National Park Service - Southwest Alaska Network
Inventory & Monitoring Program

Summary of Flora Monitoring Scoping Meeting

Vital Signs Monitoring Program
Southwest Alaska Network
16 April, 2003

Page Spencer (RBR) and Beth Koltun (RGR), AKSO

Overview:

The Southwest Alaska Network flora monitoring scoping workshop was held April 16, 2003 at the Campbell Creek Science Center in Anchorage, Alaska. This workshop was fourth in a series of focused workshops to review models, identify drivers of environmental change and begin to identify target attributes for monitoring. Earlier workshops addressed Coastal systems, Freshwater systems, and Ecosystem modeling for SWAN. The Faunal workshop was held the on April 17, and the Physical components are the subject of a future workshop.

This workshop's goals were to: !) to identify change driving agents, 2) identify possible monitoring targets and specific attributes which could be used to evaluate changes over decades and centuries. and 3) if time allowed, discuss potential sampling designs. These questions occupied three sessions,

Attendees included the Technical Committee members and several invited experts from other agencies and private companies. Invited experts were: Torre Jorgenson, ABR, Inc., Jerry Tande, AK Natural Heritage Program, UAA, Rob DeVelice, USFS, Chugach NF, Ed Burg, USFWS, Kenai National Wildlife Refuge, Dave Duffy, U of Hawaii. The meeting was facilitated by Frankie Barker of Tundra Strategies.

Attendees were provided with a background materials about the national and regional monitoring program, ecosystems of the SWAN parks and preliminary models in a notebook distributed several weeks prior to the workshop. For the most part, materials presented in that notebook will not be represented in this document. Please refer to http://www.nature.nps.gov/im/units/nw01/Documents/Workshops/VegetationNotebook.pdf for the background information.

The workshop began with each participant listing a unique feature of the SWAN parks and this monitoring program. Comments centered around the vastness and generally pristine nature of the ecosystems and the need to make the monitoring program sustainable and relevant to long term management.

Page Spencer presented an ecological overview of the unifying features of the SWAN region and the SWAN park units (Alagnak River, Katmai, Aniakchak Caldera, Lake Clark and Kenai Fjords). Tectonic events and weather are unifying driving forces in the region.

Insights from invited experts:

- Be sure to make links between the monitoring program and management decisions
- incorporate long term considerations
- establish baselines
- encourage continuity & coordination with existing studies by other agencies(such as Exxon Valdez & Forest Health Monitoring grid)

- Assemble a database
- Think of management in the broadest sense: ie we can't change glacier melt, but we can try to understand it
- Will the initial inventory be repeatable?
- Make sure the data gets dealt with, publish Technical Reports and ensure that they're distributed, protected and perpetuated
- Be sure to integrate the workshops into the process to avoid reinventing the wheel
- Focus focus focus

Figure 1 shows the links between the other five (including climate) focus disciplines and the vegetation workshop, so that we would be able to address the data needs from other studies. Previous workshops identified these parameters as particularly important for monitoring.

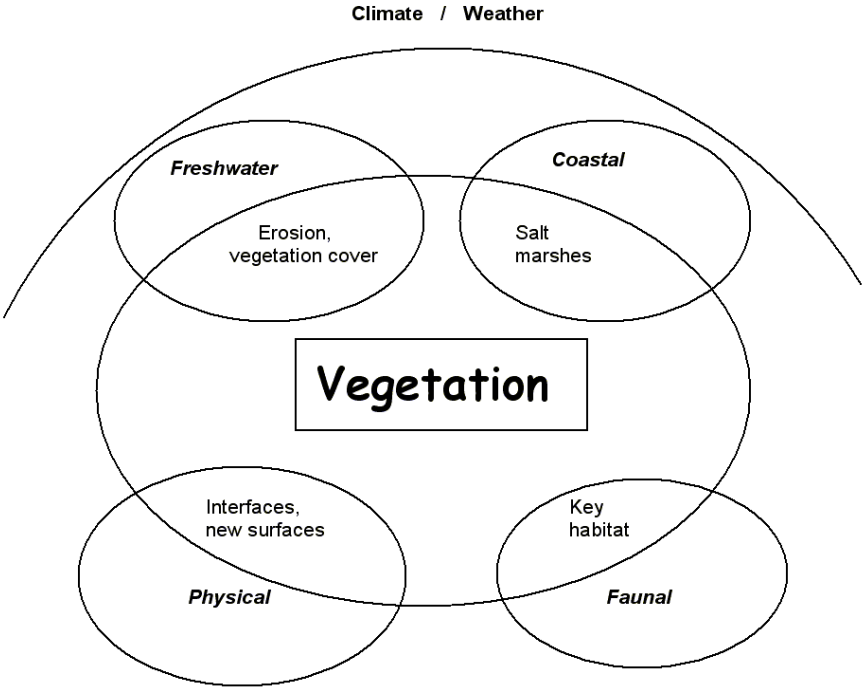

Figure 1. Data needs identified in other workshops that can be met by vegetation community monitoring.

Session 1: Identify Driving Change Agents in SWAN. Review and augment list of change agents and issues which vegetation monitoring should address. What things will cause the vegetation community to change over the next 200 years at landscape scales?

Discussion began with a model from the background materials which showed the major groups of change agents for vegetation communities, and relative time frames of action (Figure 2). As discussion became more specific, another model similar to the one proposed for the Arctic Coastal Plain (Walker and Walker 1991), was sketched out (Figure 3).

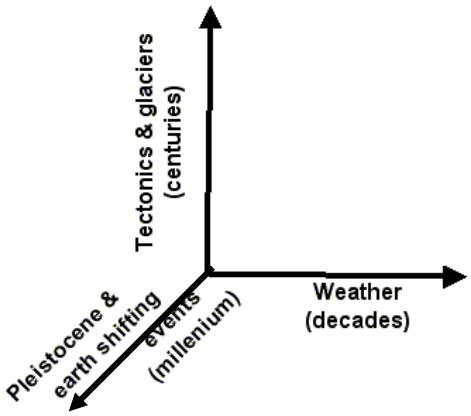

Figure 2. Large scale change events in SWAN with relative time scales.

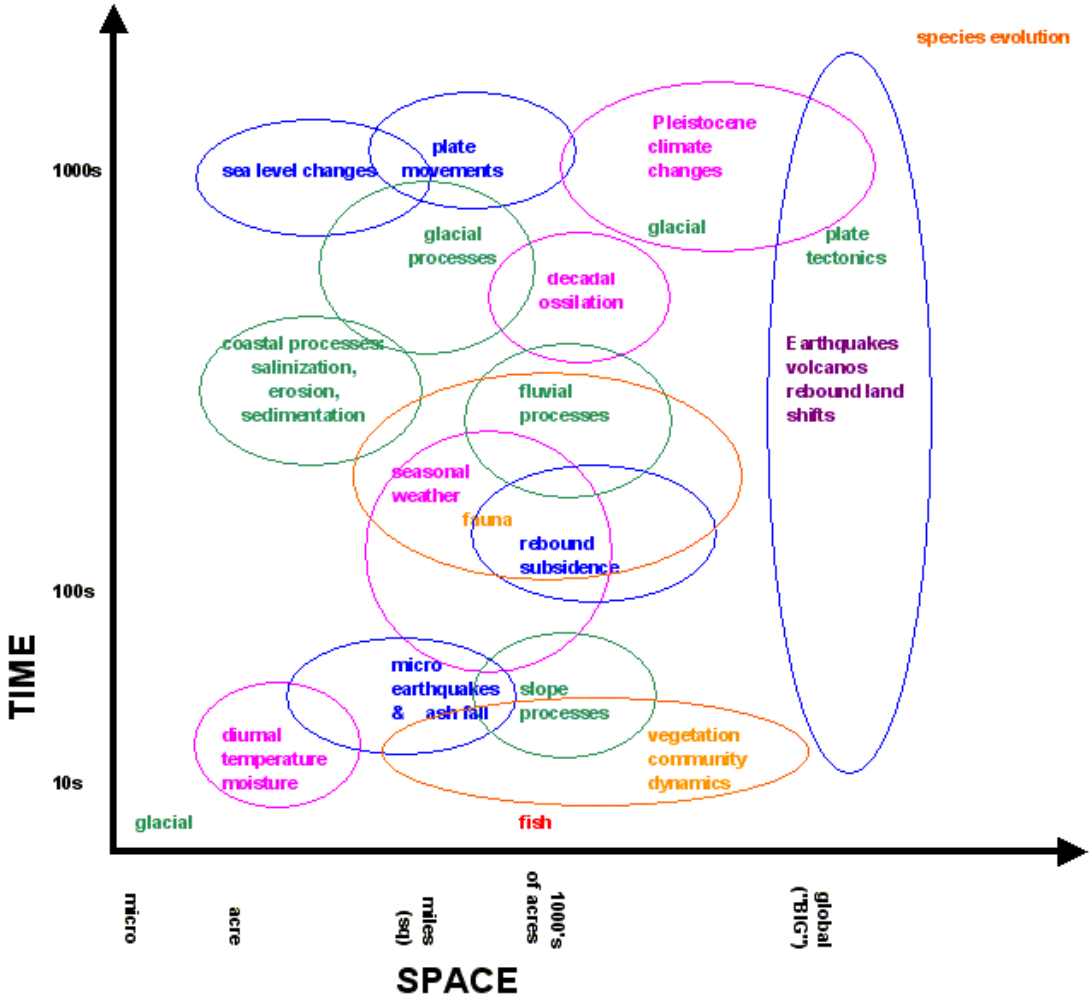

Figure 3. General disturbance and change agent processes in SWAN (follows Walker and Walker 1991). Magenta—weather and climate, orange—biotic vectors and processes, green—geomorphic processes, blue—tectonics.

Discussion:

Large scale events may not tell you what's happening with specific species; it is key to look for sensitive sites after determining what you want to evaluate. Ecotone boundaries are a good place to look; you have to look at the small scale level to understand the overall situation.

Ed Berg related the climate change on the Kenai: they've looked at treeline (which seems to be a unidirectional process, increasing in elevation). Kettle pond changes are evapotranspiration driven; warmer summers are a good barometer, and they're seeing spruce invasion on muskeg perimeters. Aerial photos document glacial retreat and help date moraines. Ed suggests that you determine what you want to look at, then find a sensitive area to watch.

Dave Duffy suggests you look where ecotones bump together. You need to look at the small scale to understand the overall picture.

(Macro) Faunal influences on vegetation:
Moose are recent on the the Kenai peninsula (<100 years) and will have an effect on vegetation. Kodiak is a classic example in that there were no browsers on the landscape until deer were introduced and it's had a dramatic effect on the landscape.

Beavers alter nutrients and the hydrologic regime. Bears dig for squirrels and crop coastal marshes which changes vegetation. Bears and salmon can be viewed as nutrient vectors (influence more from the bottom up as opposed to the top down beaver induced landscape modifications).

Moose and willow, and caribou and lichen are significantly interdependent systems and it is important to understand what role the effects of migration play in vegetation community dynamics, wildlife, and nutrient cycles (ie fish populations).

An interesting point came out of discussion about scale and sensitivity of monitoring. Although the focus of SWAN vegetation monitoring is plant community change over landscape scales (thousands to millions of acres), the most likely place to find these changes will be at ecotones and sensitive locations.

Change agents include**:**

Physical Parameters:

- Weather (diurnal, seasonal, decadal)
- Climate (long term and large scale weather patterns)
- tectonics (isostatic rebound, earthquakes, volcanism),
- large scale disturbances (Pleistocene glaciations, ash events)
- sea level changes
- fire
- avalanches
- geomorphic (coastal processes, erosion, sedimentation, salinization, riverine processes including flooding, landslides)
- deglaciation
- solar radiation

Biotic Interactions affecting vegetation include:

- Pollinators
- ungulates
- herbivores (porcupine, snowshoe hares, beaver)

- disturbivores
- disease
- invasive species (plants and animals)
- competition (shading, insects, disease, …)
- tree & shrub expansion
- *Sphagnum* invasion
- organic accumulation (increased acid in wet environments)
- natural dispersal and dispersal mechanisms

Management issues with likely impacts to vegetation include:

- ATV use (especially in coastal areas)
- invasive species
- trails
- recreational use acceptable limits of change, trampling (resulting from bear viewing fishing, hunting, camping)
- snow machines (especially regarding the definition of adequate snow cover)
- oil spills
- bear viewing
- resource extraction
- oil & gas exploration
- access and other impacts of NPS operations
- community expansion
- aquaculture (coast and associated uplands)
- increasing visitation-mass tourism
- subsistence (plus ties to ATV & snow machine use, wood cutting)
- airstrips
- harvest support structure (willows that feed moose, and hunters want fewer moose predators

Session 2. Identify candidate vegetation communities/species/attributes for monitoring.

1) Why is this community/species important? What is the ecological value of this community/species?
2) What will changes in this item tell us about ecological change?
3) What are potential methods for measuring attribute?

Note—this discussion wove freely between monitoring tools, sampling schemes and the monitoring parameters. After some general discussion with the whole group, we had a session where individuals moved between flip charts and made notes from their own experience about various monitoring parameters and techniques. This process generated much valuable discussion in smaller groups which is difficult to capture in these notes.

General Discussion

Begin at a general level (Viereck Level 3 communities) with remotely sensed (satellite) data for a comprehensive view across the SWAN. Changes in this level of vegetation would indicate major changes in the environment, such as broad tree line changes, alder expansion and wetland changes. SWAN could probably do with mapping on a 10-20 year time frame. Chugach NF is proposing mapping every 5 years or so in the Chugach Plan.

Grid sampling schemes:

FIA sampling as done by USFS could augment comprehensive mapping with more specific data. It may be possible to cooperate with FS, especially in KEFJ with simple expansion of sampling grid. Data collected include: species list, composition and abundance, horizontal and vertical structure. Combine these points with focus on sensitive sites. Grid sampling usually misses ecotones and sensitive areas. This method could allow for comparable data with nearby agency lands. Statistical power allows generalization to large areas. Results in nearby areas may indicate pending or surrounding changes before it reaches or impacts SWAN parks. Denali is considering use of sampling grid as foundation for sampling other disciplines as well. Need to carefully consider temporal sampling period. Five years may be too short—10 to 20 year interval may be more appropriate to monitor changes.

Expensive…. (Ed Berg notes about $1000/plot in the Kenai Refuge).

Alder is an important component in SWAN. Communities discussed included some as identified on the Chugach: alder/salmonberry, alder/devil's club, alder/fern, (alder/bears). Alder/*Sphagnum* is fairly well covered as a result of the Duck's Unlimited Landsat classification. The validity of Grigg's post-Katmai blast alder/*Calamagrostis* association was questioned. Is there correlation between alder and ash, alder and slope?

If sensitive habitats are identified, "the rest will follow more easily". Some habitats identified are: Alpine areas (look at the % rock, ice and snow), recently deglaciated zones, post volcanic zones, treeline sites, systems fed by snowmelt, riparian zones, kettles, muskegs, coastal, and intertidal/near tidal salt marsh communities, and avalanche runout zones.

Ground beetle pit traps are a good climate monitoring indicator because of species' narrow temperature tolerance and rapid changes in beetle species composition due to changes in temperatures. Tree rings can shed light on growth rate and productivity. Ice cores are also useful. Crows wintering in Soldotna now (because it's ~10 degrees warmer since 1978) are a indicator of climate change. Mosses and Liverworts can be useful indicators, and use of the bole lichen surveys for air quality monitoring using the Forest Service protocol might be appropriate.

Flip Chart Notes and Discussions Summary

Paleo ecological changes would be a one time survey going back in time several thousand years. Lake cores yield data about fire history, ash fall, pollen, beetle parts, climate change and even salmon runs and paleo-beaver activity (from sediments in old ponds). This puts the current changes in a longer temporal context.

Aerial Photos go back to 1955 for this region, and would yield good data on forest and alder changes.

Sitka and white spruce, boreal forest—is SWAN a hybrid zone? Pollen cores (see lake cores). Data on Kenai Refuge indicate that white and black invaded from the north 8000 yrs BP, while Sitka spruce began invading from the south 2500 yrs BP. Is there Lutz spruce in SWAN? Also monitor spruce and hemlock migration, dispersal and changes in tree lines.

Remote sensed imagery (satellite data)—synoptic, repeatable view of the world,
- NPS landcover program provides a baseline for vegetation communities
- Extent of glaciers, forests, alder
- LIDAR (plane mounted) shows structural changes when used to supplement MSS images

Tree rings can be used to monitor climate and community changes for several hundred years. Stand growth patterns, bark beetle and other insect infestations, reconstruction of summer

temperatures, death dates (glacial advance and retreat events), flood events and frequency, landslide frequency, earthquake frequency

Vegetation community studies—location, species, abundance and % cover. Alder, sphagnum, lichens, aquatic plants,

"Torre's List"—Vegetation Plot Attributes
- Structure
  - Height
  - Basal area
  - % cover by layer, height class
  - density (yikes!)
- Composition
  - Percent cover by species (all vascular, all non vasculars, dominant non-vascular)
    - Ocular estimates (+-20%)
    - Point samples (+- 10%)
    - Forest vs meadow vs shrub
- Productivity
  - Basal area
  - NPP
  - Biomass, related to NPP
  - LAI
- Stability—Sustainability
  - Change
  - 100 yr rare events
- Pathology
- Pollinators
- Grazing/browsing survey
- Phenology

- Physical Plot Variables (to go with vegetation attiributes)
  - Topo—macro (slope, aspect, elevation
    - Micro—height difference, max, mode (surface roughness)
  - Soil
    - Rooting depths
    - Depth organic layers
    - Ice
    - Soil profile
  - Hydrology
    - Ice
    - Site moisture
  - Site History—grazing, fire, disturbance, browsing etc

A list of **"sensitive sites and communities**" accumulated throughout the discussions:

- Alpine areas, subalpine ecotones, mountain tops
- Aquatic areas (wetlands and emergent vegetation, bogs, kettle lakes)
- Snowmelt areas
- Rare plants and communities
- Treeline sites (alpine and subarctic)
- Riparian zones
- Deglaciation zones
- Coastal areas, marshes, tide flats

- Volcanic deposition areas
- Aniakchak Caldera
- Avalanche runout zones
- Ed's list (Table 1)

Table 1. Ed Berg's list of potential changes for southwest and southcentral Alaska, and sensitive parameters which would be valuable for monitoring changes.

Change	**Sensitive sites and Species**
Climate	Rising treeline, drying muskegs, closed-basin ponds and lakes, retreating glaciers, ground beetles and butterflies, range extensions for plant, insect and bird species
Invasive plants	Disturbed soils, river corridors, aquatic plants
Air quality	Arboreal lichens, glacial ice cores
Soil and water contaminants	Metal selective lichens & plants, aquatic plants, lake and stream sediments
Forest health	Wideth of last 10 tree rings, conks, insect pests & diseases
Wetlands	Spruce and hardwood invasion, lichen recruitment, water table change
Tectonic	Coastal marshes and forests, tidal flats. Monitor with high precision GPS benchmarks on near-shore bedrock (Jeff Freymueller, UAF, GI
Fire, storm damage, tephra fall	Affected sites
Wildlife	Caribou-alpine lichens (changes in podetia heights and increase in disturbed crusts, e.g. *Ochrolechia* and *Pertusaria,* due to trampling
Human-direct effects	Affected sites, exotic species introductions, increased fire frequency, resource harvest
Human-indirect effects	Increased access (roads, trails, fly-in), development in adjoining areas (logging, lodges, towns)

Session 3. Discussion of sampling philosophies. Explore various schemes which may address items from Session 2, with assumptions, analysis, results and pros/cons.

This session began by a presentation from Torre Jorgenson, ABR, Inc. This presentation turned into major food for thought and input for later planning and integration phases as participants had had a long intense day and covered ground usually scheduled for two days in previous workshops.

Torre reviewed major sampling designs with pros and cons of each:

Systematic grid
Stratified systematic grid
Stratified systematic transects—based on physical gradients
Trend areas

The first three allow inference across the park or large areas. Trend areas are general single monitoring locations in the dominant physiographic region which can identify trends, but do not allow specific inferences beyond the site. Since the SWAN is dominated by strong physical change agents, Torre advocated strong consideration of systematic transects as a foundation for monitoring SWAN.

Stratify the landscape based on geomorphic change agents/processes. Each topographic landscape has unique processes functioning in it. Then establish systematic transects to cross the physical gradients. Suggested strata and corresponding processes are:

Upland/alpine	colluvial
Lowlands	sedimentation
Riverine	fluvial
Coastal	marine
Human modified	fill, extraction, trampling, contamination….

Torre further suggested monitoring priorities for SWAN:

1. Direct human impacts
2. Invasive species
3. Rare plant populations (biodiversity)
4. Photo monitoring—qualitative data, identifies trends
5. Intensive biophysical monitoring—highly detailed quanitative sampling often proves the obvious….

At the end of the day, each invited guest was asked to give parting shots, advice and wisdom.

Jerry Tande spoke from 20 years mapping and research in Alaska. He mentioned several studies (Aleutian shield fern, Elmendorf plots) where monitoring started out with a bang, but sites have never been revisited. Jerry encouraged continuity and baseline work. Monitoring is no good without followup.

Rob DeVelice reviewed protocols and monitoring efforts for Chugach NF, including bark beetle studies, FIA plots, paleoecological data and impacts of recreation visitors. He also had cost figures for some of this work. Projected 1.4 million to cover administration, staff, data manager, biometrician, field work etc.

Ed Berg suggested we consider monitoring bedrock uplift using benchmarks already along the Cook Inlet and Kenai Fjords coast. Ed favors the use of transects as a shrunken form of systematic grids, and even subjectively placed plots in some cases. Example of 9 subjective plots on Kenai Refuge for fire succession. Fifty years of data indicate valuable trends, even if statistical extrapolation is uncertain. A lot can be garnered from a few well-chosen (and well followed) plots.

David Duffy cautioned that we make sure the data become analyzed and published (grad students!) in technical reports and publications. Chop project into master's sized chunks. The value of monitoring data increases exponentially with each year. Keep on doing it even if it's not perfect.

Karen Oakley reminded us that these parks are at a number of important junctions. We need to think about the junctions of systems.

Torre Jorgenson said we have big decisions to make about monitoring targets. Two options are: 1) targeted sampling based on list of expected changes, or 2) sample vegetation for general changes. It is complicated to tie observed change to biophysical effects. ie cause and effects difficult to establish.

Then the NPS participants expressed their Next Steps:

Ian—Four workshops, four sets of lists. We need focus to pare down lists. He would rather know a lot about a little.

Tammy—need to integrate workshop outputs, meld products together into one program

Sara—how do the workshop themes relate to each other?

Judy—integration, sort out methods from targets

Jeff—don't reinvent the wheel

Troy—find a consistent theme that will give more than one target (ex paleoecology). The sampling philosophy discussion is important—do we want lots of general things with high quality or more detail about specifics things that may be so statistically robust?

Alan—integrate workshop results with sampling designs. Workshops are part of a process.

Reference:

Walker, D.A. and M.D. Walker. 1991. History and Pattern of Disturbance in Alaskan Arctic Terrestrial Ecosystems: A Hierarchical Approach to Analyzing Landscape Change. Jour. of Applied Ecology (1991), 28, 244-276.