with each core provide additional evidence of rapid landscape-level change, with acidification increasing in soils as peat development proceeds. These baseline data, paired with the installation of temperature data loggers in the soil profile (FY 2006) and establishment of permanent vegetation monitoring plots in the future, will enable us to better understand and track changes in hydrology and vegetation associated with permafrost thaw.

Upper: Lacustrine ice samples collected by Torre Jorgenson (KATM). Left: Unusually high quality lacustrine ice.

Subsidence ponds located in permafrost transects sampled by Torre Jorgenson and SWAN staff.

Landscape Changes Captured by Repeat Photography

Repeat photography is the art of locating the actual site of an old photograph, duplicating the position of the original camera and taking a repeat image of the same scene. This technique is useful for comparing landscape changes occurring during a human lifetime and longer. Since 2003, SWAN staff and scientists from ABR, Inc. have been assessing landscape changes in the SWAN through the use of repeat photography. The primary subjects of the photographs are glaciers, ocean shorelines, floodplains, volcanic features, landslides, avalanche chutes, plant succession including shrub and tree expansion, and human disturbance. The photographs are assembled in a database allowing users to sort and view photographs by the desired data fields. During 2004–2006, 214 photographs were repeated in three SWAN units by ABR and NPS personnel: 59 in LACL; 136 in KATM, and 19 in ANIA. The final report for this 3-year effort was completed in 2006. In comparing the old and recent photographs, it is evident that a variety of changes associated with vegetation succession and geomorphic processes have occurred within the parks. Volcanism in KATM and ANIA has created extensive barren landscapes that for the most part have been slowly colonized except in favorable microsites. Most glaciers have shown dramatic retreat since the early 1900s, with newly exposed surfaces becoming rapidly vegetated by tall shrubs and trees at low elevations but remaining sparsely vegetated at higher elevations. Floodplains have continued to be active over time, creating barren areas, whereas other stable, inactive areas have been colonized by vegetation. In coastal areas, little change was evident along rocky shorelines, but some dramatic colonization of halophytic vegetation occurred on tidal flats that were uplifted during the 1964 earthquake. Expansion of trees and shrubs was observed in western KATM, and an altitudinal increase in treeline was observed at many locations in LACL and KATM. Although the photographic archive provides an initial quick assessment of landscape changes that have occurred over the last century, the archive also could be used to more rigorously quantify these changes.

Left: Four-peaked Glacier (left) and unnamed glacier (right) from Cape Douglas (KATM), 1904 R. W. Stone, USGS. Right: Four-peaked Glacier area from Cape Douglas, 2005 Torre Jorgenson (ABR) and Alan Bennett (SWAN). Four-peaked Glacier has retreated ~3.8 km since 1904 and Unnamed glacier on right has retreated ~1.6 km. Both have created moraine-dammed lakes.

Marine Nearshore Monitoring

USGS and SWAN staff tested protocols for surveys of marine debris, marine mammal carcasses (especially sea otter skulls), and marine bird and mammal abundance along two sections around Hallo Bay and south of Cape Douglas on the KATM coastline in late April. Weather conditions along the flight routes and the coast reduced the 3-day survey to 1.5 days. Vessel deployment with skiffs may be a more effective means to access the coast in the future. Large logs and wood comprised much of the deposited material; relatively little man-made debris was evident. Remains of about six sea otters were discovered, but only one had a skull with teeth still present. Presence of brown bear, fox, and wolf tracks on the beach suggested carcasses may be scavenged.

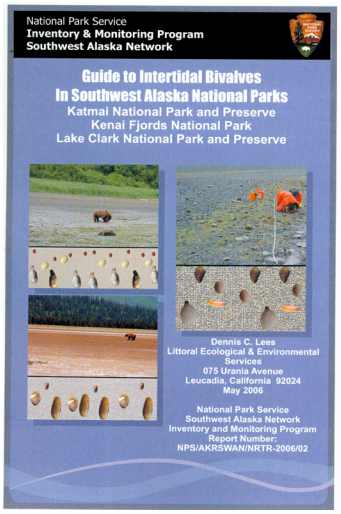
Prey items collected in the vicinity of a Black Oystercatcher nest.

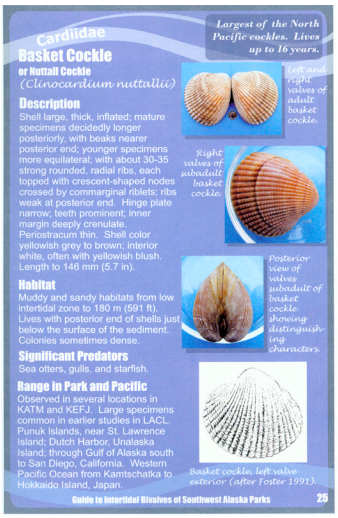
Field work in June was a collaborative effort by Jim Bodkin and Heather Coletti, USGS, Dr. Tom Dean, Coastal Resource Associates, Dr. Allan Fukuyama, Univ. Washington, SWAN, and KATM. Katmai Coastal Bear Tours provided vessel support with the R/V Waters. Protocols were tested for monitoring intertidal invertebrates and algae; black oystercatcher nest occupancy and diet; sea otter diet; marine bird and mammal abundance; marine debris and animal carcasses; and kelp and seagrass aerial extent. SOPs were tested at randomly selected transects that ranged from 100 m (invertebrates and algae) to 20 km (Black Oystercatcher). Many recommendations emerged from the testing of SOPs, including refinement of data sheets, use of data logging computers, modification of the site selection process, and extending transect lengths to increase samples sizes. Recommendations will be incorporated into the final draft of the protocol that is scheduled for completion in 2007.

SWAN and USGS scientists collecting data along transect during low tide.

Educational Field Guide to Marine Bivalves of the Southwest Alaska Network Parks

Clams are an "icon resource" of SWAN coastal parks and have been important in the success of native cultures that lived along these coastlines for thousands of years. Most visitors to the coasts of LACL and KATM can view the remains of historic commercial clam canneries, watch or photograph brown bears and sea otters digging and eating clams, dig clams themselves, or encounter clam shells while tide-pooling or beachcombing. In 2004-2006, the SWAN contracted with Dennis Lees, Littoral Ecological & Environmental Services (LEES), to inventory marine bivalve invertebrates (clams) on intertidal beaches at KATM, KEFJ, and LACL. Marine clams and other invertebrates were chosen as a SWAN vital sign for long-term monitoring because they provide an important prey resource for shorebirds, ducks, fish, bears, sea otters, humans, and other marine and terrestrial predators. They are also sedentary, long-lived organisms, and are sensitive indicators of environmental stress or change in the marine nearshore ecosystem. Upon completion of the inventory, LEES and SWAN staff assembled an interpretive field guide to provide assistance to park visitors and park staff in identifying, understanding, and enjoying bivalves found along the marine coastline of the SWAN parks. The field guide contains information on the ecology of clams including comments on their habitat preferences, feeding adaptations, and a descriptive guide to identifying clams. The descriptive guide includes drawings and photographs to depict the clams both in the hand and, where possible, distinguishing indicators of their presence in the field. The educational field guide is being distributed to park interpreters, visitor centers, and commercial lodges that serve visitors along the parks' coastlines.





Montane-nesting Birds

In the final year of a three-year effort to inventory montane-nesting birds within the SWAN, scientists from the USGS Alaska Science Center conducted surveys within KATM and LACL in early June. Sites were sampled along the Shelikof Strait and Cook Inlet coasts of each park – areas that were inaccessible in previous years due to poor weather or unsafe snow conditions. Although most study sites were still blanketed under heavy snow during the survey, the weather was excellent and birds were active at all sites. Highlights include:

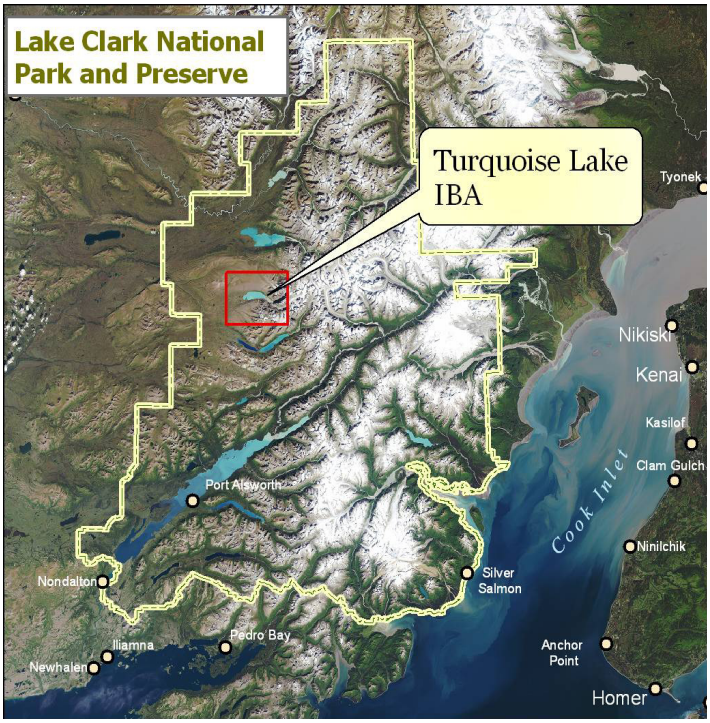
- Surveyed 885 points spread across 30 and 25 randomly-selected study plots in KATM and LACL, respectively, during the three year study.
- Recorded nearly 4,500 detections of over 5,700 individuals.
- Detected 92 species in KATM and 104 species in LACL.
- Most commonly detected species: Golden-crowned Sparrows (*Zonotrichia atricapilla*), Fox Sparrows (*Passerella iliaca*), and Wilson's Warblers (*Wilsonia pusilla*).

Data will be used to assess and predict habitat affinities and calculate breeding densities for species with enough detections. Final analysis of the inventory effort is on-going, and these data will serve not only as a basic avifaunal inventory of these parks, but will also allow for population monitoring over time.

Surfbird on a nest near Turquoise Lake (LACL).

Turquoise Lake Area (LACL) Nominated as an Important Bird Area

Data obtained from the Montane Bird Inventory (2004-2006) was used by SWAN to nominate the Turquoise Lake Region of LACL as an Important Bird Area (IBA). The IBA Program is an international effort by the National Audubon Society to identify, conserve, and monitor a network of sites that provide essential habitat for bird populations. Montane areas within LACL are nesting habitat for a unique assemblage of birds, most notably several medium to large-sized shorebirds and several passerine species. Species known to breed in the area include American Golden-Plover (*Pluvialis dominica*), Surfbird (*Aphriza virgata*), Wandering Tattler, Baird's Sandpipers (*Calidris bairdii*), Gray-crowned Rosy-Finch (*Leucosticte tephrocotis*) and Northern Wheatear (*Oenanthe oenanthe*). The Montane Bird Inventory and previous research suggest that the Turquoise Lake Region of LACL represents not only major breeding range extensions for most of these species, but also supports significant numbers of each. Recent regional and national shorebird conservation planning efforts have identified certain shorebird species (including many of the above species) and habitats as being of high conservation concern, primarily due to documented or perceived population declines and/or restricted distributions.



Satellite image of Turquoise Lake Area (LACL) nominated as an IBA.

For more information contact us at:

Southwest Alaska Network
National Park Service
240 West 5th Avenue, #114
Anchorage, Alaska 99501

Additional information on the Southwest Alaska Network vital signs monitoring program and a complete copy of the Vital Signs Monitoring Plan can be obtained from the Network's web site: http://www1.nature.nps.gov/im/units/swan/