Vital Signs Selection Historical Documentation
Southeast Alaska Network

Summary
This document was compiled by Barbara Sheinberg (Sheinberg Associates, Juneau, AK) who served an active role as a facilitator for SEAN from 2005 through 2007. In many ways, Barb performed some aspects of the role of Network Coordinator during the period from 2006-2007 when the Network Coordinator position was vacant. This document is her historical record of the reasoning and intentions behind each vital sign discussed by the SEAN Technical Committee. This March 2007 document does not include some information, such as updated monitoring objectives from the Protocol Development Summaries. It represents the state of the SEAN at the time when the Network Coordinator position was filled by Brendan Moynahan in July 2007.

INFORMATION IN THIS DOCUMENT LISTED FOR EACH VITAL SIGN	SOURCE
EMF Level 1	Table 3.3 draft chapter 3/Phase 2 Report-Fastie
EMF Level 2	Table 3.3 draft chapter 3/Phase 2 Report-Fastie
EMF Level 3	Table 3.3 draft chapter 3/Phase 2 Report-Fastie
Vital Sign Number	
SEAN VITAL SIGN	SEAN Technical Committee
Justification	April & May 2006 SEAN Technical Committee meeting reports Access database
Threats	Access database
Comments on Threats	Access database
Management Concerns	Access database
Comments on Management Concerns	Access database
Monitoring Objectives	May 2005 Freshwater Scoping Workshop report March 2006 Marine Scoping Workshop report March 2006 Terrestrial Scoping Workshop report.
Monitoring Questions	April & May 2006 SEAN Technical Committee meeting reports Access database May 2005 Freshwater Scoping Workshop report March 2006 Marine Scoping Workshop report March 2006 Terrestrial Scoping Workshop report
Example of Measures	April & May 2006 SEAN Technical Committee meeting reports Access database
Possible Partners	April & May 2006 SEAN Technical Committee meeting reports
Relevant Monitoring or Study	April & May 2006 SEAN Technical Committee meeting reports
Comments	April & May 2006 SEAN Technical Committee meeting reports Access database
GLBA/KLGO/SITK	April & May 2006 SEAN Technical Committee meeting reports
Comments, Possible Partners or Threats	March 2006 Scoping Meeting Reports

Southeast Alaska Network
Vital Signs Selection Documentation

(Organized by Ecological Monitoring Framework [EMF] Level 1, 2 and 3)

Table of Contents

Visibility and Particulate Matter B-3
Air Contaminants B-5
Weather and Climate B-10
Glacial Dynamics B-15
Landform Dynamics B-20
Surface Water Dynamics B-24
Marine Physiochemical and Biological Water Mass Characteristics B-29
Freshwater Physiochemical Water Quality B-38
Freshwater Contaminants B-41
Freshwater Benthic Macroinvertebrates and Algae B-44
Invasive Exotic Plants B-47
Invasive Exotic Animals B-51
Pests and Diseases B-54
Marine Mammals and Seabirds B-58
Intertidal Communities B-61
Wetland Communities B-64
Salmonids B-67
Forage Fishes B-70
Western Toads B-73
Murrelets B-75
Breeding Landbird Populations B-77
Bald Eagles B-81
Bears B-83
Harbor Seals B-85
Ungulates B-87
Killer Whales B-89
Biodiversity of Select Groups or Assemblages B-91
Steller Sea Lions B-94
Humpback Whales B-96
Consumptive Use B-99
Human Uses and Mode of Access B-103
Plant Communities B-110
Landcover and Land Use B-117
Phenology B-123
Airborne Sound B-125
Underwater Sound B-128

EMF Level 1 - Air and Climate
EMF Level 2 - Air Quality
EMF Level 3 - Visibility and particulate matter

SEAN VITAL SIGN
VISIBILITY AND PARTICULATE MATTER

Justification

Threats

From visibility and particulate

GLBA -- Within Glacier Bay air emission sources include exhaust from fuel combustion during vessel operations, fuel combustion for heating of buildings at Bartlett Cove, fuel use by vehicles in the park, occasional campfires, exhaust from electric power generators, and vessel traffic emissions. Emissions from motorized vessels contain respirable PM10 (particulate matter that can be taken into the lungs) and particulate matter smaller than 2.5 microns in diameter, carbon monoxide, sulfur dioxide, nitrogen dioxide, lead, and ozone. Visibility reductions occasionally occur in the park during certain unique weather conditions that trap air pollution within a layer of cold air near the surface.

KLGO -- Cruiseships docked in the Skagway harbor generate power by running their engines in port all day. On days with little wind, a brownish haze (cruiseship emissions) is visible over the town of Skagway and upper Taiya Inlet.

SITK -- Local sources such as cruise ships and motor vehicles produce emissions that effect visibility such as sulfur dioxide and produce particulate matter.

Comments on Threats

Management Concerns

From visibility and particulate

GLBA -- There is no historical data regarding visibility within the park, other than personal observations. Daily emission totals, visible plumes of smoke from vessel stacks, and weather conditions contribute to reductions in visibility. During temperature inversions or days with low winds, stack emissions do not dissipate quickly and can result in long plumes from vessel stacks that block views. Visible vessel emissions can produce haze within the park. Increases in vessel quotas could increase the particulate and pollutant load entering the air column and have a detrimental effect on air quality and visibility.

KLGO -- Impacts to the viewshed can be expected with reduced visibility. Reduced visibility would impact both the Skagway/White Pass and Dyea/Chilkoot Trail National Historic Landmarks and visitors to KLGO.

SITK -- Reduced visibility in and around the park could impact scenic vistas and visitor experience.

Comments on Management Concerns

Monitoring Objectives

Understand the natural range of variability in air quality across SEAN parks and determine if there are any air quality concerns.

Monitoring Questions

- Is the particulate matter content of air or the composition of aerosols changing in or near SEAN parks?
- Are anthropogenic sources of aerosols or particulate matter reducing visibility below historic levels?

Example of Measures

- Opacity of cruise ship plumes.
- Opacity of air over harbors of towns.
- Composition of aerosols.

Possible Partners

CAKN has a large air monitoring program run out of Denali.

Relevant Monitoring or Study

Comments

Dan -- Baseline data lacking; may be difficult to acquire cheaply; difficult to monitor efficiently in GLBA

Dan -- Baseline data lacking; may be difficult to acquire cheaply in KLGO and SITK

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Air and Climate
EMF Level 2 - Air Quality
EMF Level 3 - Air contaminants

SEAN VITAL SIGN
AIR CONTAMINANTS

Justification

A set of air quality data is needed over the long term as a baseline for park conditions both to enable change detection and as a backdrop against which other change detection may be considered.

Threats

From air contaminants

GLBA -- Fallout of air contaminants may cause foliar damage in plants (look at lichen tissue for elemental content) and bioaccumulate in terrestrial and marine apex predators. Persistent organic pollutants and mercury are the contaminants of concern. The contaminants may originate from cruise ships, smaller diesel and 2-stroke engines, or urban/industrial pollution from Asia.

KLGO -- Far-field and near-field sources of air contaminants may be impacting park resources and pose threats to human health and safety in the park/Skagway.

SITK -- Air contaminants from cruise ship emissions, local emissions, and long-range transport across the Gulf of Alaska may be reaching the park and impacting park ecosystems.

From wet and dry deposition

GLBA -- If air quality is not pristine (less-than-Class-I-quality), and wet/dry deposition of contaminants is significant or increasing, multiple biological resources dependent upon a contaminant-free environment are at risk. Mercury and POPs are especially important to know about because of their effects on biota. For example, some lichen species are highly sensitive (directly) to contaminants in precipitation, and surface/soil/water substrates can be contaminated to the detriment of other taxa. Direct foliar damage (vascular plants) was also identified as a potential impact. Many aquatic species are sensitive to certain contaminants in very low concentrations, some of which can accumulate in sediments and/or biooaccumulate up the trophic web. Natural processes of plant primary succession (terrestrially and in lakes) following deglaciation are sensitive to soil and water pH which can be perturbed by wet/dry deposition (which typically result in increased acidification). Natural phytoplankton community composition similarly is sensitive to ocean surface water pH; relatively small changes (decreases) in

pH can cause substantial changes that can cascade through the marine system. The vector would be low-pH precipitation ("acid rain"). The Level 3 category of "wet and dry deposition" was explicitly identified only in the Marine Scoping Workshop, but could be considered a potential threat in both freshwater (lakes) and terrestrial (re. lichens and soil dynamics/biota) ecosystems as well.

KLGO -- A pilot lichen-air quality study conducted in 1998/9 (Furbish et al. 2000) found elevated levels of sulfur and heavy metals in lichen tissues from the Skagway/Klondike area. The presence of sulfur in lichen tissues indicates on-going pollution, while the timing of heavy metal accumulation in lichens is less certain since metals can bioaccumulate in lichens. Historic exposure may have occurred during the time when lead/zinc ore was transported via the WP&YR trains from mines in Canada to the port in Skagway then barged south. Ore transport ceased in the 1980s, but contaminants may still be present in the environment and recirculated due to winds and construction activity. Other sources of air contaminants include cruiseship and other vessel emissions, incinerator, diesel powered trains, tour buses, vehicles, wood smoke, and transpacific sources of air pollutants such as mercury and POPs.

SITK -- Contaminants from multiple sources may be born on the wind and deposited in and around the park and enter park ecosystems. These include emissions from cruise ships and other water craft, motor vehicle traffic emissions, and long-distance transport of industrial or agricultural pollution.

Comments on Threats

<u>From air contaminants</u>

GLBA -- Statement regarding air contaminant threats (left) taken from marine and terrestrial workshop notes. Ozone was removed as potential vital sign because it is believed to be an urban pollutant, not expected to be an issue in SEAN parks. Measures noted: mercury content in mussels, carcasses of apex predators, seabird eggs, Engstrom's precipitation station already at Bartlett Cove, and microlayer measurements using SPMDs.

Management Concerns

<u>From air contaminants</u>

GLBA -- Air quality in the parks is presumed to be pristine, but this is not really documented. Vessel management schemes may influence air quality with potential effects on vascular and non-vascular plants, animals, and visitor experience. Visible emissions / opacity are already monitored and regulated. However, the amount of emissions is not accounted for, as vessel traffic of all kinds increases and as cruise ships

become increasingly large, and air contamination could increase and would not be detected by current measures.

KLGO -- Air contaminants may be impacting park biota, aquatic systems and cultural resources.

SITK -- Airborne compounds that produce acid rain, heavy metals, persistent organic compounds, other pollutants may be damaging SITK ecosystems.

From wet and dry deposition

GLBA -- Lack of data, especially re: mercury, POPs, and pH. There is a lack of information (except for Hg at Barlett Cove in the early '00s) re: past/present composition or rates of contaminant deposition. We lack a baseline against which to judge future changes/trends. GLBA should have pristine air quality ("natural" levels of wet/dry deposition), and we intend to manage and maintain our air quality as if we were a Class I airshed. In order to accomplish this we need to confirm that the park indeed possesses Class I-level air quality (i.e., "natural" levels of deposition). Cruise ship emissions may be a significant local source (internal to the park) of wet/dry deposition. GLBA reports to GPRA Air Quality Goal I(a)(3).

KLGO -- Lichen-air quality pilot study showed that air pollutants are present in the Skagway/Klondike area. ADEC monitored PM2.5 (particulate matter) in Skagway in 2004 and found no exceedences but data have not been formally reported to the public. KLGO is receiving funding from WASO-ARD in 2008 for follow up air quality work. In May 2006, the Canadian Government installed a passive air sampler (PASD) in KLGO (Dyea) to monitor transpacific mercury deposition.

SITK -- Acid rain, heavy metals, persistent organic compounds, other pollutants may be damaging SITK ecosystems.

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- What is being emitted from cruise ship air stacks?
- What is the normal range of variation in the concentration of atmospheric contaminants?
- Are there long term trends in these concentrations?

From wet and dry deposition

- What airborne contaminants are being deposited in SEAN parks?

- Where are they being deposited?
- Is there a trend in the amount or spatial cover or concentration of these deposits?
- Is there a trend in the amount or spatial cover or concentration of these deposits?

From scoping workshops

- Are contaminants brought by airborne vectors affecting marine organisms?

Example of Measures

From wet and dry deposition

- Concentrations (in foliage, lichens, or sampler surfaces) of sulfur, nitrogen, mercury, signature pollutants from cruiseship fuel, indices of Asian pollution, persistent organic compounds.

Possible Partners

Is the one regional air quality monitoring station in Petersburg, the Interagency Monitoring of Protected Visual Environment (IMPROVE), adequate for SEAN parks needs, or are local monitoring stations needed? The worst air contaminants are coming from across the Pacific Ocean, so this may be adequate. It is suspected that local cruise ship point sources are not causing air pollution, but do not know for certain. SEAN needs expert advice on air contaminants to establish a monitoring program.

CAKN has a large air monitoring program run out of Denali.

Relevant Monitoring or Study

Regional air quality monitoring station in Petersburg, IMPROVE.

Comments

Concentrations in the air of sulfates, nitrates, mercury, persistent organic compounds, suites of elements specific to different passive samplers, signature pollutants from cruise ship fuel, indices of Asian pollution. What does Denali do for its AQ monitoring program? Lichen tissue assays as a proxy for air contamination.

Dan -- Baseline data are non-existent; for determining future changes which may have deleterious effects on ecosystems, acquire for long term monitoring?

Scott -- Note the problems with relating estimates in lichen with biologically relevant (NOTE: rest of comment missing)

Greg -- Ranked Sitka higher because of its proximity to the Gulf of Alaska and Asian pollution sources

Air contaminants

Dan -- Baseline data are non-existent; for determining future changes which may have deleterious effects on ecosystems, this increases my ranking med high to high.

<u>From wet and dry deposition</u>

Dan -- KLGO and SITK local impact potentially more severe than GLBA that may reflect global sources; creative monitoring or sampling (e.g. snow chemistry) may be required to accomplish baseline data acquisition.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Air and Climate
EMF Level 2 - Weather & Climate
EMF Level 3 - Weather and Climate

SEAN VITAL SIGN
WEATHER AND CLIMATE

Justification

This is a primary driver in SEAN park ecosystems. This is the most important baseline dataset to obtain. Reliable consistent baseline weather data is very important for park management.

Threats

From weather and climate

GLBA -- Relatively small changes in weather patterns/parameters can have very large effects environmentally, potentially fundamentally altering very basic processes such as marine circulation, phytoplankton bloom dynamics (and thereby the entire marine production cycle), as well as (for example) terrestrial vegetative phenology which could have cascading effects throughout the terrestrial ecosystem.

KLGO -- Local climate in Skagway/KLGO varies significantly from the other SEAN parks and the rest of SE AK. Skagway receives approx. 26 inches of precip each year, making it one of the driest places in SE AK. Fire is a natural part of the park's ecology and is directly influenced by climate/weather patterns.

SITK -- Weather drives the function of park ecosystems. Disruptions in weather patterns such as those caused by global climate change may be negatively impacting park ecosystems.

From extreme disturbance

GLBA -- Extreme weather and accelerated glacial melting associated with climate change could cause an increase in extreme disturbance events.

SITK -- Extreme weather events are a major element that shapes the SITK terrestrial environment. The small terrestrial area of the park magnifies their effect.

Comments on Threats

Management Concerns

From weather and climate

GLBA -- Lack of data. GLBA has a thin long-term dataset of weather/climate that is mostly restricted (until the last decade) to records from Gustavus, Yakutat, Cape Spencer(?), and Bartlett Cove. Data from elsewhere in the park is notably sketchy or nonexistent. Data from within the park generally is limited to temperature and precipitation only. In order to more clearly detect local trends and place them within the context of regional and global trends, we require additional weather/climate data of more types from more locations. These types of data provide essential context for understanding trends in other VSs. Weather/climate is likely the factor(s) that will most confound efforts to distinguish natural variability from anthropogenic effects. Without a good understanding of weather/climate, this distinction will likely be impossible.

KLGO -- Changes in the park's weather/climate will affect the frequency and intensity of wildfire and other natural disturbance processes including flooding. Current climatic conditions and geographic factors are responsible for the park's diverse flora/fauna.

SITK -- Weather events such as floods and wind events often determine the direction of terrestrial succession and alter river course and hydrology.

From extreme disturbance

GLBA -- Human safety could be at risk if slope failures or outburst floods happen in areas where Park visitors are when they occur. An increase in the occurrence of extreme disturbance events could have ecological impacts.

KLGO -- Human health and safety, cultural resources and park infrastructure are all at risk from extreme disturbance events.

SITK -- Although extreme disturbance events such as floods and damaging wind storms are part of the natural ecosystem process in the temperate rainforests of Southeast Alaska, the damage of such events can be magnified in the park because its area is small and it is surrounded by development that can exacerbate the problem.

From coastal/oceanographic

GLBA -- Ecological changes that could result from oceanographic changes (due to climate change) are largely unknown, but likely would have far-reaching impacts on the marine, terrestrial and freshwater ecosystems.

Comments on Management Concerns

From extreme disturbance

SITK -- A major wind storm occurred in December 2004. Over 30 large trees were uprooted or snapped off. The Manager of a bordering trailer park decided to cut and drop an additional number of large trees into the park, causing additional severe damage. One of those trees hung up in a tree in the park and it also had to be cut down.

Monitoring Objectives

Understand the natural range of variability in climate patterns across SEAN parks to provide context for research.

Monitoring Questions

- What are the long term trends in weather at SEAN parks?
- What are the long term trends in weather offshore (upstream) from SEAN parks?
- Is the spatial variability in weather within parks constant?
- Are regional climatic patterns changing?

Example of Measures

- Snow depth.
- Hourly means of temperature, precipitation, wind speed and direction, barometric pressure, relative humidity, light (PAR) at stations at and above sea level on land, and also at sea (moorings.)
- Trends of PDO and sea surface temperature in the Gulf of Alaska.

Possible Partners

KLGO has a weather station near the mouth of the Skagway River, but obtaining data from National Weather Service is not easy. It would be helpful to institutionalize NPS obtaining of this data. This one weather station may be adequate, would be nice to have one in Taiya valley. A weather station in Bartlett Cove may be being established.

Relevant Monitoring or Study

KLGO has been measuring snow depth for 10 years at treeline.

Snow depth also measured at hundreds of sites around state, generally to predict spring flooding.

Comments

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- There is extremely deficient weather and climate data in GLBA; only available for the southern periphery.
- Paleodata can be obtained from lake, ice and marine cores.
- There is no weather climate station in KLGO's Taiya Inlet.
- Climate Data Sources: Use existing climate sampling stations: National Weather Service (NWS) at Skagway; Natural Resource Conservation Service (NRCS) snow course and weather station at Skagway, NOAA station near Sitka, State Climate Centers. There are weather stations in Yakutat, Juneau, Gustavus, Bartlett Cove and Sitka. Fill-in gaps with new stations; be careful about picking sites - scale and site-specific variability should be considerations.
- Alaback and McClellan predict increased blowdown with global warming.
- Possible to use climate monitoring sites established in GLBA by Dan Lawson for glacial studies? Uncertain as to longevity, elevation coverage?
- Sitka has 200 years of historic weather records, Skagway may too.
- Need more weather monitoring stations in GLBA to capture the microclimatic range.
- Noted that weather and climate high service-wide in selection of vital signs. Very important to have paleoclimatic data, to provide a baseline from which to evaluate current climatic trends. Paleoecology and historical geology are ways of extending the baseline back in time, increasing the power of current monitoring.
- Climate data are important to all monitoring/research efforts. If I&M does nothing else, monitor local weather data because there is so much spatial variability. BUT, if we do nothing but monitor climate, we'll KNOW only climate!
- Use remote sensing tools.
- For the "Big Picture," look as far out as the Gulf of Alaska - the location of the bifurcation of the west wind drift, where it hits Southeast Alaska.
- Weather patterns are complicated by topography when they get near shore; that is why weather needs to be measured offshore.
- Continuous recording of data are valuable. Add moorings with continuous recording capability. Solar radiation (not just daylength, but the amount of light, PAR) is a data gap. Important because it influences the phytoplankton bloom and ecosystem productivity.
- Air/Sea Interactions is key - Effect on current, Mesoscale features, and Island effect.
- Sources of offshore climate data -- Need to look at what other agencies can provide to see whether it answers the questions of the SEAN network. If not, supplement, as possible. - Satellite data – look at Gulf data sources (UAF GOA [Gulf of Alaska]), - AK Ocean Observing System, - Pacific Marine Environmental Lab (PMEL), Seattle,

-NODBC (National Oceanographic Data Buoy Center) Fairweather Grounds buoy, Sitka buoy, need one in the Park.

- Source for nearshore climate data: - Cape Spencer weather station.
- Again, historic climate data and paleoclimatic data are important. Need to look retrospectively at climate so that current climate changes can be put in context of the magnitude of changes that have occurred over geologic timescales.
- The 3 vital signs: PDO, where Alaska Coastal current bifurcates, timing of the spring bloom, are also directly connected to hydrology.T3

EMF Level 1 - Geology and Soils
EMF Level 2 - Geomorphology
EMF Level 3 - Glacial features and processes

SEAN VITAL SIGN
GLACIAL DYNAMICS

Justification

Whales, bears and glaciers are the popular signatures of GLBA, there will always be a need for knowledge and understanding of glaciers.

Threats

From glacial features

GLBA -- The local population(s) of harbor seals heavily utilizes/is dependent (for pupping habitat) upon icebergs calved from active tidewater glaciers. Their population dynamics certainly relate to the availability of preferred pupping habitat. Glacial lake outburst floods could threaten human lives/property within the park. Some species (e.g., Kittlitz' murrelets, red-throated loons) are highly adapted to periglacial environments which may be decreasing in character and/or extent. Conversely, glaciers could re-advance!

KLGO -- Both the Skagway and Taiya Rivers are glacial river systems strongly affected by glacial patterns and processes. Glacial lake outburst floods have historically shaped the Taiya River valley and may change in frequency and magnitude as the glaciers retreat up valley.

SITK – NA

From coastal/oceanographic

GLBA -- Eventual grounding of tidewater glaciers will have large but unknown effects on oceanography and other coastal processes.

From marine features

GLBA -- Glaciers in Glacier Bay continuously shape the seafloor and many oceanographic characteristics, but accelerated changes due to climate change may take things in an entirely different direction.

Comments on Threats

Management Concerns

From glacial features

GLBA -- At GLBA, glaciers (particularly tidewater ones) - and opportunities for the scientific study thereof - are values explicitly referenced in the park's enabling legislation. Visitors come to Glacier Bay in large part to view tidewater glaciers. The public expects us to have a deep and relatively complete knowledge of glacial dynamics. Recently this has become manifest in visitors' questions about the park's glaciers re. the larger global phenomena of warming and climate change and its effects. Knowledge of glaciers, although relatively robust compared to some other resources, is by no means comprehensive and is insufficient to provide managers with a sense that they can explain or predict glacial behavior and its effects on other park resources/values. Like weather/climate, glaciers are a driver of many other potential VSs (all 3 systems, perhaps most broadly in the marine), and an understanding of their influences is important to our ability to distinguish between natural variation and human-caused change. The park possesses a valuable and possibly unique opportunity to contribute knowledge to science in general re. glaciology, catastrophic glacial retreats, highly dynamic tidewater glacial systems, etc. Knowledge about local glacial history (and associated landscape evolution) is essential to the understanding/appreciation of the history of the Huna Tlingit people and their ties to the park. Glaciers rule!

KLGO -- Glacial processes are significant drivers of aquatic and floodplain ecosystems in the park. Likewise, the affects of glaciers on park fluvial systems have direct effects on cultural resources (archeological sites, artifacts) and infrastructure (trails, campgrounds).

SITK – NA

From coastal/oceanographic

GLBA -- Grounding of formerly tidewater glaciers will reduce visitor opportunities to view tidewater glaciers.

From marine features

GLBA -- Changes in seafloor shape and turbidity may create hazards for marine operations and human safety.

Comments on Management Concerns

Monitoring Objectives

- Understand effects of Pleistocene, Little Ice Age and active glaciations on SEAN ecosystems.

- Understand short- and long-term changes in the physical, biological and chemical features of glaciers.
- Understand how glaciers influence short- and long-term changes in the physical, biological and chemical features of freshwater ecosystems.
- Understand the short- and long-term changes in the physical, biological and chemical features of permanent snow packs.
- Understand how permanent snow packs affect short- and long-term changes in the physical, biological and chemical features of freshwater ecosystems.

Monitoring Questions

- Are glaciers in and near SEAN parks growing or shrinking?
- Are the flow rates of glaciers changing?
- Are calving rates of tidewater glaciers changing?
- What is the rate of volume change in park glaciers?
- How is the glaciers' mass balance changing?

<u>From scoping meetings</u>

- How have past and ongoing glacial cycles affected marine environments?
- How do tidewater glaciers affect marine ecosystems?

Example of Measures

- Annually measure the terminal position and firn line position.
- Measure how glaciers influence and interact with rivers, streams and at the marine margin.
- Measure nutrient value of glacially-derived sediment and water.
- Locations of glacier termini.
- Locations of lateral boundaries of glaciers.
- Elevation profiles of glaciers.
- Glacier mass balance (firnline is a measure of this, capture in late September before snow falls).
- Glacier flow rates.
- Glacial retreat.

Possible Partners

Relevant Monitoring or Study

Burroughs Glacier has been studied for decades.

Comments

Do we want retrospective data sets from ice and sediment cores. Remember how much we talked about that during the workshops?

Glacial dynamics includes process, hydraulics, hydrology, the physical interaction, three dimensional nature and processes. Glacial dynamics is a connector between ecosystems. Just because a glacier is slowly receding doesn't tell you anything about how it influences the environment or the ecosystem. People think about mapping when you say glacial extent, and that's really not what's important.

Some glaciers mass balance changes are due to micro-climatic influences, for example the configuration of the ice shed makes a huge difference. If you monitor a suite of glaciers you would see more long term effect, not micro-climatic induced effects. Is the annual variation in mass balance likely more dynamic for those glaciers that are more responsive to micro climatic changes? Topography might cause snow to drift over ice, even in bad snow years you'd get a high snow content, therefore, it would have a higher ratio of accumulation compared to times where it was a bad snow year and you didn't have that factor. So I'm not sure how the sensitivity would respond. But if you want to know what is going on with glaciers in any park, you would pick something like a Brady Icefield where there are less of these influences. One thing you can do now that is simple and very inexpensive is to use aerial photography to measure the terminal position and the firnline position yearly. And there are photography records going back 100 years. Use this baseline data, it may be critical in terms of the long term records of (whatever the parameter is).

Dan -- Glaciers are sensitive indicators of changes in climate and affect each of the three ecosystems; strong influence on biological and physical systems and processes. SEAN technical committee notes that as a group this is true, but it may not be true for individual glaciers; in Kenai they are not finding this to be true (Hahr), not true for Harding Icefield.

Greg -- Not pervasive in park, but very important "lateral" contributors; easy to monitor.

Dan -- Alpine and small valley glaciers are sensitive indicators of climate change; less extensive here than GLBA, still very important in affecting freshwater and (NOTE: rest of comment is missing).

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**

Comments, Possible Partners or Threats from Scoping Workshops

- Tidewater glacial face hydrodynamics (especially carbon, dissolved nutrients, sediment) are really important.
- Use remote sensing, mapping for current glacial extent.

Glacial dynamics

- Geomorphology is a significant driver in the ecosystem, it is linked to climate.
- Some suggest that glacial activity is not geomorphology.
- Is the goal to understand dynamics and changes in the parks or to address impacts in the parks? Answer: both.

EMF Level 1 - Geology and Soils
EMF Level 2 - Geomorphology
EMF Level 3 - Hillslope features and processes

SEAN VITAL SIGN
LANDFORM DYNAMICS

Justification

The landcover and land use vital sign focuses on documenting the extent of vegetation and features; the landform dynamics vital sign focuses on geomorphology and their processes. This will document landforms and how they change through time. Much in GLB.

Threats

<u>From extreme disturbance</u>

KLGO -- Glacial lake outburst floods, forest fires, tsunamis have shaped KLGO's landscapes up until the present.

<u>From coastal/oceanographic</u>

GLBA -- Eventual grounding of tidewater glaciers will have large but unknown effects on oceanography and other coastal processes.

Comments on Threats

<u>From extreme disturbance</u>

GLBA -- According to vital sign list notes: This vital sign includes slope failures, glacial outburst flooding and other extreme disturbances. This potential vital sign is meant to imply documenting the specifics of these events after they occur. Measures of the ecological impacts of extreme disturbance events may or may not be measurable in a systematic fashion, since each one will be unique.

Management Concerns

Comments on Management Concerns

Monitoring Objectives

- Understand the non-glacial physical processes effecting terrestrial ecosystem stability and change. Understand how geomorphic processes affect the terrestrial ecoystem.

- Understand landscape processes well enough to reconstruct the paleo-landscape and project landscapes into the future.
- Understand how extreme disturbance events affect terrestrial communities and processes.
- Understand how changes in marine and terrestrial topography affect park terrains.

Monitoring Questions

- How are selected landforms changing over time?

<u>From floodplain dynamics</u>

- How are river channels migrating across their floodplains?

<u>From scoping meetings</u>

- How much (and which) change is attributable to natural successional processes? ("Succession" - community development through time, distance from influence of tidewater glaciers/turbid outwash streams).
- What other processes affect landscape dynamic components in a marine system?
- How do changes in terrestrial ecosystems and landscapes affect the marine landscape and ecosystems?
- Are coastal shorelines changing by erosion, uplift, earthquakes or other processes?
- How do extreme disturbance events such as marine storms, tsunamis and earthquakes affect park lands, especially coastal areas?

Example of Measures

- Rate of isostatic rebound.
- Geomorphologic map with location and extent of various (or select areas of) landforms: floodplains, river channels and course, fault lines, shoreline, estuaries, periglacial features, avalanche shoots, break-out lakes, rock slides etc.
- Location, extent, geometry, surface shape.
- Rate of change for select erosional and depositional processes.
- Results of extreme events.
- Maps of stream channel courses.
- Rates of bank erosion and channel migration.
- In SITK and KLGO take vital signs in the watershed, not just the park.
- Tools: Lidar, repeat mapping, aerial and satellite imagery.
- Sampling design may be to focus on subset of park. Need DEM elevation data on map. Use USGS protocol.
- Estimate changes in outer coast beaches, in periglacial environment, lakes that are going extinct (Nunatak Cove, Birdbay North).
- Need to design a SOP/protocol to set up a database to document anecdotal information (e.g. pilot observations w/ reports of landslides and other extreme

disturbances). Need to define what goes in database (e.g. do we want to document avalanches, which happen all the time?).

From scoping meetings

- What are the changes in the landscape that are having measurable effects on vegetative distribution?
- How do extreme disturbance events, such as storms, tsunamis, floods, and earthquakes, affect park lands (especially coastal areas?)

Possible Partners

Relevant Monitoring or Study

There is a long database on glacial extent available. Need to reoccupy some past monitoring stations and take measurements.

Comments

This vital sign crosses over with landcover in that both care about and document extreme disturbance events. Also crosses over with surface water dynamics, relative to floodplain dynamics.

KLGO wants to determine erosion rates to assist with management.

Greg: Flood plain dynamics is a 'biggie,' especially in KLGO.

Lakes are disappearing at Dry Bay and dramatically changing the ecology of the valley. Different scales are relevant and different dynamics are at play in each park. For changes in beach geomorphology you need one scale and frequency of data, for landcover changes due to fire you need a different one.

250 years ago Dundas Valley was one big floodplain; it is on its way to becoming like Excursion Valley now. The whole ecology of the valley will change.

KLGO -- Coastal processes affect the nature and productivity of the Taiya River estuary thereby influencing the use of the area by fish and wildlife including eulachon, bald eagles, migrating waterbirds, river otters, salmon, and harbor seals.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- KLGO is interested in the sediment load in park glacial streams; this effects channel movements, flood plain dynamics, and management of infrastructure in the floodplain. The more sediment, the more braided the rivers. The floodplains are where the salmon spawning habitat is and the deciduous riparian forest.
- Way to monitor episodic/drastic events is to document after they occur.
- Document small events on a yearly basis to feed into future models.
- Document when extreme disturbance events occur and results; these events are difficult to "monitor." Use post-event mapping/satellite imagery.
- Can use seismic stations (one is located in Deception Hills on the fault just southeast of Dry Bay) for detecting extreme disturbance events.

EMF Level 1 -
EMF Level 2 -
EMF Level 3 -

SEAN VITAL SIGN
SURFACE WATER DYNAMICS

Justification

Threats

From surface water dynamics

GLBA -- Without a reasonable understanding of surface currents, our ability to protect marine and intertidal resources from spill impacts will continue to be limited.

KLGO -- Changes in the characteristics of surface waters through the year directly affect the distribution and abundance of associated biota including salmon, eulechon, beaver, river otters, harlequin ducks, bald eagles, bears, macroinvertebrates and mink.

SITK -- Only the lower 0.6 miles of the Indian River is within the park boundary, yet the surface water the park receives represents the entire Indian River Basin and all the impacts to the entire system as the result of human activity.

From stream/river channel

GLBA -- Abundance and distribution of spawning salmon and their predators (seasonally) is strongly influenced by stream channel characteristics. As channels evolve, salmon/predators will appropriately respond. It is important to understand the degree to which changes in these biotic resources are primarily attributable to natural channel evolution, vs. human-caused impacts.

KLGO -- The Taiya River is a highly dynamic glacial river that dominates the Dyea and Chilkoot Trail Units of KLGO. Channel morphology and dynamics are of great interest to the park. Past development has altered lower portions of the river and future planned developments may also result in direct impacts to the river and its tributaries.

SITK -- Human activities in and outside the Indian River channel outside the park boundary can alter the hydrological process of the river, causing changes in erosion rates and locations that could impact park resources and its tributaries.

Comments on Threats

Management Concerns

From surface water dynamics

GLBA -- Spilled contaminants (e.g., petroleum) are transported largely by surface currents. Surface water physical dynamics (freshwater and marine), including flow and general character, can be an essential driver of surface water biota (e.g., marine hytoplankton blooms) which in turn powers the entire marine ecosystem and ultimately has some important effects on some portions of the terrestrial and FW systems. For Glacier Bay proper we currently possess a decent dataset for surface and near-surface oceanographic parameters (except currents), and this trend monitoring must continue. Although crude qualitative models of marine surface current dynamics have been developed, our empirical knowledge is extremely scant. GLBA reports to 3 GPRA Goals that might have relevance to this Vital Sign: Surface Water Quality (Ia4A), Water Quality (Ia4B), and Water Quantity (Ia4C). There is also the Goal for Land Health - Marine and Coastal (Ia1F) that might pertain.GLBA -- Spilled contaminants (e.g., petroleum) are transported largely by surface currents.

KLGO -- Management of the White Pass & Yukon Route railroad/tracks and plans for future development of a trail to White Pass City may affect surface water dynamics within the White Pass Unit. Proposed development within the Taiya River Watershed will have significant effects on surface waters within the watershed.

SITK -- Human subdivision and other developments that have the potential for adding contaminants and increasing siltation to the river, water extraction (instream flow reduction), recreation activity, and other upstream impacts threaten the integrity of the Indian River surface water which the park receives.

From stream/river channel

GLBA -- GLBA park enabling legislation references opportunities for scientific study of environmental changes (like primary stream development) associated with dynamic glaciation. GLBA has become fertile ground for research on stream physical (and community) development following glacial recession (Milner et al.). Long-term monitoring provides the fundament for this important and valuable (to science) work; this research can also provide information to managers regarding stream response to human disturbance. Understanding of channel trajectories can provide information for predicting quality of critical spawning habitat quality of economically valuable salmon resources. Importantly, this category includes discharge characteristics of streams and tidewater glaciers (including sedimentation) - which strongly influence an abundance of park resources and VSs. Management must recognize and understand trends in order to respond appropriately to change. GLBA reports to 3 related GPRA Goals that might have relevance to this VS: Surface Water Quality (Ia4A), Water Quality (Ia4B), and Water Quantity (Ia4C).

KLGO -- Bank stabilization, bridge construction, roads, gravel extraction and recreational activities affect river dynamics, erosional process and floodplains within the park.

SITK -- River bed gravel extract and the fill that extended the trailer park adjacent to the boundary have altered the river channel in the park, resulting in increased erosion that threatens park resources. These activities continue periodically to the present day.

Comments on Management Concerns

Monitoring Objectives

- Understand how hydrologic processes affect the terrestrial ecosystem.
- Understand short and long term changes in physical, chemical and biological features of rivers, streams and other moving water (lotic) systems (watersheds, stream channel characteristics, groundwater dynamics, surface water dynamics, water quality, water chemistry, aquatic macroinvertebrates, exotic plants and animals, fish, benthic algae, benthic invertebrates).
- How is the connectivity among different freshwater bodies and ecosystems changing over time?

Monitoring Questions

- Are there long terms trends in annual rate or seasonality of streamflow?
- Is in-stream flow adequate to support aquatic life? (particularly important to SITK)
- Is the amount of discharge of freshwater into seawater changing?
- Is the sediment load of discharge changing?
- Is the nutrient or carbon load of discharge changing?

<u>From floodplain dynamics</u>

- Are changing discharge characteristics making rivers more erosive?
- Is flood frequency or severity changing?

<u>From scoping meetings</u>

- How do groundwater processes affect intertidal communities?
- How do changing water sources influence freshwater bodies, e.g., influence of glacial melt, snow melt, rainfall, and ground water?
- How are water sources changing temporally and spatially, i.e., what are the relative contributions of various water sources to freshwater systems (same vital signs as in previous question)?
- How do freshwater inputs influence near-shore marine productivity?
- What is the influence of marine-derived nutrients on freshwater systems over time?

Example of Measures

- Stream discharge (rate [volume/time]) of stream flow.
- Stage height of flood events.
- Modeled flow from tidewater glaciers (e.g., based on mass balance.)
- Periodic analysis of sediment concentration in streamwater.
- Need to know what is in the discharge too; sediment load is important. Continue (Chris Larson) work that is determining how many cubic kilometers of ice we've lost in GLBA. All that exited the marine system and had a huge estuarine-marine effect, which is continuing. That freshwater exit is a huge physical and chemical driver. It is noted that the best opportunity to detect oxides in nitrogen and sulfur is when snow melts and you measure it in freshwater streams (rather than measuring soils.)

Possible Partners

Relevant Monitoring or Study

Comments

Chris G - For all parks: Not sure of the distinction between floodplain and surface water dynamics. Combine?

Greg - Freshwater dominates much of park.

Greg - Discharge integrates many things from physical world.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- Tidewater glacial face hydrodynamics (especially carbon, dissolved nutrients, sediment) are really important.
- How does freshwater input change in space and time? What is it transporting? How does the pattern change over time?
- Use stream gauges - instrument a few streams and model from there.
- On a watershed basis, you would want to know what is coming off the hillsides and what is being generated by the ice itself. Once you have a benchmark for how much the watershed is inputting, then glacial mass balance will provide an indication of change. See Lawson, Arendt's work. If you have a system that is not glacially influenced, you may want information on temperature, nutrients and volume.
- There has been a lot of stream mapping in Southeast Alaska. Obtain stream gauge data. Other sources of basic hydrologic data: monitoring wells, piezometers (Bishop, Streveler).

Surface water dynamics

Types of water body

- Wetlands (bogs, fens, marshes, forested wetlands; occupied by macroscopic plants)
- Glaciers and ice fields (glacier-associated water bodies: ponds, trap, supra-, en- and sub-glacial, stagnant and buried ice, proglacial lakes)
- Seasonal snow pack
- Liquid water bodies
- Ground water (minus hyporheic flow, karst hydrology)
- Permafrost (ground ice)
- Ponds (ephemeral, high-elevation bedrock, inter-morainal, kettle, dredge {amphibian habitat}, ponds on glaciers, trap lakes and ponds, supraglacial {see glaciers list})
- Permanent snow pack

EMF Level 1 - Water
EMF Level 2 - Hydrology
EMF Level 3 - Marine hydrology

SEAN VITAL SIGN
MARINE PHYSIOCHEMICAL AND BIOLOGICAL WATER MASS CHARACTERISTICS

Justification

A set of marine water data is needed over the long term as a baseline for the condition of this park ecosystem, to enable change detection, and as a backdrop against which other change detection may be considered. This vital sign is important to GLBA and SITK.

Threats

From water chemistry

GLBA -- Legal and illegal discharges from marine vessels have the potential to negatively affect Park resources.

From toxics

GLBA -- Marine water quality threats include potential impacts caused by wastewater discharges (treated wastewater, bilge and ballast water), antifouling paints, air emissions that may precipitate into marine water and accidental oil discharges.

From marine hydrology

GLBA -- An inadequate understanding of GLBA oceanography (how upwelling, large, medium and small scale ocean currents affect marine processes) leaves us unable to distinguish change, not to mention determine the causes of change, at the ecosystem level. Climate change and management actions may result in oceanographic changes that are difficult to detect but have far-reaching effects on the marine ecosystem. Need to determine whether the turbidity caused by cruise ship prop wash affects the distribution of small schooling fishes. Information on the correlation between oceanography and the relative abundance and distribution of zooplankton and forage fish is needed to account for natural change.

KLGO – NA

SITK -- NA

From point-source human

GLBA -- Pollution from shipboard wastewater (blackwater and graywater) effluent from small and large vessels may affect marine life. Non-regulated endocrine disrupters and toxic flame retardants are found even in the highly treated wastewater from cruise ships, which may have biological effects on a variety of marine species. Petroleum leakage from outboard engines and exhaust at low levels may affect marine life.

From non-point source human

GLBA -- Pollution a threat from non-point source human impacts, including vessel wastewater discharges.

From coastal/oceanographic

GLBA -- Changes in water column stratification that could result from climate change and glacial retreat would likely change plankton species composition and biomass, timing of spring bloom, timing and volume of freshwater input and ocean temperature with cascading effects on marine vertebrates and other taxa. The Pacific Decadel Oscillation (PDO) and where the Alaska Coastal Current bifurcates will have an effect on this vital sign.

Comments on Threats

From water chemistry

GLBA -- Marine workshop report says: tidewater glacial face hydrodynamics are really important, especially carbon, dissolved nutrients, sediment. Not sure how to interpret this into a management concern or threat

Management Concerns

From water chemistry

GLBA -- Monitoring of water quality in Glacier Bay is needed to determine whether legal or illegal discharges from marine vessels are occurring and have the potential to negatively affect Park resources.

From toxics

GLBA -- Potential impacts of toxics both in the marine and freshwater systems are a management concern. The park needs to determine whether legal or illegal discharges from marine vessels are occurring.

From marine hydrology

GLBA -- Managers currently lack the data necessary to detect oceanographic change or determine causal factors. Changes in marine hydrology will affect T&E species, at-risk biota, anadromous fish and terrestrial and freshwater taxa in profound but unknown ways. Management actions may be having direct but unmeasured effects on marine hydrology. For example, de-stratification of the water column by cruise ship turbulence in transit and as they sit at the glaciers, may have effects on habitat suitability for marine species ranging from plankton to fish, with effects throughout the ecosystem, from larval fish to harbor seals. Oceanographic system is foundation for all other marine processes in Glacier Bay. Present studies need to continue in order to maintain contemporary oceanographic data, attempt to account for observed variability in biological resources, and additional studies are needed to identify effects vessels might have on certain oceanographic parameters.

KLGO -- NA

SITK -- NA

From point-source human

GLBA -- Human health and safety is a concern related to chemical contaminants, heavy metals, and sewage contamination of surface waters. The impacts of chemical contaminants (e.g. reproductive failure, change in endocrine function, tissue damage) are of most concern in relation to marine species.

From marine features

GLBA -- Ecological changes that occur in response to changes in marine processes and features could impact habitats for biota at risk, T&E species, anadromous fish and coastal vegetation.

Comments on Management Concerns

Monitoring Objectives

- Understand oceanographic processes influencing the marine ecosystem.
- Understand the natural range in variability of marine water quality parameters.
- Determine the concentration of contaminants in marine ecosystems.

Monitoring Questions

- How do currents change in speed, direction and timing?
- How do the physical characteristics of the water mass change in space and time (and how does that affect dependent biology)?

- Why do marine hotspots, where large numbers of marine mammals and seabirds aggregate and feed, shift in time and space?
- What will the impact be to the marine ecosystem when the terminus of retreating tidewater glaciers is no longer in marine waters?

From scoping meetings

- How do the three levels of ocean currents (large-Alaska Coastal Current, medium-e.g. the bifurcation near Sitka, small-those within or in front of parks) affect marine processes?

Questions about circulation and upwelling

- Are the temporal and spatial patterns of marine upwelling changing?
- Are the temporal and spatial patterns of marine circulation changing?
- Is the nutrient and energy content of upwelling water masses changing?

From bioaccumulated toxics

- Has there been a change in the level of target contaminants in top level predators?

From marine and freshwater primary productivity

- Has there been a change in the location or amount of marine primary productivity in park waters?
- Is there a long term trend associated with the annual spatial variability of the spring phytoplankton bloom in GLBA?
- Has there been a change in the species composition of the phytoplankton blooms in Glacier Bay?

From marine contaminants

- Are there long term trends in the concentration of contaminants in marine waters?
- Are there long term trends in the concentration of contaminants in marine sediments? from marine derived nutrients
- Has there been a change in the amount of marine-derived nutrients introduced to focal streams in SEAN parks?
- Has there been a change in the amount of marine-derived nutrients introduced into the riparian zone of focal streams?
- Has there been a change in the response of stream or riparian communities to introduced marine-derived nutrients?

From scoping meetings:

- What are the concentrations of contaminants being released into the marine environment from known pollution sources?

- What are the biological indicators of the health of marine water quality (marine ecosystem)?
- What are the biological indicators of toxicity and pathology in marine water quality (marine ecosystem)?

From water column core parameters

- How do depth profiles of physical and chemical characteristics of seawater change?
- How do biotic, chemical, and physical characteristics of seawater vary spatially?

From scoping meetings:

- How are marine biological processes affected by the water column's physical properties and dynamics?
- What are the changes in the nearshore geomorphic features?
- How do longshore currents affect shoreline processes?

From hydrocarbons

- Is there a change in the contamination of marine water by engine fuels or lubricants?

From sewage

- Is there a change in the incidence or degree of contamination of marine waters by sewage?
- Is there a change in the effects of nitrogen and phosphorus fertilization of plants or animals in marine waters near wastewater outflows?
- How do currents change in speed, direction and timing?

Example of Measures

You can monitor some of this suite of parameters at once:

- CTDs (temp, salinity, DO, turbidity, nutrients, others).
- Contaminants (toxics, hydrocarbons, sewage); gather from water, sediments, tissues (mussels, etc.)
- Primary production (chlorophyll A); could be with CTDs.
- Water mass characteristics -- location and timing of upwelling; vessel transects of temp, salinity, nitrate, ammonia, phosphate, silicate, pH, DO, chlorophyll-A, turbidity, sediment load; seasonal maps of estuarine currents; nutrient and carbon concentrations in upwelling water masses; simultaneous measures of discharge flow rates and circulation patterns.

Marine physicochemical and biological water mass characteristics

From bioaccumulated toxics

- Concentration of target contaminants in predator tissue.

From marine and freshwater primary productivity

- Distribution and concentration of chlorophyll-a.
- Time course of chlorophyll-a (or other productivity indicator) at moorings.
- Phytoplankton species composition.

From marine contaminants

- Concentrations of target inorganic and organic compounds in seawater.
- Concentrations of target inorganic and organic compounds in marine sediments.

From marine derived nutrients

- Isotopic ratios of carbon and nitrogen in stream organisms and riparian zone organisms and soil.
- Nitrogen content, biomass, and growth rates of stream and riparian zone organisms.

From water column core parameters

- Depth profiles of temperature, salinity, nitrate, ammonia, phosphate, silicate, pH, dissolved oxygen, chlorophyll-a, turbidity, sediment load.
- Stationary measures of above parameters from moorings.
- Transects of above parameters from vessels.

From hydrocarbons

- Reports of fuel or lubricant spills.
- Observations of hydrocarbon slicks on soil or water.
- Concentration of hydrocarbon in water samples.

From sewage

- Presence of coliform bacteria in marine waters.
- Difference in biomass, growth rate, or element content of marine organisms near versus far from wastewater outflows.
- Need a mixed sampling protocol. Target both problem areas and baseline stations.
- Whenever a marine mammal and seabird hotspot is observed, collect distribution and relative abundance data and marine physiochemical and biological water mass data.

Possible Partners

Relevant Monitoring or Study

Robars 2003: near-glacier productivity should be monitored.

Comments

Sampling design; Collect data in select areas to include hotspots, at face of tidewater glaciers where enter marine ecosystem.

Protocol/sampling design for first three measures (CTDs, contaminants, primary production) and parts of the fourth (water mass characteristics) is the same; monitor whole suite of measures at once. But, protocol for measuring water mass characteristics would be to obtain data from remotely sensed map. Therefore, some scientists suggest that fourth set of measures belong with vital sign 33, land (and ocean) cover and land use. From remotely sensed map and/or satellite data, can get sea surface water temp, surface salinity, chlorophyll distribution, surface discharge patterns, vertical fronts, sea level altimetry, seasonal sediment plumes, etc. Oceanographers can learn interesting things from remotely sensed maps of the nearshore environment. This could be a very inexpensive way to get outer coast data. Not sure how often one would repeat this - every season, annually, every 10 years? How would one ground-truth remotely sensed marine data (ask NOAA/use NOAA's data, ask Dave Douglas)?

Have we sufficiently covered marine primary productivity? It seems like we always skip over zooplankton and calcareous things. One of the global threats that may be coming is ocean acidification. Should we have a vital sign that includes measuring this?

<u>From bioaccumulated toxics</u>

Greg -- One of the best!

Dan -- Baseline data are virtually non-existent; should such baseline data be acquired now and re-sampling not done for 10-20 years?

<u>From marine and freshwater primary productivity</u>

Scott -- Productivity is driven by other lower order things (nutrients, light) and zooplankton grazing dynamics; good linkages but not sure how sensitive as an indicator.

<u>From marine contaminants</u>

Dan -- Important to know but limited help in detecting ecosystem change - baseline lacking; cost of sampling to acquire baseline?

Greg -- Ranked higher because of proximity of sources; why is KLGO not in the mix? from marine derived nutrients

Scott -- Difference here is the potential to serve as an indicator vs. what we know about dynamics of delN or delC values and their reflection of SDN in freshwater or riparian ecosystems…

If anyone reads this comment, they deserve a badge for commitment…

Greg -- impoverished

Greg -- ranks a little lower than GB because marine source offsite mostly

<u>From water column core parameters</u>

Greg -- a 'biggie'

Dan -- Change detection will be limited to regional scale; major changes may be detected; locations of water masses more dependent on local conditions and processes (e.g. glacier margin or stream mouths)

<u>From hydrocarbons</u>

Dan - Baseline data needed but monitoring hydrocarbons as an ecosystem indicator of change does not seem justified; could be included in comprehensive water quality sampling scheme with 10 or more year frequency repetition?

Greg - Indicator high because of SKG harbor proximity

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- Refer to results of December 2005 workshop on GLBA oceanography. Information regarding ocean currents is essential. GLBA has a long-term dataset on physical oceanography (24 sampling stations). However, dataset is not related to known sites and does not include current data. Use existing dataset to model currents and identify information gaps. There should be data at the park specific to Muir Glacier, where oceanographic data was collected for 10 years. Should be a report in park library.
- Use data from Icy Strait (outside GLBA). Source: NOAA Auke Bay Lab, SE Coastal Monitoring program.
- Park equipment is being used to some extent. CTD (conductivity-temperature-depth) data could be used to model currents.

- Install moorings.
- May be able to use Water Quality program funding for current data.
- A recurring theme is that a challenge for the marine ecosystem is that it's a highly protected area in a non-protected region. This is particularly true for the marine ecosystem, and the connectivity is so high between what is happening in the marine ecosystem within the parks and outside of the parks and in the region. The vital signs picked may well be outside the park; very few marine species spend their entire lives within the parks.
- Partners for current monitoring: NOAA-Southeast Coastal Monitoring program (SECM); NOAA's old drift card data; Alaska Ocean Observing System (AOOS, little money for Southeast); Dr. John Whitney-NOAA, has computer trajectory models; University researchers; National Pacific Research Board (work with oceanographic priorities for Gulf of Alaska and Southeast Alaska).
- Install thermosalinographs on ships of opportunity (with flourometer nutrient sensor). Add moorings for temporal component.
- Nutrients drive phytoplankton bloom dynamics and marine productivity dynamics generally.
- Look at NOAA Auke Bay SE Coastal Monitoring program data.
- EMAP (EPA) program sampled Southeast Alaska in 2004 - all water chemistry and nutrients measured, 40 stations.
- Talk to Deb Rudis & Jeff Short about means to monitor (think in terms of Oilspill Protection Act 1990).
- Mussel Watch (NOAA) is an existing bioassay program. Establish sites in SEAN parks. Nice time integrator. May be very cheap, or even at no cost to parks.
- Sitka notes that there are a lot more barnacles than mussels in the park. Wonder about utility of Mussel Watch there?
- There are well-established protocols for sediment contamination.

<u>regarding productivity hotspots:</u>

- Limited nutrient data collected in GLBA (summer 2002 - Taggart; summer 2004 - Piatt not yet analyzed)
- Sonar fish school tracking/mapping (USGS/Piatt/Dragoo surveys)

EMF Level 1 - Water
EMF Level 2 - Water Quality
EMF Level 3 - Water chemistry

SEAN VITAL SIGN
FRESHWATER PHYSIOCHEMICAL WATER QUALITY

Justification

A set of freshwater data is needed over the long term as a baseline for park conditions, to enable change detection, and as a backdrop against which other change detection may be considered.

Threats

GLBA -- Groundwater quality can indicate soil contamination from petroleum products and other toxics; contaminant sources and high concentrations can be located via groundwater.

KLGO -- groundwater dynamics determine the location, distribution and types of wetlands and surface waters in the park. Groundwater quality may be affected by human waste management (pit toilets, septic systems) and fuel storage within the watershed.

SITK -- Little is know about the groundwater processes that effect park resources. Human development around the park and in the Indian River Basin has the potential to radically alter ground water dynamics in the park.

Comments on Threats

Management Concerns

GLBA -- Lack of data. The only knowledge of GLBA hyporheic character come from a handful of currently unmonitored (except at Dry Bay) wells in Bartlett Cove associated with groundwater contamination studies at the solid waste depot and the fuel farm/VIS area. Also an additional small handful at Dry Bay, and a triple handful in Gustavus. Knowledge of groundwater character/dynamics is key to understanding certain processes of stream and lake development (nutrients and C flow within and between ecosystem types, especially from the terrestrial system). GLBA reports to 2 GPRA Goals that might have relevance to this VS: Water Quality (Ia4B), and Water Quantity (Ia4C).

KLGO -- The park knows very little about the characteristics of groundwater within the Taiya and Skagway watersheds. Groundwater dynamics appear to be closely linked to wetland dynamics and western toad breeding phenology. Isostatic rebound is altering groundwater dynamics within KLGO with an average uplift rate of 3/4" per year.

SITK -- Human activities outside the park could have drastic impacts to the groundwater dynamics within the park.

Comments on Management Concerns

Monitoring Objectives

- Understand short and long term changes in physical, chemical and biological features of rivers, streams and other moving water (lotic) systems (watersheds, stream channel characteristics, groundwater dynamics, surface water dynamics, water quality, water chemistry, aquatic macroinvertebrates, exotic plants and animals, fish, benthic algae, benthic invertebrates).
- Understand short and long term changes in physical, chemical and biological features of lakes, ponds and other still water (lentic) systems.

Monitoring Questions

- What are the long term trends in water quality of streams and lakes?
- What is the status of the "health" of large rivers (water quality, macroinvertebrates)?
- What are the (present) conditions of freshwater bodies (water quality)?
- How do marine derived nutrients affect freshwater systems?

Example of Measures

<u>Repeated measures of:</u>

- dissolved oxygen
- temperature
- pH
- oxygen
- siltation
- nutrients (phosphorous, nitrogen, etc.)
- alkalinity
- hardness
- silica
- dissolved organic carbon
- conductivity
- turbidity
- sediment load

Possible Partners

Relevant Monitoring or Study

Dan - Limited data exist on freshwater parameters; baseline acquisition needed.

Comments

Greg - A 'biggie' in all parks.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- How does freshwater input change in space and time? What is it transporting? How does the pattern change over time?
- Have we lost the concept of freshwater productivity, with the vital sign lumping and nesting? If so, does this matter?

EMF Level 1 - Water
EMF Level 2 - Water Quality
EMF Level 3 - Toxics

SEAN VITAL SIGN
FRESHWATER CONTAMINANTS

Justification

Freshwater contaminant data integrates information about the entire watershed and impact of humans.

Threats

From water chemistry

KLGO -- Due to the linear nature of both the Chilkoot Trail and White Pass units of KLGO, these park units are dominated by valley bottom and floodplain ecosystems. Water chemistry is a major driver of aquatic systems and the biota present within these systems.

SITK -- Only the lower 0.6 miles of the Indian River is within the park boundary, yet the surface water the park receives represents the entire Indian River Basin and all the impacts to the entire system as the result of human activity.

From toxics

KLGO -- Toxins may be released into park aquatic systems from a number of sources: WPYR, fuels spills, stormwater runoff, and intentional dumping.

SITK -- Upstream development in the Indian River Basin has been rapid and continues to accelerate. This development increases the risk that toxic chemicals will be released into the Indian River.

From point-source human

KLGO -- Point sources such as pit toilets, septic systems, grey water disposal WP&YR, and stormwater runoff could negatively impact surface water quality in KLGO.

From non-point source human

GLBA -- Pollution a threat from non-point source human impacts.

Comments on Threats

Management Concerns

From water chemistry

KLGO -- WP&YR railroad, Chilkoot Trail recreational use, inholdings, surrounding development (subdivisions with septic systems), and stormwater runoff from homes/roads are management concerns.

SITK -- Human subdivision and other developments that have the potential for adding contaminants and increasing siltation to the river, gravel extraction, and dam maintenance threaten the integrity of the Indian River water chemistry, the accumulative impacts of which are received in the park in the lower 0.6 miles of the river.

From toxics

KLGO -- Discharges of toxins into park aquatic systems are a management concern. Potential sources should be identified and monitored.

SITK -- Upstream development in the Indian River Basin may result in the release of toxic chemicals into the Indian River which may impact the stream ecosystem included the portion of the river within the park.

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Are there trends in the concentration of contaminants in the water of streams and lakes (water, sediments or biological tissues)?
- Is there a change in the incidence or degree of contamination of surface waters or groundwater by sewage?
- Is there a change in the effects of nitrogen and phosphorus fertilization of plants or animals near wastewater outflows?
- Is there a change in the contamination of soil or water by engine fuels or lubricants?
- What is the level of contaminants in freshwater systems?

Example of Measures

- fecal coliform (in groundwater or surface water)
- heavy metals
- concentrations of target inorganic and organic compounds
- persistent organic pollutants
- difference in biomass, growth rate, or element content of organisms near versus far from wastewater outflows
- concentrations of hydrocarbons (polycyclic aromatic hydrocarbons)

- reports of fuel or lubricant spills
- observations of hydrocarbon slicks on soil or water

Possible Partners

Relevant Monitoring or Study

Comments

Monitor freshwater contaminants because we know they are not supposed to be there. But a problem is, what levels are unhealthy? It is hard to get a dose response effect as a measure of an impact from contaminants. But you could say that monitoring this is reflective of something you might want to tackle.

Greg - Freshwater contaminants a 'biggie,' especially for Sitka.

Dan - Baseline data limited on freshwater contaminants; may be useful to acquire data now for future.

The Hydrocarbon issue is quite important in SITK and KLGO as they are adjacent to urban areas.

Greg - Hydrocarbon indicator high because of SKG harbor proximity.

Dan - Baseline data on hydrocarbons needed, but monitoring as an ecosystem indicator of change does not seem justified; could be included in comprehensive water quality sampling scheme with ten or more year frequency repetition?

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Water
EMF Level 2 - Water Quality
EMF Level 3 - Aquatic macro-invertebrates and algae

SEAN VITAL SIGN
FRESHWATER BENTHIC MACROINVERTEBRATES AND ALGAE

Justification

Threats

From aquatic macroinvertebrates

GLBA -- The vital sign here is freshwater benthic macroinvertebrates and algae. These comprise an essential element of the freshwater ecosystem. No known immediate (or likely potential) threats.

KLGO -- Good indicators of water quality and aquatic health in clearwater systems. No indices have yet been developed for glacial systems, which the Taiya and Skagway rivers are.

SITK -- Aquatic macroinvertebrates and benthic algae (diatoms, etc.) are good indicators of water quality and the health of stream ecosystems. Human development that has the potential for adding contaminants and increasing siltation to the river, gravel extraction, and water diversion (instream flow reduction) in the Indian River Basin threaten to shift macroinvertebrates and benthic algae species composition to that representing a degraded stream. Species diversity may also be reduced.

Comments on Threats

Management Concerns

From aquatic macroinvertebrates

GLBA -- Benthic macroinvertebrate/algal dynamics comprise an important driver of freshwater (especially stream) systems. Fishes, including rearing salmon, rely heavily upon benthic macroinvertebrates (some of which graze upon algae) for food and are sensitive to their composition, abundance, and distribution.

KLGO -- Much work would need to be done within park glacial river systems in order to use macroinverts and algae as indicators of WQ and stream health.

SITK -- Human development that has the potential for adding contaminants and increasing siltation to the river, gravel extraction, and water diversion (instream flow

reduction) in the Indian River Basin could degrade the Indian River, the accumulated effects of which would be seem in the final 0.6 miles of the river within the park. Aquatic macroinvertebrates and benthic algae would be some of the first organism to be effected and the most sensitive species to these changes would be lost or reduced.

Comments on Management Concerns

Monitoring Objectives

Understand short and long term changes in physical, chemical and biological features of rivers, streams and other moving water (lotic) systems (watersheds, stream channel characteristics, groundwater dynamics, surface water dynamics, water quality, water chemistry, aquatic macroinvertebrates, exotic plants and animals, fish, benthic algae, benthic invertebrates).

Monitoring Questions

<u>From freshwater algae</u>

- Are there long term changes in the community of freshwater algae in streams or lakes?
- Are there long term changes in the abundance of indicator taxa of freshwater algae in streams and lakes?

<u>From freshwater macroinvertebrates</u>

- Are there long term changes in the community of stream invertebrates?
- Are there long term changes in the abundance of indicator taxa of stream invertebrates?

- What is the status of the “health” of large rivers (water quality, macroinvertebrates)?

Example of Measures

<u>From freshwater algae</u>

- Area of stream bottom occupied by each species of freshwater algae.
- Concentration (individuals/volume) of diatoms and phytoplankton in lake water.
- Diversity, community composition, and biomass of freshwater algae in streams or lakes.

<u>From freshwater macroinvertebrates</u>

- Counts per area of stream bottom of aquatic insect and other invertebrate taxa.
- Diversity, community composition, and biomass of invertebrate taxa.

Possible Partners

Relevant Monitoring or Study

Comments

Freshwater macroinvertebrates are a biological index that is very sensitive to change. Measure caddis fly, may fly, stone fly etc. If change is detected, then increase water quality parameters being measured to determine cause. If sole reason to measure is to determine water chemistry, why not just do water quality measures? Measuring macroinvertebrate levels is complementary with water quality monitoring, nor redundant. Only monitor macroinvertebrates in clear water streams.

<u>From freshwater algae</u>

Greg -- benthic algae small part of GLBA freshwater ecosystems; same at KLGO

<u>From freshwater macroinvertebrates</u>

Greg -- Generally a good index to water quality

Greg -- Great index to water quality on Indian river at SITK

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Biological Integrity
EMF Level 2 - Invasive Species
EMF Level 3 - Invasive/Exotic plants

SEAN VITAL SIGN
INVASIVE EXOTIC PLANTS

Justification

If not controlled immediately, invasive and exotic plant entry to the park ecosystem will cause huge change to the vegetation community and all that depend upon it. This could be an ecosystem controller. This is an immediate concern in SITK, and a management concern for all SEAN parks.

Threats

From invasive plants

GLBA -- Replace native flora, cascading disturbance throughout the natural system. Invasive plants appear to be on the cusp of a rapid expansion in the GLBA terrestrial ecosystem. They could also invade FW systems. Invasive scan threaten the integrity of entire ecosystems and are viewed as a good indicator of overall ecosystem health. They can out compete native plants and perturb an entire flora (and thereby the fauna), fundamentally altering the ecosystem.

KLGO -- Big problem. Number of new species is increasing and distribution throughout park may be increasing as well. Exotic/invasives are second to habitat loss worldwide and the top threats to biodiversity and causes of species imperilment worldwide. As AK climate warms, the threat from exotic species will likely increase as well.

SITK -- Exotic plants are threatening to disrupt the terrestrial ecosystems of the park. Over 14 species are now present in the park of which at least four are or have the potential to spread rapidly. Others such as spotted knapweed and garlic mustard may arrive on Baranof Island any time and get transported into the park from the over 300,000 visitors that come to the park each year.

From terrestrial complex
KLGO -- Invasive species are a threat to the terrestrial complex.

From point-source human
GLBA -- Exotic species from bilges may invade marine ecosystems or transmit disease. Invasive plants may travel in with people via various means.

Comments on Threats

Management Concerns

From invasive plants

GLBA -- GLBA has only a token inventory of invasive plants. We understand the composition, distribution, and relative abundance of exotics from only a few select sites, and have only two years of data. Our concentration of effort has been focused on low-elevation sites near tidewater; we have no information from higher-elevation communities. It is likely that human activity is the primary cause of the spread of invasive plants, so invasive plant status can be a good indicator of human influence on otherwise pristine ecosystems. GLBA reports to GPRA Goal Ia1B, Invasive (non-native) Vegetation.

KLGO -- Numerous species have been detected within the park and several especially noxious species have shown up in Skagway - bird vetch and white sweetclover. Lots of vectors for introductions and difficult to manage potential sources due to mixed ownership within park boundary and multitude of uses.

SITK -- Highly aggressive exotic plants present in the park included Japanese knotweed, creeping buttercup, dandelion, and European mountain ash. The buttercup is moving into forested areas rapidly and needs to be immediately controlled. Other highly aggressive species, like reed canary grass, have been found just outside the park boundary in the 2005 survey.

Comments on Management Concerns

Monitoring Objectives

- Determine if any invasive species are present in the parks.

Monitoring Questions

- Are there any near- or offshore marine invasive plant species present, and are they increasing in area or abundance?
- Which terrestrial invasive plant species are present in SEAN parks?
- What is the abundance and distribution of invasive plant species in SEAN parks?
- What is the rate of increase of abundance and distribution of invasive species?
- What is introducing invasive/exotic plants and what measures can be taken to limit or control invasion?
- To what extent are exotic species affecting freshwater systems?

Example of Measures

- Distribution and extent of invasive and exotic plants.

Invasive exotic plants

Marine

- Population sizes and locations of marine exotic eelgrasses and exotic algae.

Terrestrial/aquatic

- Population sizes and locations of dandelions, European mountain ash, creeping buttercup.

- National protocol being developed.

Possible Partners

Hope to rely on Environmental Management Plan (EMP) for eradication efforts; NPS needs to coordinate with them. NPS role may be to take EMP data and summarize it every five years, and keep an early eye out for invasion in SEAN parks.

Relevant Monitoring or Study

Comments

Monitor invasive plants and animals because we know that they can cause huge destruction in many ways and that they're not supposed to be there. We don't know the mechanism, but we do know if they start showing up with greater frequency we better identify it right away because we could potentially have a disaster. We may not have an invasives problem at SEAN parks now, but 100 years from now we probably will.

Dan -- Seems this falls under another NPS program and can be considered there, given limited resources for I&M?

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- Presence of invasive species can be indicative of overall park health.
- Invasive species change with time. One can’t predict which plant will become the aggressive invasive. A patch can sit there for six months, then suddenly explode.
- Build on NPS Exotic Plant Management Team (EPMT) work. Note that EPMT may not be sufficient -- it will implement treatment, but parks would be expected to monitor the results of that treatment.
- USFS just completed a white paper on invasive species for the Alaska region -- both current and potential invasive species. Will send that report to the NPS.

- USFS has funding, has done a lot of surveys. They will be a good partner, coordinate with them.
- There is a central databank with USFS S&PF, Alaska Natural heritage Center, and NPS to a smaller degree.
- The definition between exotic and invasive is not straight-forward. It is suggested that exotic is non-native, and invasive is a particularly aggressive non-native. Spatial scale and time are factors in the definition. One groups states that for NPS purposes, "invasives" are species exotic to an ecosystem.
- Distribution is critical.
- Invasives are coming down the Alsek/Tat Rivers.
- Do paired studies-an invasive species and vectors of distribution (boats, boat drop off sites, wind, trucks/cars, ferries/vehicles, rafters, kayakers).
- KLGO is most at risk for plant invasions.
- Can we identify techniques to reduce invasive species transmission (e.g. wash boots in water before coming ashore)?
- What would protocol and sample design be if parkwide inferences were desired on the degree of invasiveness, or the level of exotic species and invasive species that are in the Park, and monitor that over time? This would be a good indicator of how intact the park's native plant community was, whether it was being impacted by a number of different species. There would be interruptions to natural processes, included successional dynamics, if invasive species were having a large impact.
- GLBA is a rapidly changing environment. How do we distinguish an invasive species from something that would normally colonize the area?
- Exotic versus invasive.

EMF Level 1 - Biological Integrity
EMF Level 2 - Invasive Species
EMF Level 3 - Invasive/Exotic animals

SEAN VITAL SIGN
INVASIVE EXOTIC ANIMALS

Justification

Concerns include Atlantic salmon, introduction of exotics by bilge water, exotic slugs and their impact on vegetation, starlings in SITK and GLBA.

Threats

From invasive animals

GLBA -- GLBA invasive animals include a slug (terrestrial) that may be outcompeting native slugs and overgrazing native plants. Another known exotic is Atlantic salmon that may be outcompeting native salmon both at sea and for spawning habitat, may interbreed with and genetically alter native salmon, and may introduce disease into native salmon populations. Invasives can threaten the integrity of entire ecosystems and are viewed as a good indicator of overall ecosystem health.

KLGO -- domestic cats, dogs, rabbits have all been documented within KLGO. Bobwhite quail, eastern grey squirrel, starling, pigeons, turkeys, turtles, a lizard have been seen.

SITK -- SITK has several exotic animals that could be negatively affecting the park's ecosystems.

From terrestrial complex

KLGO -- Invasive species are a threat to the terrestrial complex.

From point-source human

GLBA -- Exotic species from bilges may invade marine ecosystems or transmit disease.

Comments on Threats

Management Concerns

From invasive animals

GLBA -- There has been no directed focus on the status/trends of invasive animals in GLBA. We do not understand the magnitude of the potential threat of invasive animals to native biota. We suspect that other exotics so far unknown within the park may in fact occur there or be poised to invade. GLBA reports to GPRA Goal Ia2C, Invasive Animal Species.

KLGO -- Doesn't appear to be a significant concern at the moment, but things could change.

SITK -- Little is know of the effects that exotic animal infestations are having on park ecosystems. Species know to be present include European starlings, pigeons, exotic slugs, domestic dogs, cats, and possibly rats. Starling populations appear to be increasing rapidly. Large flocks are using the park for feeding and some starlings may even be breeding in the park.

Comments on Management Concerns

Monitoring Objectives

- Determine if any marine invasive species are present.

Monitoring Questions

- Are there any near- or offshore marine invasive animal species present, and are they increasing in abundance?
- Which terrestrial invasive animal species are present in SEAN parks?
- What is their abundance and distribution?
- What is the rate of increase of invasive animal species abundance and distribution?
- What is the ecological relationship between exotic and natural animals?
- Are invasive/exotic animals causing a detrimental effect on natural animals?
- Are there places that are particularly prone to invasion by invasive/exotic animals?

Example of Measures

- Distribution and extent of invasive and exotic animals.
- Population sizes and locations of Atlantic salmon, green crab, European starlings, pigeons, domestic (and feral?) dogs and cats, rats, rabbits, northern bobwhite, exotic slugs, wild turkeys.
- Marine invertebrates in ballast water

  Protocol could be to set up a database to document anecdotal reports of invasive/exotic animals.

Possible Partners

Relevant Monitoring or Study

Comments

Greg -- not much in the way of animals.

Dan -- Does this fall under another NPS program and can be considered there, given limited resources for I&M? Are new species to GLBA invasive or due to ecosystem changes?

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- Invasives are important. Track colonization events or processes.
- Ballast water not discharged in SEAN parks (per MARPOL).
- Hull fouling organisms are mostly an issue for sedentary ships, rather than moving vessel traffic.
- It would be very difficult to monitor anything disengaging from a hull and entering marine waters in the parks.
- Be aware of potential invasives (e.g., those affecting Gulf of Alaska).
- ADFG program is monitoring for Atlantic salmon.

Also see comments for 11 Invasive/exotic

EMF Level 1 - Biological Integrity
EMF Level 2 - Infestations and Diseases
EMF Level 3 - Insect pests

SEAN VITAL SIGN
PESTS AND DISEASES

Justification

When pests and diseases attack it can reorganize the ecosystem. They drive change. Pest or disease outbreaks will typically be park management concerns. Pests and diseases can be from native and non native species.

Threats

From insect pests

GLBA -- The "threats" here are those posed to natural terrestrial vegetation assemblages by epidemic outbreaks of spruce bark beetles, aphids, hemlock looper. The potential vital sign is one of these insect "pests" or a suite of them. These are not threats if they occur naturally under natural conditions, but they ARE threats if they occur anthropogenically. A Sitka spruce weevil (Pissodes strobei) is currently moving northward through B.C. (not in Southeast AK yet); this beetle infests young spruce leaders, with major impacts to spruce regeneration.

KLGO -- Western balsam bark beetle (White Pass subalpine fir), lodgepole pine needle miner (Dyea). Native species that have had localized outbreaks.

SITK -- Insect pest like aphids have the potential to kill large numbers of mature trees in the area. Infestations seem particularly bad after warm winters. Warm winters are more common then in the past, possibly because of global climate change.

From animal diseases

GLBA -- Toxic algal blooms have the potential to kill marine organisms. Algal blooms may be naturally-occurring or caused by pollution. Avian flu and West Nile virus have the potential to decimate wild bird populations in Alaska. Parasites originating from farmed Atlantic salmon may affect wild salmon stocks. Genetic changes in populations may occur as a result of animal diseases. Climate change is expected to change animals' susceptibility to disease.

KLGO -- Avian Influenza, West Nile Virus, Chytrid Fungus (detected in western toads in KLGO), huntavirus.

SITK -- Diseases that are carried by birds and have the potential to spread rapidly around the world through migratory bird flyways or visitor use could reach SITK and cause ecosystem distributions and present a health hazard for visitors and staff.

From point-source human

GLBA -- Exotic species from bilges may invade marine ecosystems or transmit disease.

Comments on Threats

Management Concerns

From insect pests

GLBA -- In light of the "Threats" from insect pests, it is essential to distinguish between natural outbreaks and those triggered anthropogenically. Currently we have little ability to accomplish this, and no knowledge upon which to base a determination of cause and effect. These events are of considerable concern because of their ability to fundamentally alter the character of large portions of terrestrial habitat (witness lower G.B. following the spruce bark beetle outbreak of the early 1980s). If such an event could be linked to human activity, management would doubtless consider some reaction (and/or some preventative actions). GLBA reports to GPRA Goal Ia1E (Land Health - Upland) that might have relevance to this VS.

KLGO -- Non-native species may become a concern or unnatural behaviors of natives. Work with Mark Schultz of the Tongass N.F. to monitor.

SITK -- Aphids have killed many large spruce and hemlock trees in the park in recent years.

From animal diseases

GLBA -- Human safety is at risk when animal diseases affect humans, including poisoning from the consumption of tainted meat, fish or shellfish, or through direct disease transmission to people. Animal diseases may decimate populations of T&E species, at-risk biota and other taxa, bringing about profound ecological change in some cases. Visitor access and experience could be constrained by concerns about animal diseases, depending on the situation. Pollutants resulting from management actions are sometimes a factor in animal disease.

KLGO -- Could have significant impacts on park wildlife and implications for human health and safety.

SITK -- Diseases such as the Avian Influenza could reach the park when infected birds arrive after breeding in Asia or travel on overlapping migratory flyways with Asian routes. West Nile Virus could reach the park from migratory birds that come from the south.

Comments on Management Concerns

Monitoring Objectives

- Understand effects of marine infestations and diseases.
- Determine if there are any native insect or disease outbreaks adversely affecting the terrestrial ecosystem.

Monitoring Questions

From insect pests

- Has there been a change in the population size of spruce bark beetles, or an increase in the areal extent of infestation?
- Has there been a change in the population size of spruce aphid, or an increase in the areal extent of infestation?

From scoping meetings:

- Are there any infestations or diseases or changes in genetic structure of organisms prevalent in the marine ecosystem from either human-caused pollution or ecosystem-related changes?
- Are harmful algae blooms (HABs) affecting marine ecosystems?
- Are there any insect or disease outbreaks affecting the terrestrial ecosystem?

Example of Measures

- Map extent of outbreak areas
- Map distribution of outbreak areas
- Document early warning signs for avian flu

From insect pests

- Number of bark beetles captured in traps.
- Areal extent of dying or dead spruce trees in outbreak areas.
- Distribution of trees affected by spruce aphid.

Protocol should include monitoring where outbreaks could be expected.

Key pests/diseases to monitor: aphids, red tide, spruce bark beetle, spruce root fungus, avian flu, chytrid fungus

Possible Partners

Relevant Monitoring or Study

Comments

<u>From insect pests</u>

What to do with Spruce bark beetles and other insect pests in the park? USFS will be all over it if there's an eruption in one of the parks. Maybe we should put them on the list? It is not worth monitoring them to see if the population is ready to erupt - it's not going to happen that way. You just wait for it to erupt.

Greg -- ranked lowest because of generally youthful forests

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- ADFG program is monitoring for Atlantic salmon/disease. There are more parasites showing up in farmed salmon than in wild fish.
- ADFG Palmer (or Homer?) Lab has new monitoring capabilities for paralytic shellfish poisoning.
- Larval surveys with PCR analyses or bio-chemical analyses.
- Taggart commented on diseases and infections. He said there are changes in genetics with the structure of populations. He passed out reference material about *Traits Acquired from Results of Commercial Fishing*.
- In GLBA, spruce bark beetle is currently the only insect pathogen in the park.
- There are native species that go through episodic outbreaks. How to distinguish whether it is a natural infestation or occurrence or part of succession or habitat evolution?
- Hennon et al (FSL) can predict what insects will increase with a warming climate.
- Hennon has noted Sitka spruce weevil, Pissodes strobei, are moving north through British Columbia. The weevils infest young spruce leaders, with major impacts to spruce regeneration.
- Sitka and Excursion Inlet (near GLBA) both have aphids.
- It may be harder for invasives to colonize islands so they may be less at risk, but once colonization has occurred, extinctions are more common on islands.
- The MOST important things to do are education and establish a warning system.
- USFS S&PF will be a good partner, has a program. Encourage them to continue their work.

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Marine communities

SEAN VITAL SIGN
MARINE MAMMALS AND SEABIRDS

Justification

Marine mammals are long lived, some species are resident, and all are good integrators of ecological information. We need information on a guild of marine mammals and seabirds, not just single species. There is a single protocol, predator surveys, for monitoring this suite of marine mammals and seabirds. It is important to monitor a suite of species in our most trampled environment, within their habitat. This is important baseline monitoring information to acquire and maintain. This dataset is important for cruise ship management. The relative abundance of species to each other provides another set of information.

Changes in relative abundance of seabirds that are divers versus those that feed at higher levels in the water column informs us about conditions at those differing trophic levels and can serve as a proxy for forage fishes. It has been said that "the best plankton nets are seabirds."

Threats

<u>From mammals</u>

GLBA -- Apparent decline in harbor porpoise numbers is unconfirmed.
"Determine if vessel wakes change the behavior of whales ..., rafting sea otters and other marine mammals to determine the biological significance of these effects" (from VQOR-EIS).

<u>From birds</u>

GLBA -- Seabird populations will be affected by oceanographic changes caused by global climate change. Pressure to open Bartlett Cove to all traffic, not subject to vessel permit limits would negatively affect the many seabirds that use Bartlett Cove.

Comments on Threats

<u>From birds</u>

GLBA -- Harlequin ducks, Black oystercatchers, Kittlitz's murrelets and marbled murrelets mentioned specifically in Marine Report.

Management Concerns

From mammals

GLBA -- Sea otter re-colonization of GLBA will have far reaching effects on other marine species (kelp, urchins, clams, crabs).
We need to determine if the observed decline in harbor porpoise sightings indicates a true population decline and whether aspects of NPS and regional vessel management policies can reverse any negative trends.

From birds

GLBA -- Visitor experience will be negatively affected if we lose charismatic seabird species, such as puffins. Traditional Tlingit gull egg collection at South Marble Island may not be sustainable if climate change reduces the viability of the gull population.

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Why do marine hotspots, where large numbers of marine mammals and seabirds aggregate and feed, shift in time and space?
- How are the relative abundance and distribution of different species changing?

Example of Measures

- Relative abundance of species and guilds.
- Distribution of species and guilds.
- Whenever a marine mammal and seabird hotspot is observed, collect distribution and relative abundance data and marine physiochemical and biological water mass data.

From seabirds

Choose K-selected species to monitor that spend most of their life in the parks.

Possible Partners

NRPP proposal and funding.

Relevant Monitoring or Study

Continue predator surveys; have about 10 years of data.

Comments

From seabirds

Is this a gap if we don't include? Choose K-selected seabird species to monitor that spend most of their life in the parks.

K-Selected marine mammals

Monitor K-selected marine mammals. Look at numbers of marine mammals in the park, think about the measures that would give information about park specific versus non park specific matters. There is no mechanistic link there unless you couple it with something else on the cause and effect of marine mammal decline, because it could be so many things.

Parks Where Vital Sign will be Monitored
✓ **GLBA**

Comments, Possible Partners or Threats from Scoping Workshops

- Harbor seals and sea otters best to monitor (park-specific processes).

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Intertidal communities

SEAN VITAL SIGN
INTERTIDAL COMMUNITIES

Justification

Threats

From intertidal communities

GLBA -- Spills and trampling. Marine intertidal communities' habitats comprise the boundary between the marine and terrestrial ecosystems, and are the concentration/accumulation areas for "floating" pollutants such as petroleum and marine debris - both of which are damaging not only to intertidal communities but also to other biota. Marine vessel spills are a constant threat. Intertidal communities are vulnerable to human trampling, and the intertidal zone is an area of focused human activity because of easy human access/travel and because they attract human investigation. Much human activity in the park (that doesn't occur on marine waters) happens in the intertidal zone.

KLGO -- Threats to intertidal communities include visitor use, oil spills, and toxins.

SITK -- Intertidal communities in the park are at risk from human activity, including ship and boat traffic, oil spills, boat groundings, visitor use, and proposed developments such as a deepwater cruise ship dock to be built adjacent to the park boundary.

From point-source human
SITK -- Point-source pollution, such as the waste water treatment plant and the fish processing plant outfall, may be negatively affecting the park's intertidal zone.

From non-point source human

SITK -- No point pollution sources such as the discharges from ships and boats and oil emissions from outboard engines may be effecting the park's intertidal zone. Contaminants could be entering and bioaccumulating in the intertidal ecosystem.

From coastal/oceanographic

SITK -- Human alterations and activity can alter the shoreline processes that would have direct and indirect effects on the SITK's intertidal zone.

From Threats in Access, when we were considering "estuarine communities" as a vital sign:

KLGO -- The Taiya River estuary appears to be quite productive as is evidenced by the year.

Comments on Threats

Management Concerns

From intertidal communities

GLBA -- Negative impacts of spills/trampling cannot be accurately recognized, assessed, and effectively rehabilitated/restored without good information on the natural condition. The known range of natural variability is very broad, so long-term monitoring is essential if we hope to distinguish between that kind of variability and anthropogenic impacts. GLBA reports to GPRA Goal Ia1F (Land Health - Marine and Coastal) that might have relevance to this VS.

KLGO -- There's little info on KLGO's intertidal communities. Most are outside of the park's management jurisdiction although they are within the park boundary.

SITK -- Little is known about the intertidal community of the park. This zone comprises almost half of the park acreage. Monitoring the health of the intertidal zone is crucial in detecting impacts that might be occurring to theses critical park resources.

From point-source human

SITK -- The outfall from the fish processing plants in Sitka may be adding nutrient loading to the intertidal ecosystem.

From non-point-source human

SITK -- The park intertidal zone may be experiencing negative impacts from nonpoint pollution sources unknown to park managers.

From coastal/oceanographic

SITK -- Proposed developments such as a deep water dock for cruise ships to be built adjacent to the SITK boundary could alter shoreline processes including longshore drift and the deposition/erosional process. This could severely impact the park's intertidal zone.

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Have there been changes in the species composition of marine intertidal communities?
- Has there been a change in the biomass or productivity of marine intertidal communities?

Example of Measures

- Species composition of intertidal communities.
- Biomass of intertidal community components.
- Productivity of intertidal community components.

When picking what to monitor, consider cause and effect. Intertidal communities are resilient; they are subject to high disturbance. What is not changeable in the marine communities? What comes back quicker? What is the natural range of oscillation? What is the natural response and variability? If you know this, then if there is a natural or anthropogenic change that causes a disturbance outside the normal range, this would be important to detect and understand.

Possible Partners

Relevant Monitoring or Study

Comments

Greg - Ranked highest because of relative prevalence in park.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- Because of global recognition of oil spills as a major impact to marine communities, should have a specific question related to this potential cause of change in the marine environment. Need to have data on the status and trends of the communities before a spill event, to be able to assess effect of a spill on the environment. In response to the question: “Isn’t this just doing inventory?” the response was: “Inventory becomes your first data point in a monitoring program.” Need a physical model of what would happen in event of an oil spill. Use this modeling to select areas that are most susceptible to spill impact, and gather baseline data in those locations. Recent information shows that offshore weather in the Gulf of Alaska heads southward, then east through Icy Strait and north into GLBA. Organisms most likely to be impacted are those in contact with the sea surface (e.g., sea ducks) and those in contact with the intertidal zone.

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Wetland communities

SEAN VITAL SIGN
WETLAND COMMUNITIES

Justification

Threats

From wetland communities

GLBA -- Wetlands in the park provide important resting habitat for migratory waterfowl, notably cranes; and ground-nesting birds. Wetlands also support unique plant species. For example, the "poor fen" type wetland or open shrub and herb wetlands contain some rare plant species and also supports plant diversity that may be important. The relative scarcity of this habitat type in southeast Alaska, its low level of disturbance, and its easy access enhance these wetlands value for education and scientific study.

The preserve supports extremely concentrated ORV use during the commercial and subsistence fishing seasons. ORV access is through wetlands and adjacent shorelines that support a high density of nesting shore and seabirds and serves as a major migratory stopover for waterfowl and shorebirds. The preserve is also the sole take-out point for rafters floating the Tatshenshini-Alsek River corridor and receives international attention as part of a World Heritage Site.

Access road to Bartlett Cove passes through a variety of wetlands. Threats to both wetlands and fish habitat because of the poor road design and inadequate erosion control has been a concern to the park. There have been threats to the wetlands and salmonid spawning and rearing habitat from erosion and sedimentation problems in ditches and waterways adjacent to the entrance road.

KLGO -- Unlike most of SE AK, KLGO has a limited number of wetlands. Wetlands in the Dyea area may be drying and diminishing in area as a result of isostatic rebound.

SITK -- Most of the terrestrial area of the park is a form of wetland. Threats include change in climate (warming and drying), negative groundwater interactions from outside the park as the result of development, and building structures and increasing the breath of the trail system in the park as the result of park management decisions.

Comments on Threats

GLBA -- Clean Water Act, Executive Order 11990 ("Protection of Wetlands") and 11988 ("Floodplain Management").
GPRA Ia1C Land Health-Wetlands

Management Concerns

<u>From wetland communities</u>

GLBA -- Motorized use in support of commercial and subsistence fishing is authorized and occurs extensively in the park preserve. Routes and areas for ORV use have not been formally designated. The park needs accurate information regarding existing routes, sensitive wetlands, natural hydrological processes, and long-term monitoring. Management has concerns to wetlands adjacent to the park road. Best management practices to stabilize exposed soil, minimize erosion and sedimentation has continued and the park has made considerable progress.

KLGO -- Chytrid fungus has been detected in western toads in KLGO. This non-native aquatic fungus has been implicated in amphibian die-offs around the world. Need to collect info on the distribution of the pathogen in park wetlands. Wetlands contribute to the heterogeneity of habitats within the park and susceptible to human disturbances.

SITK -- Protecting wetlands in the park is a GPRA goal (Ia01C) and the NPS is directed to protect wetlands from Executive Order 11990.

Comments on Management Concerns

Monitoring Objectives

Understand short- and long-term changes in the physical, biological and chemical features of wetlands.

Monitoring Questions

- Are individual wetlands changing in size, hydrology, or species composition?
- Is the total area of wetlands in a park changing?

Example of Measures

- Land cover of wetland vegetation types.
- Hydrology of selected wetlands.
- Plant community composition of wetlands.

Possible Partners

Relevant Monitoring or Study

Comments

There is a GRPA goal addressing wetlands.

There is wetland damage from ORV use in Dry Bay.

Greg - but change is kind of slow to monitor

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- Hydrology drives vegetation if landscape doesn't interfere.
- Flow regime is a driver of riparian vegetation. Riparian vegetation is at the intersection of hydrology and the terrestrial environment.

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Fishes

SEAN VITAL SIGN
SALMONIDS

Justification

Threats

From fishes

GLBA -- Marine pollution may affect populations of marine fishes. Parasites and diseases from escaped farmed fish may affect wild populations. Exotic parasites and diseases originating from ship bilge/ballast water may spread to wild fish populations. Underwater sound from vessels may affect the distribution and behavior of marine fishes, with effects on marine mammals and seabirds. Sport harvest in small systems such as the Bartlett River may be occurring at too high a level for steelhead cutthroat trout and other small populations. Invasion of farm-escaped Atlantic salmon (one has already been caught in East Alsek river system). Natural ecosystem processes driven by uplift like in East Alsek River may have profound effects on local populations of salmonids and other fish. Sport harvest of largest individual marine fish may lead to decreasing fish size over time through natural selection and other forces. Remnant population of Dolly Varden trout upstream of the Falls Creek hydroelectric dam will be affected by the hydro plant.

KLGO -- Native Coho, pink and chum salmon occur in the Taiya River. Salmon runs are important for the park's black and brown bears. There are no hatcheries or human-made barriers to fish passage along the Taiya River.

SITK -- New regulations proposed by Alaska Department of Fish and Game would open the Indian River to salmon fishing, including subsistence and person take fishing. This means a daily harvest of as many as 50 pinks and 20 kings per person per day would be allowed depending on the type of fishery. Equipment that will be allowed for taking fish will include hook and line, gaff, purse seine, and dip net.

Comments on Threats

Management Concerns

From fishes

GLBA -- Threats to some fishes will affect T&E species and other at-risk biota with ecosystem wide effects. Sport fishery harvest levels are set by State ADFG so Park may not be able to control over harvest of small or vulnerable populations. GLBA

Commercial fishing closures in 1990s created rifts between the Park and many local residents. Increasing marketing of Icy Strait waters as a sport fishing haven may increase fishing effort in and near Park waters. Actual sport fishing effort in Park waters is difficult to document because ADFG statistical areas don't match up with Park administrative boundaries.

KLGO -- As glacial inputs to the Taiya River decrease through time, salmon population and nearshore fishes (herring spawn [Sitka], gunnels): relative abundance, distribution dynamics would be expected to alter. Proposals to build a very large fish hatchery in Skagway could negatively impact native fish populations in the Taiya River.

SITK -- Salmon populations may be considerably altered by the new proposed ADF&G fishing regulations on the Indian River.

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Has there been long term changes in the presence of salmon species in park streams?
- Has there been a long term change in the timing, reproduction, or numbers of returning salmon of each species in park streams?
- Has there been a change in the diet of salmon in park waters?
- How are juvenile salmon densities changing over time in the Indian River?

Example of Measures

- Presence/absence of salmon in park streams.
- Number of returning fish at selected park streams.
- Number of recruits per spawner, freshwater residence time, and body condition.
- Diet from stomach contents.
- Spring spawner numbers.
- If relevant, this can include monitoring of cutthroat or steelhead.
- Density, absolute and relative abundance, growth rates, and species compositions.

Possible Partners

Relevant Monitoring or Study

Comments

Some life history stages of salmon occur exclusively within a park.

For salmon, which life history stage are we talking about? Fry, smolt, adult, etc.? Are we separating the marine derived nutrients, which are primarily from salmon, versus any

other ecological effect from adult salmon in freshwater? Are salmon important for ecological or management reasons? Adult salmon are not that important for their ecological role in marine communities. Adult salmon may have a prominent role in freshwater, but that's mostly covered through marine derived nutrients (unless concern is behavioral response of predators moving in).

Landcover dynamics are not going to be that sensitive for adult salmon but would be for fry; the fry: smolt ratios, or fry weights or in-stream processes, for example, that may be influenced by overland or land cover management issues. So there are a number of management issues, depending on which life history stage of salmon are of concern.

GLBA may be more concerned about population dynamics. SITK may be concerned about water quality parameters, which may influence scour, which would influence egg production. Salmon rated highly for different reasons for each rater and each park.

The adult spawning numbers and behavior dramatically influence algae and the distribution and density of benthic macro invertebrates in the stream. Just from the amount of redds that they dig up and the amount of gravel that they move plays an important role.

Should we measure some of those effects, or should we measure marine-derived nutrients through isotopic signatures? There are differing issues based on which life history stage is being considered.

Hatchery is biggest issue for SITK; is the population in Indian River an induced run? ADFG does not do juvenile salmon counts, which we need as this is life stage when salmon is in the SITK park.

Scott -- I think population dynamics of adult salmon are a function of things outside the park and thus are not a useful indicator of park change. Juvenile salmon (fry:smolt ratios; survival or body mass) may be a better indicator

Parks Where Vital Sign will be Monitored

✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Fishes

SEAN VITAL SIGN
FORAGE FISHES

Justification

Threats

From fishes

GLBA -- Marine pollution may affect populations of marine fishes. Parasites and diseases from escaped farmed fish may affect wild populations. Exotic parasites and diseases originating from ship bilge/ballast water may spread to wild fish populations. Underwater sound from vessels may affect the distribution and behavior of marine fishes, with effects on marine mammals and seabirds. Weathervane scallop dredge fishery on GLBA outer coast may have negative effects on benthic and demersal fish. Over harvest of commercial and sport lingcod and rockfish may be occurring. Natural ecosystem processes driven by uplift like in East Alsek River may have profound effects on local populations of salmonids and other fish. Sport harvest of largest individual marine fish may lead to decreasing fish size over time through natural selection and other forces. Killing and mutilation of spiny dogfish by sport and commercial fishermen may have population level effects.

KLGO -- NA

SITK -- NA

Comments on Threats

GLBA -- From marine report: Are the composition, distribution or abundance of organisms within the apex trophic level of the pelagic (forage fishes) marine food web changing and, if so, how?

Management Concerns

From fishes

GLBA -- Threats to some fishes will affect T&E species and other at-risk biota with ecosystemwide effects. Sport fishery harvest levels are set by State ADFG so Park may not be able to control overharvest of small or vulnerable populations. Weathervane scallop harvest is managed by ADFG so park has limited control on its effects on fishes or other benthic inhabitants. GLBA Commercial fishing closures in 1990s created rifts

between the Park and many local residents. Increasing marketing of Icy Strait waters as a sportfishing haven may increase fishing effort in and near Park waters. Actual sportfishing effort in Park waters is difficult to document because ADFG statistical areas don't match up with Park administrative boundaries.

KLGO -- As glacial inputs to the Taiya River decrease through time, nearshore fishes (herring spawn [Sitka], gunnels): relative abundance, distribution dynamics would be expected to alter.

SITK -- NA

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Have there been changes in the distribution of forage fishes in park waters?
- Have there been changes in the species composition of forage fishes in park waters?
- Have there been changes in the population structure of forage fishes in park waters?

Example of Measures

- Distribution and abundance of forage fish species in park waters.
- Size or age structure of forage fish species in park waters.
- Changes in relative abundance of seabirds can serve as a proxy for forage fishes.

Possible Partners

Relevant Monitoring or Study

Comments

Lots of K-selected species feed on forage fishes. Marine mammal success may depend upon their health and abundance. It is hard to conceive of a protocol for measuring forage fishes; there are different groups with differing and unknown life histories. Presumably rated highly in some parks because euchalon run in rivers there. There are so many things that rely on the forage fish, they would provide some insight into what some of the top level predators are doing.

Greg -- A big deal at GLBA; only drawback is it is hard to monitor.

Scott -- would focus on anadromous species (eulachon etc. in KLGO) which are quite ephemeral in space and time.

Parks Where Vital Sign will be Monitored

Forage fishes

✓ **GLBA**
✓ **KLGO**

Comments, Possible Partners or Threats from Scoping Workshops

Forage fish diet (stomach contents) could be an indirect measure of zooplankton.

- It was noted that forage fish and krill need to be a vital sign somewhere in this series of questions on productivity in order to capture nearshore information because most vital signs we listed focus on offshore.

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Amphibians and Reptiles

SEAN VITAL SIGN
WESTERN TOADS

Justification

Threats

From amphibians and reptiles

GLBA -- The vital sign of interest here is the western toad. Just as many amphibians are in deep trouble globally, toads are declining rather precipitously throughout their Alaskan range, and this decline appears to hold for the GLBA population. The causes are completely unknown (although chytrid fungus was just recently isolated from a toad in SE Alaska).

KLGO -- Western Toads have apparently declined in the park over the last 15-20 years based on anecdotal observations by park staff and local residents. Western toads are the only species of amphibian in the park.

SITK -- It is reported that the Sitka area once had a large boreal toad population. The species is now scarce in the region. The loss of this population could be an indication of habitat alteration, climate change, or some other anthropogenic agent.

Comments on Threats

Management Concerns

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Has there been a change in the local population size or distribution of the western toad?
- Has there been a change in the local reproductive rate of the western toad?
- How is amphibian distribution and abundance changing?

Example of Measures

- Number of documented breeding sites of western toads.
- Counts of adults, tadpoles, or egg masses.

Possible Partners

Relevant Monitoring or Study

Comments

This may be important. Toads are very sensitive to change, good indicators of change. But they're not controllers, toads could disappear and the ecosystem probably wouldn't change much.

Greg - great indicator, that's all.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**

Comments, Possible Partners or Threats from Scoping Workshops

- It is noted that there is anecdotal evidence to suggest a decline in the western toad, but there is no research or long-term monitoring data set to substantiate this.

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Birds

SEAN VITAL SIGN
MURRELETS

Justification

Kittlitz's murrelets are a candidate threatened and endangered (T&E) species and will be listed soon. They are a park management concern. They are the only rare species on the SEAN vital sign list. The protocol for monitoring them is different from other marine mammals or seabirds. Their population is dramatically declining and no one knows why; it may be a decline in their food, habitat or other. Half the global population is in GLBA. They are closely associated with tidewater glaciers, but no one knows why.

Threats

Comments on Threats

<u>From birds</u>

GLBA -- Kittlitz's murrelets mentioned specifically in Marine Workshop Report.

Management Concerns

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Has there been a long term change in the local population size of Kittlitz's murrelet?
- If so, why is kittlitz's murrelet population declining?
- Has there been a long term change in the nesting area or reproductive success of Kittlitz's murrelet?
- Has there been a long term change in the local distribution of Kittlitz's murrelet?
- Has there been a long term change in the diet of local Kittlitz's murrelet?
- Where do Kittlitz's murrelets nest, where are they foraging, what are they eating?
- Are Kittlitz's murrelets a 'mine canary'?

Example of Measures

- Distribution.
- Relative abundance.

- Nesting habitat.
- Breeding surveys.
- Diet, from stomach contents.

Possible Partners

Relevant Monitoring or Study

Piatt has population data.

Comments

The possibility of expanding this vital sign to include Marbled murrelets was discussed. Some researchers find it hard to distinguish between the two species when monitoring.

Parks Where Vital Sign will be Monitored
✓ **GLBA l**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Birds

SEAN VITAL SIGN
BREEDING LANDBIRD POPULATIONS

Justification

Landbirds per se are not a good indicator of park health because they spend much time outside park, but reproductive success for those breeding in SEAN parks is a good indicator of park health. This is a '1st order' indicator – if a change is documented it alerts us that other types of investigations or monitoring is needed (e.g. decline in sparrows now attributed to decline in caterpillars).

Threats

From birds

GLBA -- Camper disturbance of nesting shorebirds in popular camping areas like the Beardslees may eventually have population level effects. Receding glaciers may reduce the abundance of periglacial species, such as the red-throated loon and Kittlitz's murrelet. Increasing landscape fragmentation may affect populations of terrestrial breeding birds. Poor understanding of how species composition and population of breeding birds are changing in parks, in response to local and global pressures.

KLGO -- KLGO has been monitoring breeding landbirds since 1995. Large numbers of migrating waterbirds pass through the park each spring and fall, stopping over in the Taiya River estuary. Harlequin ducks breed in the park.

SITK -- Neotropical, shore birds, and other migratory birds face many threats on their migratory routes, including habitat destruction, exposure to pollution and pesticides, storm events, and habitat fragmentation.

Comments on Threats

From birds

GLBA -- Terr Wksp Report: The breeding birds listed as "species of concern" are listed due to limited population size, or because their migratory route or breeding grounds brings them to places where they are at risk (e.g., the wandering tattler breeding habitat is in a zone that could be influenced by oil spills, putting breeding population at risk.)

Management Concerns

From birds

GLBA -- Five species of terrestrial birds in SE Alaska (Bald Eagle, Queen Charlotte Goshawk, Western Screech-Owl, Northern Saw-whet Owl, and Black Merlin) have been identified as being of high conservation concern at the continental level by Partners in Flight. All of these have been identified as high priority birds within Alaska and the nation (Boreal Partners in Flight 1999, U.S. Fish and Wildlife Service 2005). Concerns related to the availability of nesting habitat and suspected prey species have elevated Western Screech-Owl and Northern Saw-whet Owl as management issues at the state and national level. Blue grouse, red-breasted sapsucker, varied thrush, and Pacific slope flycatcher were also listed as being of concern at the continental level because large proportions of the global population of each breeds in SE Alaska. Birds on the parks' existing "species of concern" list: peregrine falcon (GLBA), blackpoll warbler (KLGO), golden eagle (KLGO), olive-sided flycatcher (KLGO), Queen Charlotte goshawk (GLBA), wandering tattler (KLGO) also continue to be of concern. Falls Creek hydroelectric project roads and recreational trails will increase access to "yellowlegs savannah" and other previously inaccessible bird habitats.

KLGO -- Habitat loss and the introduction of non-native species (e.g., starlings, pigeons) due to increasing human development may impact bird populations. Increasing numbers of corvids (crows, jays, ravens) have also been noted in association with expanding human developments. Corvid abundance is negatively correlated with song-bird reproductive success due to increased predation. There is a great deal of local interest in birds from the Skagway Bird Club members.

SITK -- SITK has a rich complement of neotropical migrants and resident passerines that breed and/or overwinter in the park. Monitoring records can be used to compare and be incorporated in regional and larger scale studies that evaluate the health of neotropical and other bird populations.

Comments on Management Concerns

From birds

GLBA -- Terrestrial birds info from BPIF letter to Tongass managers in winter 2006 (circulated by Meg Hahr).

Monitoring Objectives

Monitoring Questions

- Has there been a long term change in the number of local breeding land birds?
- Has there been a long term change in the local population sizes of breeding land birds?

- Has there been a long term change in the local reproductive success of land birds?

From scoping meetings:

- How are species composition and population of breeding birds changing in our parks, in response to local and global pressures?
- How is increasing landscape fragmentation affecting populations of breeding birds?

Example of Measures

- Relative abundance of encounters from breeding bird surveys.
- Capture-recapture results from banding program.
- Association of habitats.

When selecting species to monitor, consider species for which there is past data that are at edges of their range (e.g. Caspian terns at edge just moving in).

When selecting species to monitor, use guilds that represent different niches (seed eaters, insect eaters) to learn about the health of different communities for which they are dependent. They are proxies for the health of these different habitat types, and species for which they are prey depend upon them.

Data on plant communities (vital sign 32) is needed for protocol to monitor breeding land birds. This vital sign must be linked with the plant community's vital sign.

Possible Partners

Relevant Monitoring or Study

Kessel has habitat classification and protocol to use for breeding bird studies; use this.

Comments

This is of low importance for GLBA; high importance for SITK and KLGO.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- To select birds for vital signs, consider species with smaller habitats, nesting success, population status.
- There are well-established protocols for breeding songbirds in a statewide monitoring effort. KLGO participates in this program. The reason that breeding birds tend to be

monitored in parks is because they are impacted in the rest of their range, and their numbers can be measured in parks as an indicator of how they are faring globally.

- Note: Some species are at risk due to changes in the SEAN park(s) that affect their habitat. Others are at risk due to impacts outside of the park (or even outside of Alaska) that are not within park control.
- The breeding birds listed as "species of concern" are listed due to limited population size, or because their migratory route or breeding grounds brings them to places where they are at risk (e.g., the wandering tattler breeding habitat is in a zone that could be influenced by oil spills, putting breeding population at risk.)
- For breeding birds, use data from statewide breeding bird surveys. There are well-established protocols for breeding songbirds in a statewide monitoring effort. KLGO participated in this program.

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Birds

SEAN VITAL SIGN
BALD EAGLES

Justification

The public is quite interested in bald eagles. They are a charismatic watchable wildlife species. Until very recently they were a T&E species. There is decades of baseline data available. They are an abundant top predator. They may affect bird diversity. Monitoring distribution, relative abundance and breeding success is relatively easy to accomplish. Jacobson hypothesizes that Southeast Alaska is now at carrying capacity; things impacting their food and habitat would show up quickly in changed numbers or breeding success.

Threats

Comments on Threats

Management Concerns

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Has there been a long term change in the local population size of bald eagles?
- Has there been a long term change in the local reproductive success of bald eagles?
- Has there been a long term change in the local distribution of bald eagle breeding sites?

Example of Measures

- Distribution.
- Relative abundance.
- Successfully breeding pairs.
- Shoreline counts of active bald eagle nests.
- Occupancy of nesting territories.
- Census of bald eagle nesting success.
- Brood sizes, population productivity, eggshell thickness, contaminant concentrations.

Use USFWS protocols; boat or aerial surveys.

Possible Partners

Relevant Monitoring or Study

Comments

Greg -- Major top predator; great integrator since preys broadly

Meg - Do have 3 nests in KLGO, one is active in 2006

Greg - Nests in SITK park; is good indicator and integrator; ranked lower than GLBA because park eagles at SITK are so influenced by circumstances outside of park.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Mammals

SEAN VITAL SIGN
BEARS

Justification

Bears are one of two signature animals for GLBA.

Threats

From mammals

GLBA -- Climate change may affect bear denning behavior and food supply.

KLGO -- Brown and black bears are present in the Park.

Comments on Threats

Management Concerns

From mammals

GLBA -- Bear distribution and abundance and behavior can be a human safety concern. Conversely, campers and boaters may disturb bears on shorelines.

KLGO -- Defense of life and property (DLP) killings of bears negatively impact population in the Park.

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Has the range of brown or black bears within a park changed?
- Has the size of brown or black bear populations within a park changed?
- Has the incidence or nature of human encounters with brown or black bears changed?

Example of Measures

- Distribution and density of brown and black bears.
- Records of human-bear encounters.

- Measure changes in density.

Possible Partners

Relevant Monitoring or Study

Comments

Bears are a K-selected species; they are a top level predator.
Are bears indicative of the health of the ecosystem? They are very important from a management perspective; they are a charismatic animal and 'watchable wildlife.' Bears hibernation habits may change as snow level and duration changes.

Greg -- common throughout; great integrator and well linked.

Scott -- population dynamics could be function of park specific processes; important ecologically in terrestrial community.

Greg -- bears common some places in park; see GB

Greg -- no bears

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Mammals

SEAN VITAL SIGN
HARBOR SEALS

Justification

There has been a major decline in SEAN harbor seal populations (we've lost 3000 since ___), they are a charismatic species, they are an important part of the upper trophic level food chain. We want to know different things about them than the data that will be gathered for the marine mammal and seabird vital sign, for harbor seals we want to know about haul-outs (location, use).

Threats

From mammals

GLBA -- The causes of the substantial decline in harbor seal numbers in Glacier Bay are unknown. "Determine if vessel wakes change the behavior of ... hauled-out pinnipeds, ... to determine the biological significance of these effects" (from VQOR-EIS).

KLGO -- Harbor seals are present in the park.

Comments on Threats

Management Concerns

From mammals

GLBA -- Harbor seal decline is of concern to Hoonah Tlingit tribe. Vessel traffic in harbor seal pupping and breeding habitat may disturb the seals at sensitive times in their life history. Native hunting of harbor seals outside the Park will have an effect on seal population inside the Park.

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- What is the distribution and relative abundance of harbor seals?
- Has the distribution of harbor seal feeding areas changed?
- Has the distribution or number of pupping sites changed?

- Have there been changes in the number of pups produced each year?
- Has there been a change in forage area selection?
- Has there been a change in mortality patterns?
- Has pup survival changed?
- What do harbor seal population trends tell us about the availability of forage food?

Example of Measures

- Distribution and relative abundance of harbor seals.
- Distribution and number of pupping sites.
- Counts of pupping success.
- Pup survival.
- Count how many pups are born on land and how many are born on ice.

Possible Partners

Relevant Monitoring or Study

Comments

Greg -- Seals: what are they trying to tell us?

Dan -- Monitoring harbor seal population may reveal change, but cause may be changes to physical environment; monitoring of glacier extent, marine water quality, iceberg discharge, etc., may prove useful to understand.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Mammals

SEAN VITAL SIGN
UNGULATES

Justification

Moose and goats are the two primary species of interest. They affect the structure of the food base, they are landscape transformers. Moose are a large, charismatic species in GLBA. Most of their range is in the park, a small part is out of the part which is where they are heavily harvested. Park managers will continue to need to know about moose hunting and the impact on the population and ranges even if that activity occurs outside the park. Vegetative communities are linked to moose.

Threats

<u>From mammals</u>

GLBA -- Moose hunting outside the park, managed by ADFG, will affect populations inside the Park.

KLGO -- Mountain goats and, more recently, moose are present in the Park.

Comments on Threats

Management Concerns

<u>From mammals</u>

GLBA -- Moose hunting outside the park, managed by ADFG, will affect populations inside the Park.

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

• What is the effect of hunting during the rutting season on moose populations and disbursement?

Example of Measures

Ungulates

- Distribution
- Relative abundance
- Use and extend ADFG mensuration techniques.
- Use BLM baseline data and techniques for goats at KLGO.
- Don't want to collar moose.

Possible Partners

Relevant Monitoring or Study

Comments

GLBA added this for consideration, but on May 3-4 we eliminated moose. Did we decide to eliminate herbivores as a VS?

Without moose willows would dominate; moose make a difference in plant community successional trajectories.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Mammals

SEAN VITAL SIGN
KILLER WHALES

Justification

Killer whales are a top predator. They feed on other marine life (seals, salmon), and are an indicator about the marine species they feed on. Killer whales are a K-selected species.

Threats

From mammals

GLBA -- Bioaccumulation of marine contaminants may affect health of apex predators like the killer whale. Killer whales are at risk of lethal or serious injury from entanglement with sport or commercial fishing gear. "Determine if vessel wakes change the behavior or whales ... to determine the biological significance of these effects" (from VQOR-EIS).

Comments on Threats

Management Concerns

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Has the distribution and number of transient and resident killer whales using park waters changed?
- Has the diet of transient and resident killer whales using park waters changed?

Example of Measures

• Relative abundance.
• Distribution.
• Reproductive rate.
• Type and level of contaminants.
• Location of killer whale sightings.
• Diet from feeding observations.

Possible Partners

Relevant Monitoring or Study

Comments

Parks Where Vital Sign will be Monitored
✓ **GLBA**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Biological Integrity
EMF Level 2 - Focal Species or Communities
EMF Level 3 - Terrestrial complex

SEAN VITAL SIGN
BIODIVERSITY OF SELECT GROUPS OR ASSEMBLAGES

Justification

Indices of species richness can be a good indicator of ecosystem health. One of the National Park Service's duties is to protect biodiversity.

Threats

From terrestrial complex

GLBA -- Vital sign of interest here is biological diversity. Connectivity. Species dispersal.

Comments on Threats

Management Concerns

From terrestrial complex

GLBA -- Management's major concern is maintaining biological diversity in the Park. The key is to concentrate on protecting the most sensitive components of the terrestrial complex. In addition, connectivity between ecosystems is also essential. Despite uncertainty (global warming; major ecological disturbance; species decline.)

Comments on Management Concerns

Monitoring Objectives

Understand trends in biodiversity.

We want to know what certain cohorts are doing; for example, what is happening with the GLBA shallow subtidal community (Bodkin's crew's work)?

Monitoring Questions

- Is species richness or diversity of major plant or animal groups changing?
- Is the genetic variability of key populations or species changing?
- Is the genetic structure of key metapopulations changing?

From scoping meetings:

- What are the trends in biodiversity at a variety of organizational levels (e.g., species diversity, genetic diversity)?

Example of Measures

- Species Richness, indices of select communities (monitoring the 'middle' of the range)
- Indices of biodiversity.
- Indices of genetic variation of key groups.
- Metapopulation dynamics.
- When selecting assemblages to monitor, consider including some that are: 1) ‘mine canaries’ throughout the ecosystem and monitor them for relative abundance at both ends of the range (e.g., in KLGO this could be pica, arctic ground squirrels and other animals at the edge of their range); 2) at the southern and northern end of their range that are moving in or out (e.g. red cedar).

Set up an index of species richness; need a standardized effort, every 'x' number of years. (Can do this by keeping a good species list.)

Possible Partners

Relevant Monitoring or Study

Comments

From May 18-19 meeting summary:

Are ‘select’ and ‘diversity’ oxymoronic?
We have 3 or 4 assemblages on our vital sign list; consider measuring species richness for those. This focuses on the ‘obvious’ ones. One scientist raises a question about whether we should also be measuring some of the ‘non-obvious’ ones? Southeast’s island biogeography may confound things, or, conversely may help determine what we monitor. It is noted that the marine ecosystem is not bound to island biographic parameters, it is an open system.

From May 2-4 Attachment A:

This is so broad, what do we measure? Depending on the scale, you measure a carefully selected list or area(s) for number of species, species density, species richness, species evenness. Classically you measure immigration and extinction rates. Can look at metapopulations and genetic diversity.
Biological inventories have value.
The diversity of organisms is indicative of change.
Biodiversity at its simplest is species richness over time.

Biodiversity of select groups or assemblages

Biodiversity may fail at times to capture/indicate change and ecosystem health (e.g., Robinson work in Midwest on migratory birds – no change to species richness and diversity over 15 years but reproductive success plummeted due to edge predators moving in). Are we capturing the right process? If this remains a selected vital sign we must be convinced that there is a good way to measure it. Ecosystem-wide biodiversity is a good 'umbrella' vital signs, many other vital signs can fit 'under' it, such as subtidal communities. Is how biodiversity changes something that is useful to know?
Should biodiversity of animals be included, or only plants?
Scale is a factor in what to measure, for example may be able to assess species richness in Sitka because area is small.
Pick an area carefully then identify a suite of species (plants, animals or birds) to monitor; determine which community if monitored will help us to understand change.

Greg - biodiversity is a key index of insularity

Scott - just not sure how to monitor this in a useful way.

Sara - I can see getting at this for plant biodiversity, but would we actually measure faunal biodiversity? Of all animal species? Seems beyond our reach.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

EMF Level 1 - Biological Integrity
EMF Level 2 - At-risk Biota
EMF Level 3 - T&E species and communities

SEAN VITAL SIGN
STELLER SEA LIONS

Justification

They are top level carnivores, long-lived, easy to observe, and easy to enumerate. They're relative abundance and distribution is indicative of underwater conditions and informs about vessel disturbance.

Threats

From T&E species

GLBA -- Steller sea lions are at risk of mortality and serious injury from entanglement in sport and commercial fishing gear. Steller sea lions are at risk of behavioral disturbance from close approaches by tour vessels to South Marble Island haulout sites. Climate change and its effects on the marine ecosystem will have unknown effects on Steller sea lions. Steller sea lions travel outside Park boundaries where they are subject to a variety of other threats.

KLGO – NA

SITK -- NA

Comments on Threats

Management Concerns

From T&E species

GLBA -- The number of Steller sea lions from the endangered Western stock that uses Glacier Bay waters needs to be tracked in order to determine the extent that GBNP management policies have on that population.

KLGO -- NA

SITK -- NA

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Is the number of steller sea lions using park waters changing?
- Is the seasonality of steller sea lions use of park waters changing?
- Has there been a change in the location of areas used by stellar sea lions for feeding, breeding or haulouts?
- Is the age structure of stellar sea lions in park waters changing?

Example of Measures

- Relative abundance.
- Distribution.
- Reproductive rate.
- Type and level of contaminants.
- Location of areas used by stellar sea lions for feeding, breeding or haulouts.
- Counts of adults and young at haul-outs.

Possible Partners

Relevant Monitoring or Study

Comments

Parks Where Vital Sign will be Monitored
✓ **GLBA**

Comments, Possible Partners or Threats from Scoping Workshops

At risk biota- Sea lion in GLBA?

EMF Level 1 - Biological Integrity
EMF Level 2 - At-risk Biota
EMF Level 3 - T&E species and communities

SEAN VITAL SIGN
HUMPBACK WHALES

Justification

Humpback whales are an endangered species, a charismatic 'watchable wildlife' species, popular with the public, and of concern to park management. Humpback whales are one of two signature animals for GLBA. The number of Humpback whales in GLBA has tripled in the last five years and because they are huge mammals that eat large quantities of food their impact on the ecosystem has also increased. More needs top be know about their distribution and ecological impact.

Threats

<u>From mammals</u>

GLBA -- "Determine if vessel wakes change the behavior or whales ... to determine the biological significance of these effects" (from VQOR-EIS).

<u>From T&E species</u>

GLBA -- Humpback whales are at risk of fatal or injurious vessel collisions within the Park and outside of it. Humpback whales are at risk of behavioral disturbance and temporary or permanent hearing loss due to acute or chronic exposure to vessel noise. Humpback whales are at risk of mortality and serious injury from entanglement in sport and commercial fishing gear. Climate change and its effects on the marine ecosystem will have unknown effects on humpback whales. Humpback whales travel outside Park boundaries where they are subject to a variety of other threats.

KLGO – NA

SITK -- NA

Comments on Threats

Management Concerns

<u>From T&E species</u>

GLBA -- Vessel management actions including cruise ship numbers, whale waters areas, and baywide cruise ship speed limits are made routinely and need to be based on sound,

objective criteria. Pressure to increase cruise ship traffic can result in increases regardless of scientific justifications. Pressure to open Bartlett Cove to all traffic, not subject to vessel permit limits would negatively affect the many whales that use Bartlett Cove. Vessel and fishery management outside the park (or the lack thereof) affects whales that also use Park waters. Humpback whales are one of the prime charismatic species that visitors come to see in GLBA, so negative effects on humpbacks will diminish visitor experience.

KLGO -- NA

SITK -- NA

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Is the number of humpback whales using park waters changing?
- Is the seasonality of humpback whale use of park waters changing?
- Has there been a change in the location of feeding areas used by humpback whales?
- Is the age structure of humpback whales in park waters changing?
- Is the diet of humpback whales in park waters changing?
- What is the duration of residency of whales in GLBA?

Example of Measures

- Locations and dates of individual whale sightings.
- Ages of individual whales.
- Diet from feeding observations and deciduous epidermis.
- Duration of residency
- Reproductive success
- Mortality (from direct observation)

Possible Partners

Relevant Monitoring or Study

Comments

Greg -- Not a controller, not a great linker

Scott -- Population dynamics and feeding drives sightings of humpback whales; how much do park specific processes influence population dynamics? Distribution mostly management concern…

Parks Where Vital Sign will be Monitored
✓ **GLBA**

Comments, Possible Partners or Threats from Scoping Workshops

- Humpback whales are increasing in abundance.

EMF Level 1 - Human Use
EMF Level 2 - Consumptive Use
EMF Level 3 - Consumptive Use

SEAN VITAL SIGN
CONSUMPTIVE USE

Justification

A huge but currently unquantified amount of biomass is being removed annually from park ecosystems through commercial and sport harvest of all types of fish and marine life, birds, animals and plants.

Threats

<u>From consumptive use</u>

GLBA -- GLBA Preserve - sport and subsistence hunting, fishing, and trapping is allowed. Commercial Fishing (outer coast, Dry Bay). Sport Fishing.

KLGO -- Hunting, fishing and trapping are all allowed within the park.

SITK -- NA

Comments on Threats

Management Concerns

<u>From consumptive use</u>

GLBA -- Lack of info on populations of species of traditional/cultural concerns: Bear, Mountain goats, and glaucous-winged gull.

KLGO -- Black and brown bear, beaver, marten, wolf, wolverine, mountain goat, moose, salmon?, dolly varden char. Hunting appears to be limiting ability of some species to colonize the park - especially moose and deer. May significantly lower population levels of fur-bearers as well. Limited info.

SITK – NA

Comments on Management Concerns

Monitoring Objectives

Consumptive use

Understand if human consumption of natural resources is adversely affecting SEAN ecosystem components.

Monitoring Questions

From migratory bird and egg harvest

- Have there been changes in the number of eggs and birds harvested in SEAN parks.

From commercial harvest of fish and invertebrates

- How are the numbers of commercially harvested marine organisms changing?
- How are the sizes of commercially harvested organisms changing?
- How is the bycatch of commercial harvest changing?

From moose, marten, bear harvest

- How are the numbers and sizes of harvested moose, marten and bear changing in and near SEAN parks?

From scoping meetings

- Are the current levels of resource harvest sustainable?
- What are the levels of consumptive use, both within and adjacent to the parks?
- Are the levels and patterns of consumptive use changing, both within and adjacent to the park?
- How do populations change in the absence of harvest?
- What is the movement of harvested species in and out of the parks?

Example of Measures

- Type and amount (numbers, weight) of what is being caught, hunted, harvested or gathered.
- Date that it was taken.

From migratory bird and egg harvest

- Counts of harvested eggs and birds.

From commercial harvest of fish and invertebrates

- Estimates of numbers, sizes, and bycatch from harvest reports and sample inspections

Consumptive use

From moose, marten and bear harvest

- Counts and size of harvested animals.

- Do not need a region-wide sampling effort; do a directed sampling effort in focused areas.

Possible Partners

Relevant Monitoring or Study

Comments

Crab pot lines are thought to be a major source of whale entanglement.

From commercial harvest of fish and invertebrates

Greg - Not a useful indicator of ecological conditions

Scott - Mostly for intrusive or degrading practices such as dredge fishery or weathervane scallop fishery

Sara - I think commercial and sport harvest of fish should be a single vital sign

From moose, marten and bear harvest

Greg - Not a good indicator; driven by politics and harvest philosophy as much as ecology

Greg - Not enough harvest

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**

Comments, Possible Partners or Threats from Scoping Workshops

- Need to consider what consumption of marine resources is occurring outside of the SEAN parks and how that consumption is affecting marine resources in the parks.
- ADFG data source for commercial and sport harvest data.
- Want quantity of sport and commercial harvest, population trends, age and size structure and numbers.
- How do we obtain bycatch data? May not be able to get that data from ADFG. This is very important, and for some species is more important than data on the harvested species. Don't discount sport (charter) fish harvest. Data so far shows that non-charter sport fishing in marine waters is pretty minimal in GLBA, with the exception

of Dungeness crab in Bartlett Cove. Note, however, that the recreation use could continue to grow and become more important.

- Marine mammal data sources: USFWS otter; NOAA harbor seals.
- Regional numbers and scale are important.
- Dry Bay - leave to ADF&G
- ADF&G good partner, source for harvest data.
- Use ADFG harvest data; ADFG and NPS data re: defense of life & property kills (bear); State fish and wildlife population data

EMF Level 1 - Human Use
EMF Level 2 - Visitor and Recreation Use
EMF Level 3 - Visitor usage

SEAN VITAL SIGN
HUMAN USES AND MODE OF ACCESS

Justification

One of the purposes of the monitoring program is to detect change in the health of park resources, and to determine whether that change is caused by anthropogenic or natural processes. Human use and mode of access is a primary and fundamental dataset against which change detection will be evaluated to determine whether it is induced by anthropogenic means.

The demand for a variety of human uses and access to SEAN parks is expected to increase over time.

Need data on all human users - all types of visitors; researchers; fishers, harvesters, and gatherers; and others.

Threats

<u>From visitor usage</u>

GLBA -- Threats from visitor usage are the increasing numbers of visitors on private and commercial vessel trips, backcountry visitors, kayak drop-offs, camp sites, pollutants, vessel wastewater discharges, and vegetation impacts. Increasing visitation is not under the direct control of Park managers despite planning processes (e.g. VQOR-EIS) due to political pressure from outside sources, as well as legal mandates arising from conveyance of Native allotments inside Park boundaries.

KLGO -- 3,000 people a year hike the entire Chilkoot Trail. Thousands more day hike along the lower portion of the trail each summer. 400,000 travel through the White Pass unit via the WP&YR. Several commercial operators (horse, bike, raft, hike) bring thousands into the Dyea area each summer. Visitation is high in the Dyea/Chilkoot Trail unit. 950,000 visitors to the Skagway Unit.

SITK -- SITK averages about 300,000 visitors a year that utilize just 50 acres of terrestrial habitat and 50 acres of intertidal zone. This concentrated use has the potential to degrade park habitats over time.

Human uses and mode of access

From terrestrial complex

KLGO -- Habitat fragmentation is a threat to the terrestrial complex.

From point-source human

GLBA -- Light pollution from NPS structures affects the night sky and may attract birds and moths. Campers may be a source of pollution. Marine debris from vessels is a source of pollution that can be ingested by marine animals or litter the beaches.

From non-point source human

GLBA -- Non-point source human impacts can include increasing numbers of backcountry visitors, kayak drop-offs, and camp sites.

KLGO -- Impacts from visitors in backcountry areas of the park. Surrounding land uses and development.

From coastal/oceanographic

SITK -- Human alterations and activity can alter the shoreline processes that would have direct and indirect effects on the SITK's intertidal zone.

From Threats in Access, when we were considering “estuarine communities” as a vital sign:

SITK -- Human-altered stream bed dynamics, floods, and a degraded stream ecosystem could negatively influence the estuary of the park where freshwater interacts with the ocean tidal cycle.

Comments on Threats

Management Concerns

From visitor usage

GLBA -- Development and use of native allotments adds to this threat because of legal mandates for providing access to inholdings and these are wild cards so it is difficult to predict what will happen. Along with air and water pollution, vessel based visitation has the potential to disturb marine and terrestrial wildlife, as well as threaten them with collision. Vegetation impacts and disturbance of shore-nesting birds will occur from camping.

Human uses and mode of access

KLGO -- KLGO is preparing a VERP for Dyea. Plans to increase visitation to backcountry, undisturbed areas of White Pass Unit. Visitation along Chilkoot Trail is controlled by Parks Canada limit of 50 hikers/day but increases are possible in shoulder season. Helicopter overflights also an issue.

SITK -- Little is known about the impacts SITK's concentrated visitation (300,000/yr) is having on park habitats.

From terrestrial complex

KLGO -- Development outside of the park could alter habitat connectivity, metapopulation dynamics, edge effects, migration/travel corridors, and mortality factors.

From point-source human

GLBA -- Concern related to point source light (see also noise concerns under soundscape) relates to primarily to degradation of visitor experience and preservation of wilderness values. There are also potential impacts to other wildlife. Marine debris on beaches as well as carcasses of animals that died from marine debris encounters will diminish visitor experience.

From non-point source human

GLBA -- Major management concerns with walk-in campground at Barlett Cove that provides land-based overnight accommodations.

From coastal/oceanographic

KLGO -- Increased development within the Taiya River watershed and recreational activities on the Dyea Flats could affect coastal processes and associated biota.

SITK -- Proposed developments such as a deep water dock for cruise ships to be built adjacent to the SITK boundary could alter shoreline processes including longshore drift and the deposition/erosional process. This could severely impact the park's intertidal zone.

From groundwater dynamics

SITK -- Human activities outside the park could have drastic impacts on the groundwater dynamics within the park.

From Management Concerns in Access, when we were considering “estuarine communities” as a vital sign:

KLGO -- The Taiya River estuary is one of a limited number of estuaries where eulachon breed in SE AK. Anything that impacts the estuary or its marine and riverine influences is a management concern for KLGO.

SITK -- A healthy estuary depends on a healthy and unaltered river system and its interaction with the ocean. Alterations in the stream channel and the banks outside and inside the park have caused drastic chances in erosion, flow, and other dynamics of the Indian River estuarine area.

Comments on Management Concerns

Monitoring Objectives

- Understand how park and preserve ecosystems are affected by local and regional human use (visitor, recreation and park research/ administrative activities).
- Understand how park and preserve ecosystems are affected by both point and non-point source activities.

Monitoring Questions

- How is the number of visitors changing in SEAN parks?
- How is the type of visitor use, timing of visits, and areas of use changing in SEAN parks?
- How are visitors accessing SEAN parks and where are modes of access changing?

<u>From scoping meetings</u>:

- How are human use numbers and activities changing and which resources are at risk?
- What are the frequency, distribution and intensity of fires? (KLGO)
- How is the type and volume of marine debris changing on park beaches?
- How frequently do seabird and marine mammal mortalities relate to ingestion of or entanglement in marine debris?

<u>From camp sites and drop-off points</u>

- Has there been a change in the frequency or intensity of use of camp sites and drop-off points?
- Has there been a change in the soil, vegetation, water quality or debris near frequently used camp sites and drop-off points?

Example of Measures

Need to do a comprehensive analysis on all uses and means of access.
Use data is already being collected. Measures include:

- Counts or estimates of different types of visitors.
- Counts of visitors at different entry points.
- Logs of park activities by park personnel, contractors, or researchers.
- Group size
- Area user is going
- Number, size, and type of transportation device (e.g. one 32' fishing vessel, four single kayaks, one 1000 foot cruise ship, one ATV, one 24' research vessel, one 4-seat floatplane, two Bell helicopters, etc.)
- Route to destination(s)
- Condition of route, if applicable
- Length of stay at each destination
- Miles of trails
- Need data on admin. & research vessels (data gap)

<u>From camp sites and drop-off points</u>

- Need number using camp sites and drop-off points
- Need surveys of soil compaction (% bare soil) and debris near camp sites and drop-off points

Possible Partners

Relevant Monitoring or Study

NPS job is to collect and analyze existing data.

Comments

ANILCA opened up floatplane landings in the parks; floatplanes require an entry permit in GLBA.

<u>From camp sites and drop-off points</u>

Greg - Camping pervasive enough that sites begin to become ecologically consequential; not so for KLGO

Scott -- may be more important for trampling etc on trail; unknown impacts on wildlife.

<u>From boating impacts</u>

GLBA is always going to be accessed by boats (cruise ships, private vessels, tour boats, kayaks). We don't know exactly what and where the impacts will be, especially since they are getting cleaner - could be hydrocarbons will become less a concern. Could be related sport fishing, or where they moor and what is disturbed, or lack of treated sewage? We should monitor the level of boating impact relative to the type of boats and what the potential impacts would be.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

Should permanent vessel moorings in GLBA be considered a point source? Park gets considerable pressure to install them. Other point sources could include discharge outfalls (e.g., wastewater treatment, fish processing plant).

- Could use a simple, relatively inexpensive protocol for monitoring beach debris, search for one in use at another location. Directly describes a Park management value.
- Annual survey, beach debris collection at natural collection areas, visitor survey cards, opportunistic observer opportunities.
- NMFS (and NPS GLBA for lower GB proper) old marine debris study on the outer coast.

- These are essential questions. Link to the results of ecological monitoring.
- Need to monitor disturbance levels and indicators, with links to demographic information.
- Sitka impact -- intertidal trampling.
- Issue: disturbance and displacement of marine mammals and birds (impacts nesting, rearing, molting).

- It was noted that the CAKN vital signs for this objective (how park resources are affected by non-point source human effects) are related to tracking the population of gateway and adjacent communities (e.g., Gustavus, Yakutat, Haines, Skagway, Sitka).
- Non-point source human effects are more important than point-source human effects.
- Use park data characterizing users; special use permits; administrative permits, concessionaire data.
- Monitor the human use that's causing the change AND monitor the monitoring resources potentially affected - conduct a paired study.
- One group talked a lot about whether wilderness was or was not included. A scientist shared that he attended a kayak symposium in Juneau about 10 years ago where, due to human impact on animals, Donald Lawrence proposed a system of anchored barges be used for overnights instead of camping onshore. This would lesson impacts to vegetation and wildlife including bear problems. He ventured that he had never spent a night onshore as a researcher on GLBA. When asked to show hands for those that would be willing to spend the night on an anchored barge during trips to GLBA, 5 out of 50 said yes. This suggested it is all about wilderness, not animals.

Human uses and mode of access

- This is an issue for KLGO: historically, fire is a major organizing feature of the KLGO ecosystem. Over the last 200 years, the entire KLGO system has burned, except for a few gulches and above 2,000 feet elevation. Also a factor in SITK.
- Discussion of whether fire suppression has had an impact on plant succession. This is a research question (KLGO is looking into this via repeat aerial photography), not a monitoring question for vital signs.

EMF Level 1 - Landscapes (Ecosystem Pattern and Processes)
EMF Level 2 - Landscape dynamics
EMF Level 3 - Land cover and use

SEAN VITAL SIGN
PLANT COMMUNITIES

Justification

Threats

From vegetation complex

GLBA -- The vital signs of interest here are rare vascular and non-vascular plants (per the ANHP list), along with general ecosystem-wide plant biodiversity. We are presently unaware of declines/changes in any of these (but we haven't really looked, either).

KLGO -- Due to its geographic position and unique climate, KLGO has a very diverse vascular and non-vascular flora. Lichen inventory will be conducted in 2007.

SITK – NA

From "sparsely vegetated"

GLBA -- The VS of interest here (for GLBA) is periglacial barrens (and the species that depend on them). This community type will almost certainly decline as low-elevation glaciers "ground out" and cease or slow their retreats. These young communities will cease to be exposed/produced as rapidly as natural plant succession proceeds, such that the communities will succeed to older communities having different habitat conditions that are less suitable to specialized species such as Kittlitz's murrelets and red-throated loons.

KLGO -- NA

SITK -- NA

From grassland/herbaceous

GLBA -- Loss of grasslands and herbaceous communities. Invasive species, recreation activities (camping); global warming; disease
SITK -- NA

KLGO -- Beach meadows and uplifted tidelands on the Dyea Flats are a unique habitat and limited type within KLGO. Several species of passerines breed in these meadows. Small mammals likely occur here in some abundance, attracting coyotes and raptors.

SITK -- NA

From forest/woodland

GLBA -- No response given.

KLGO -- Deciduous riparian forest is a habitat type that is considered limited in Southeast Alaska. Due to an active floodplain and frequent flooding (as well as periodic catastrophic glacial lake outburst floods), the Taiya Valley has extensive deciduous riparian forests (black cottonwood - Sitka spruce). This habitat is important for several species of breeding landbirds.

SITK -- NA

From non-point source human

GLBA -- Vegetation impacts could result from non-point source human activities.

From Threats in Access, when we were considering “estuarine communities” as a vital sign:

GLBA -- The potential VS of interest here is eelgrass beds. Eelgrass is rare in G.B. proper, and the most likely threat here is petroleum spills.

Comments on Threats

Management Concerns

From vegetation complex

GLBA -- Rare plants, because they may be already "living on the edge" (that's why they're rare), may be sensitive indicators of environmental change. Therefore, it is important to understand the status of their populations, and to monitor trends in their distribution/relative abundance. Currently we have virtually no information on status or trends. We do have a good baseline for basic vascular plant biodiversity (species richness) courtesy of the Vascular Plants Biological Inventory, but no plans to monitor it. GLBA's enabling legislation strongly suggests that long-term monitoring may be appropriate because it recognizes the value of studying changing vegetation associated with glacial retreat and landscape development. GLBA reports to the following GPRA Goals that might have relevance to this VS: Ia01C (Land Health - Wetlands), Ia1D (Land Health - Riparian), Ia1E (Land Health - Upland), and Ia02B (Other Species of Concern, without park mgmt. objectives).

KLGO -- Changing climate, invasive species, herbivore immigrations, and air pollutants may have significant effects on park flora. Species richness and rare species may be altered by these changing drivers.

SITK -- NA

From "sparsely vegetated"

GLBA -- This process of landscape evolution is in this case natural, predictable, and inevitable. The big issues for management are 1) ensuring that the drivers are indeed natural ones (not anthropogenic), and 2) accepting the potential loss of some obligate species (or at least substantial declines in local abundance) or, alternatively, taking management action to preserve diversity/relative abundance potentially through active habitat manipulation. GLBA reports to GPRA Goal Ia1E (Land Health - Upland) that might have relevance to this VS.

KLGO – NA

SITK -- NA

From grassland/herbaceous

GLBA -- Increasing abundance and distribution of invasive species. Lack of baseline information addressing "current condition" and predicting "future condition". Lack of inventory data (species of management concern Where are they? Populations? Natural versus anthropogenic causes. Lack of info to detect external and internal threats. Identifying minimum and maximum ranges of variability. Can we do this? Modeling efforts. What steps do we need to take to more effectively protect the grassland/herbaceous communities from external and internal threats.

KLGO -- Impacts to beach meadows from OHV use. Removal of driftwood for firewood. Invasive species.

SITK -- NA

From forest/woodland
GLBA -- No response for forest woodland.

KLGO -- As glaciers retreat and floodplain dynamics change through time, large-scale disturbance patterns in the Taiya River floodplain may be altered. The cottonwood forest is gradually succeeding to Sitka spruce and over time, habitat suitability for deciduous riparian forest associated species may decrease.

SITK -- NA

From Management Concerns in Access, when we were considering “estuarine communities” as a vital sign:

GLBA -- Eelgrass is known to be important to certain invertebrates and fishes as preferred nursery/rearing habitat. This community type is relatively rare in GLBA.

Distribution and eelgrass patch dynamics are poorly known within the park. GLBA reports to GPRA Goal Ia1F (Land Health - Marine and Coastal) that might have relevance to this VS.

Comments on Management Concerns

Monitoring Objectives

To understand the range and variation of select plant communities in response to natural disturbance, so we can distinguish anthropogenic induced disturbance.

Monitoring Questions

- How is vegetation type, stand structure and composition changing across the landscape over time, in response to changes in landscape/terrain?

Example of Measures

- Plant composition and structure for select areas or assemblages. (What is there, how much is there, where is it)
- Measure biodiversity - specifically species types and densities, evenness of diversity and how this changes
- Age and size structure of woody plants in selected vegetation types
- Species composition of selected vegetation types (e.g., riparian vegetation, yellow cedar, or similar old growth community)
- Rare vascular and non-vascular plants

<u>From deciduous riparian forests</u>

- Species composition in permanent plots or along transects.
- Tree sizes or ages from permanent plots or along transects.

<u>From pro-glacial barrens at risk</u>

- Plant species composition of pro-glacial barrens communities
- Animal species using pro-glacial barren communities

<u>From rare vascular/non-vascular plants</u>

- Census results for target species
- Measures of encroachment on known populations of target species.

<u>From floodplain dynamics</u>

- Floodplain (including riparian) vegetation maps.

From eelgrass beds

- Location of eelgrass beds.
- Spatial extent of eelgrass beds.
- Density and biomass of eelgrass beds.

From yellow cedar

- Land cover of yellow cedar forest types.
- Tree density in yellow cedar stands.
- Growth rate of yellow cedar trees.
- Rates of mortality and recruitment.

Consider mapping at Dry Bay, Bartlett Cove, Falls Creek.
Focal types may include pro-glacial barrens, eelgrass.

When designing protocol and working on sampling design, think about selecting plots that: 1) could capture exotic plant data, 2) are communities prone to invasion, 3) include "training plots," 4) are areas that need to be ground-truthed to improve land cover maps, 5) are where change is expected, and 6) include some permanent and some temporary plots.

Plant succession is occurring at the same time that other change is occurring, which confounds our understanding. Change we observe may or may not be induced by natural causes. To help sort this out, pick some plots that are likely to change and some that are not likely to change to sample.

The landcover map tells you where to go, and then plant community investigations and mapping are needed to ground truth and provide detail.

There are linkages among this vital sign (plant communities) and biodiversity, invasive plants, phenology, herbivores. Keep this in mind during protocol development; this may be a case where we can do many things with one protocol.

Possible Partners

Relevant Monitoring or Study

KLGO has 24 plots where they measure breeding birds every year; their protocol may include some of the measures listed here.

Comments

This vital sign is like a tool to get information about other vital signs.

Plant community and structure is a more detailed, dynamic, smaller scale analysis than

land cover and land use. It includes community changes over time, mortality, recruitment, and other things that are lost in a land cover map. Plant community and structure analysis in select plots or areas might be done to ground truth land cover maps, to focus on areas where we suspect we will detect change, or to lengthen the baseline by redoing areas done 10-20 years ago. Identify community types or areas where we would focus this work. What are the specific environments where plant composition is critical as an indicator of change (alpine? pro-glacial barrens? wetlands? forest fuels in areas w/ fires?) All three of the other park networks rated this highly. Setting up permanent plots that you monitor long term is a hugely important dataset to detect change and as an indictor of forest health.

To check effects of global warming, make a list of all the species in the park and look at their ranges, say which communities have the largest share at the southern margins of their range. Then figure out protocol for watching maybe one or two of those communities. But, unless you define what changing phenomenon you are trying to catch, it's a 'pig in a poke,' extremely general question.

It is noted that lichens are a food source for many animals.
Non-vascular plants are important in SITK, their diversity could be a vital sign.
Nutrients are released when soils are disturbed.

<u>From plant communities</u>

Scott -- Natural vegetation changes in Sitka may be much lower than changes in GLBA, so differences in sensitivity as such, IF we aren't including invasive plants.

<u>From rare vascular/non-vascular plants</u>

Greg -- Rare vascular/non-vascular plants are a great indicator, but ecologically minor.

<u>From eelgrass beds</u>

May be a good indicator of change for SITK

<u>From yellow cedar</u>

Yellow cedar is typical of late successional communities, systems that are more at risk. It may be a 'mine canary' for older systems. Or, is there something else to monitor that gives information about late successional communities?
Potentially declining only in GLBA.

Yellow cedar is now assumed to be an early indicator of a particular kind of climate change. Apparently when there is less snow and the snow cover has a shorter season, the roots get cold and the trees die. It might be interesting to monitor yellow cedar but not sure how important it is really. Treeline is an excellent indicator of past regional climate

change, but so are thermometers.

Greg - may be more important than I'm indicating.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- Ground truth plots, long-term plot establishment.
- Hydrology drives vegetation if landscape doesn't interfere.
- Flow regime is a driver of riparian vegetation. Riparian vegetation is at the intersection of hydrology and the terrestrial environment.
- Note that AKNHP is producing a classification of all plant communities in the park, and in association with Landfire doing the same for the Tongass. These lists will be ranked for species at risk based on sensitivity to disturbance and rarity. A scientist notes that one must worry about plants that can be easily changed by human activities, whether they are rare or not.
- Monitor bounds of deciduous riparian forest (low elevation, low slope). This is a forest type that is particularly productive. Many more insects, which attract birds for breeding. Relatively uncommon throughout Southeast Alaska. Common for GLBA, but that is changing with vegetative succession.
- Yellow cedar is added to mid-elevation list: It is declining in southern and mid-Southeast Alaska, but not declining in northern SE Alaska (not present in KLGO). It is a long-lived, slow reproducing species in the mid-elevation, and could be a good indicator of change. USFS is currently doing a lot of research into yellow cedar decline.
- Shrub-line, and possibly treeline, is moving up in elevation, although this has not been measured. Evidence that this is true for alder, also reasonable evidence for spruce and hemlock. Could be in relation to localized climate change (e.g., general retreat of glaciers affects microclimates), or changes in hydrology, dewatering, less snow, drying out. (Connects to suggestion, under weather & climate section, to monitor snow pack longevity and distribution of snow beds.)

EMF Level 1 - Landscapes (Ecosystem Pattern and Processes)
EMF Level 2 - Landscape dynamics
EMF Level 3 - Land cover and use

SEAN VITAL SIGN
LANDCOVER AND LAND USE (includes freshwater bodies)

Justification

Vegetation and community types are both responding variables and controllers of other variables. Land use immediately adjacent to and in park inholdings is important in all three parks. In SITK and KLGO it will drive some change in park ecosystems; in KLGO adjacent and land use will cause habitat fragmentation in the park.

Land cover includes (but not limited to) landcover and land use such as beach meadows, deciduous riparian forest, shrub and treeline, pro-glacial barrens, freshwater bodies. Also includes physical and geomorphic processes such as (but not limited to) snow cover and depth, isostatic rebound, periglacial landforms, coastal and riparian geomorphology.

Threats

<u>From landcover and use</u>

GLBA -- Intensively managed areas that exist outside the boundaries of the park (fragmentation from logging and road building). Pollution. Climate change. Changes in critical habitat, connectivity, and pathways of migration. Insect outbreaks. Loss of keystone species.

KLGO -- Land use changes at the watershed scale could have significant impacts on park natural resources.

SITK -- Indian River basin developments have a potential to impact park aquatic and terrestrial ecosystems. Landcover and use changes rapidly in the area do to the high demand for suitable land for development.

Comments on Threats

Management Concerns

<u>From landcover and use</u>

GLBA -- Defining the current condition of the landscape. What should the landscape of the future look like? The role GLBA landscape as a core protected area (affects of climate change). How to maintain biological diversity including the health and integrity of entire ecosystem. Understanding how the structure of ecosystems and landscapes

influence key processes. Understanding the rate at which threats such as wind, insects, and disease may have on the landscape. Understanding the most threatening disturbances. Which landscapes are most fragile/susceptible to change? Which landscapes are not?

KLGO -- Development within park watersheds could result in increased fragmentation, habitat loss, invasive species, disturbance, noise, air/water pollution, human-triggered fires, etc.

SITK -- The park needs to continually update landcover and use maps and aerial photos of the Indian River Basin to assess the potential impacts that may occur to the Indian River water quality and hydrology.

From terrestrial complex

KLGO -- Distribution of terrestrial landcover types and vegetation associations directly relates to the distribution and abundance of wildlife populations.

Comments on Management Concerns

Monitoring Objectives

Understand how the pattern and distribution of freshwater features is changing across the landscape (land cover).

Monitoring Questions

From land cover

- How has the proportion of land cover types changed in SEAN parks?
- How has the distribution of major land cover types changed in SEAN parks?
- How has the number of units (patches) of land cover types changed in SEAN parks?
- Has the vegetation composition and structure within major landcover types changed in SEAN parks?

From extreme disturbance events

- Is the frequency of extreme disturbance events in or near SEAN parks changing?
- Is the severity of extreme disturbance events in or near SEAN parks changing?

From deciduous riparian forests

- Have there been changes within the parks in the aerial extent of deciduous riparian forest?
- Have there been changes within the parks in the species composition of deciduous riparian forest?

- Have there been changes within the parks in the age- or size-structure of deciduous riparian forest?

From pro-glacial barrens at risk

- What is the distribution and area of pro-glacial barrens communities?
- What is the species composition or pro-glacial barrens communities?
- Is the rate of loss of pro-glacial barrens communities a threat to their existence or to the existence of key community members?

From shrub/treeline communities

- Have there been changes in the elevation of alpine treeline or shrubline?
- Is the mosaic of alpine and subalpine vegetation patches changing?

From freshwater bodies

- Are there long-term trends in means or seasonal patterns of lake level or lake extent?

From glacier extent and dynamics

- What percent of each park is covered by ice and snow?

Example of Measures

From landcover

- Area of selected landcover type
- Distribution and number of individual units of each land cover type
- Glacial extent
- Change in extent and distribution of vegetative community types

From extreme disturbance events

- Date, intensity and size of individual disturbance events
- Frequency of events from long term record

From deciduous riparian forests

- Land cover of deciduous riparian forest types

From pro-glacial barrens at risk

- Distribution of pro-glacial barrens communities

From shrub/treeline communities

- Land cover delineating the treeline or shrubline
- Land cover of alpine and subalpine vegetation types

From freshwater bodies

- Annual time course of lake level and lake extent

From glacier extent

- Aerial mapping documentation of glacial extent (need to see whole profile)
- Extent of ice accumulation
- Number and size of icebergs

Want park-wide and watershed-wide coarse-scale landcover map, with finer-scale maps for selected areas.

This vital sign crosses over with landform dynamics in that both care about and document extreme disturbance effects.

Data will be gathered with remotely sensed maps; a landcover map will be created, and it is a tool. This gives information on everything from glacial extent to various vegetation communities to size of lakes to documenting extreme disturbance events, etc. These are all coarser data/categories - plant communities and structure mapping will give you a finer level of data. A landcover map captures what you can see from the air. Note that beach meadows and tree and shrub line and riparian forests are all dynamic and landcover will show the dynamism. Also, they are all either rare or the treeline is an indicator.

For landcover, 1:250,000 scale mapping doesn't tell anything; at KLGO and Sitka, use 1:12,000 mapping. Land use is important KLGO and SITK, because there's going to be tremendous development in Dyea and Skagway over the next 20 years that will cause habitat fragmentation issues in the park. In SITK park fragmentation is NOT a concern; it is outside of the park though.

Possible Partners

Relevant Monitoring or Study

Each SEAN park has some type of land cover map, as a starting point:

- GLBA has a photo-interpretation map (not a satellite map) at a 1:63,360 scale for its 300,000 acres, based on a 1996 photograph. Smallest unit is 20 acres. They also have more recent imagery available.
- KLGO has a plant association map from 1990(?) USFS aerial photos for its 13,000 acres. It identifies 7 plant associations. This may be okay for a basic landcover map,

but for long term monitoring something much more accurate with more than 7 plant associations is needed. NPS did random stratification and found its accuracy on the ground to be limited. KLGO also has very high resolution DOQs 2003 digital imagery for the park, and LIDAR with elevation data too.

- SITK has an ecological units map, produced by USFS using infrared (IR) imagery at 1:12,000 scale. The imagery is from the late 1990's. It identifies 10-11 plant associations and identifies landforms.

Comments

This is a biologic map, the landform dynamics map (vital sign #5) is a physical map.

Landcover mapping and landscape dynamics are identified as the top priority vital sign in KLGO; can't do anything without a good land cover map.

If land cover map scale is too coarse, it simply does not have the accuracy needed for a monitoring program. Too refine it for a monitoring program, need to identify the places for which you need more detailed data, then do plan community mapping (a different vital sign) for these areas.

There is a spectrum: from land cover maps, to flying areas with a digital camera, to on-the-ground plant community (structure and composition) mapping. BLM and USFS use digital photography now; don't know about USGS.

This is data from a point in time; it is what a satellite can see.

<u>From landcover</u>

Greg -- a 'biggie;' however, as indicator of some things, changes may be too slow or small to detected

<u>From extreme disturbance events</u>

Greg -- would be a 'biggie' if not essentially unmonitorable due to infrequency and unpredictability

Dan -- Although large area of wilderness, but magnitude and frequency of events(landslides, floods, earthquakes, storms) may have significant consequence

Dan -- Glacier outburst floods may have severe impact on flood plain ecosystems

<u>From deciduous riparian forests</u>

Greg -- not good indicators, as are impinged upon by many things

Dan -- Land cover mapping can be useful to assess deciduous forest distribution and done over longer time periods (15 - 25 years?)

Scott -- just seems that the dynamic nature of riparian *(Note, appears to be incomplete comment)*

<u>From pro-glacial barrens at risk</u>

Greg -- excellent indicator of change, but ecologically minor

Scott -- The 'at risk' implies management emphasis

Sara -- I couldn't see these as controllers, indicators, or linkages to network ecosystems. However, they are of interest in and of t *(NOTE incomplete comment)*

Data will be gathered with remotely sensed maps, a landcover map will be created, and it is a tool. This gives information on everything from glacial extent to various vegetation communities to size of lakes to documenting extreme disturbance events, etc. These are all coarser data/categories - plant communities and structure mapping will give you a finer level of data. A landcover map captures what you can see from the air. Note that beach meadows and tree and shrub line and riparian forests are all dynamic and landcover will show the dynamism. Also, they are all either rare or the treeline is an indicator.
For landcover, 1:250,000 scale mapping doesn't tell anything at KLGO and Sitka, use 1:24,000 1:12,000 mapping. Land use is important KLGO and SITK because there's going to be tremendous development in Dyea and Skagway over the next 20 years that will cause habitat fragmentation issues in the park. In SITK fragmentation is NOT a concern, it is all outside of the park though.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

Need to finish the benthic map for GLBA. Fill data gap in benthic mapping (between greater depth and shallow benthic map, there is an unmapped “gap”).

- Aerial photos best source to track landscape changes.
- Most effects on animal species from landscape changes would be indirect, through changes in plant communities/habitats. However, some might be direct, such as uplift draining areas that were breeding ponds for western toads. Or, mass wasting changing a route of a game trail.
- We know that we’re losing some periglacial habitat and vegetation communities. Will lose some guilds and species that live there.
- Use remote sensing as primary tool for monitoring. +T31

EMF Level 1 - Landscapes (Ecosystem Pattern and Processes)
EMF Level 2 - Landscape dynamics
EMF Level 3 - Land cover and use

SEAN VITAL SIGN
PHENOLOGY

Justification

Phenology is both a driver and a recipient. It is a result of global weather and climate, tectonics and human activity, and it drives productivity and the timing thereof in the marine and terrestrial ecosystems.

Threats

Comments on Threats

Management Concerns

Comments on Management Concerns

Monitoring Objectives

Monitoring Questions

- Has there been a shift in the timing of critical seasonal events in SEAN parks?
- Has there been a change in the length of the growing season in SEAN parks?
- Has there been a change in the time of migrational arrivals or departures for focal species in SEAN parks?

Example of Measures

- Times of vegetation green-up, blooming, ripening, and leaf fall.
- Times of migrational arrivals and departures.
- Times of reproductive behavior.

Possible Partners

Relevant Monitoring or Study

Comments

Phenology and its direct effect to the ecosystem is manifest in riparian areas where it is a big driver of biomass. In the terrestrial system, phenology doesn't seem as important?

Greg -- a 'biggie' as it integrates general climate

Dan -- Perhaps can be monitored through climate and weather data acquisition?

Scott -- phenology likely linked to climate changes or snow cover, etc., which should thus be more important than phenology

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- Changes in productivity and phenology will effect changes in flora and fauna species and in biological communities. If you're going to model or monitor the potential for certain species that haven't occurred in the parks to date, which species will depend on the length of the growing season? hat information may also be relevant to invasive species of concern, as well as species that are native.
- Source of remote sensing data is NDVI – infer productivity or phenology from greenness (looking at different spectral bands).
- USGS data (contact Dave Douglas).
- NPS developing national methodologies for monitoring phenology (per Meg).
- Leverage SEAN network funding to enlist universities to do work on this issue. Get the experts in this to give SEAN a good picture of what is going to happen with park productivity and seasonality, and what to monitor. There are places in GLBA that are going to green up, that were never green before.

EMF Level 1 - Landscapes (Ecosystem Pattern and Processes)
EMF Level 2 - Soundscape
EMF Level 3 - Soundscape

SEAN VITAL SIGN
AIRBORNE SOUND

Justification

The soundscape is an extremely important attribute in SEAN parks. Impact of airborne sounds on goats, nesting birds and other animals is at issue, in addition to impact on social and human enjoyment. Soundscape is a park management issue - if there were no remote areas with only natural sound in 20 years in SEAN and KLGO parks, park management have failed.

Threats

<u>From soundscape</u>

GLBA -- Airborne noise from unrestricted numbers of aircraft overflights over wilderness areas diminishes the experience of campers seeking wilderness experience. Airborne noise from aircraft and vessels masks the natural sounds in backcountry areas. Airborne noise from Bartlett Cove facilities and activities masks the natural sounds in front-country and nearby backcountry in the Beardslee Islands. Increasing vessel traffic generates airborne vessel noise that can disturb terrestrial wildlife and wilderness users.

KLGO -- Helicopters, fixed wing aircraft, trains, vehicle traffic, visitors, and boats impact KLGO's soundscape.

SITK -- Noise from ships and boats, vehicle highway traffic, float planes, jets, shooting ranges, etc. make SITK a very noisy place.

Comments on Threats

Management Concerns

<u>From soundscape</u>

GLBA -- Wilderness experiences of visitors are diminished by noise pollution in backcountry (and
front country) settings. GLBA lacks any real information on airborne soundscapes with which to judge the severity of threats. Changes in wildlife distribution and behavior resulting from diminished airborne soundscapes are nearly impossible to measure.

KLGO -- Human generated noise impacts the visitor's experience and disturbs park wildlife.

SITK -- Technical assistance was requested to abate human noise in SITK. It is difficult to find a place in the park that is free from human-generated noise.

Comments on Management Concerns

Monitoring Objectives

Understand how the terrestrial ecosystem responds to human generated sound.

Monitoring Questions

- Is the level, duration, frequency, location, or type of airborne sound changing in SEAN parks?
- Has there been a change in the response of park visitors or wildlife to airborne sound?
- Do creatures that gather food by streams depend on the soundscape to ensure food gathering success?

Example of Measures

- Level, frequency, location, type of sound, and duration of human-caused airborne sounds at focal locations.
- Reports of visitor response to sound.
- Observations of wildlife response to sound.

Possible Partners

Relevant Monitoring or Study

Comments

Greg -- sound probably doesn't control much, and is not a sensitive indicator, nor is it linked to a lot of important phenomena. Land critters acclimate well to sound, generally. Same for all parks

Greg -- will assume: KLGO & SITK are more trammeled than GLBA and therefore not as sensitive to noise pollution

Dan -- KLGO may be impacted in future as road from Juneau is constructed; may be useful as evidence of human impacts

Dan -- Given the setting of Sitka, this may be important sign of human impacts or potential for human impacts

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**
✓ **SITK**

Comments, Possible Partners or Threats from Scoping Workshops

- Above-water sound could play into bear management plan. How does human sound from drop-off sites and camping areas affect bears. Animal behavior can't be a vital sign for this though, it is too difficult to make the connection to above-water sound.
- If dose-response (re: goats for example) is issue, then jet noise does not matter; if wilderness is issue, then all sound matters.
- If studying goats, adopt- don't invent protocols; they are available.
- This is a research question, not a monitoring question applicable on a landscape scale. Or, perhaps targeted monitoring program in specific areas where noise is occurring next to sensitive terrestrial populations (e.g., helicopter overflight paths in mountain goat habitat).
- Monitoring above-water sound could be very expensive because areas are so large, must be selective.

EMF Level 1 - Landscapes (Ecosystem Pattern and Processes)
EMF Level 2 - Soundscape
EMF Level 3 - Soundscape

SEAN VITAL SIGN
UNDERWATER SOUND

Justification

GLBA has been and will always be accessed and traversed by a variety of vessels generating underwater sound. Vessel noise dominates underwater sound where it is being monitored. Underwater sound is a measure being used for cruise ship management. GLBA has a six year baseline dataset on ambient underwater sound taken from a hydrophone in Bartlett Cove, using an already established protocol. Comparable baseline datasets are rare. A National Academy of Sciences panel and NOAA are developing a national centralized effort on underwater sound. GLBA needs to expand its program, have some sites farther up bay. The effect of underwater sound on anything other than marine mammals is unknown.

Threats

<u>From soundscape</u>

GLBA -- Underwater noise from vessels (increasing in size and in number) generates noise that masks natural underwater sounds. Underwater vessel noise has the potential to result in behavioral change, masking of communication signals, temporary or permanent hearing loss in a variety of marine species including endangered whales and other biota at risk such as harbor seals.

KLGO -- Helicopters, fixed wing aircraft, trains, vehicle traffic, visitors, and boats impact KLGO's soundscape.

SITK -- Noise from ships and boats, vehicle highway traffic, float planes, jets, shooting ranges, etc. make SITK a very noisy place.

Comments on Threats

<u>From soundscape</u>

GLBA -- From Marine workshop: Underwater: What does the bay sound signature look like during the presence of vessels of different types (cruise ships versus small vessels)? What does the sound signature look like without vessels? What percentage of time will the bay's signature be altered by vessel noise, and is this percentage greater when ships travel at different speeds? Are whale vocalizations different during this noisy period and if so, what type of vocalizations are they (stress, contact attempts with others,

navigational attempts)? Are the percentages of different vocalizations altered in the presence of large ships? From VQOR: Information on the presence and extent of 'acoustic shadows' in front of cruise ships, and the possible role of these shadows in whale vessel collisions is needed to determine the optimal operating requirements for cruise ships in Glacier Bay. A better estimate of acoustic output of private and commercial vessels smaller than cruise ships is needed to estimate the distances at which they influence the underwater environment. A better estimate of acoustic output of cruise ships using new propulsion technology is needed to estimate the distances at which they influence the underwater environment.

Management Concerns

<u>From soundscape</u>

GLBA -- Background noise in the underwater soundscape may play a role in whale confusion that leads to ship strikes. Changes in wildlife distribution and behavior resulting from diminished underwater soundscapes are nearly impossible to measure. GLBA lacks underwater soundscape information in all areas except lower Glacier Bay. Diversity of private, vessel characteristics makes it difficult to choose a representative sound signature necessary to modeling their effects. New propulsion technologies in cruise ships necessitate continuous updating of sound signature information, needed for modeling their acoustic effects on soundscape and whales. It is unknown whether there are side-effects of decreasing ship speed (which would decrease ship loudness), such as decreased fuel efficiency, increased stack emissions, increased duration, that would make speed limits a bad idea.

KLGO -- Human generated noise impacts the visitor's experience and disturbs park wildlife.

SITK -- Technical assistance was requested to abate human noise in SITK. It is difficult to find a place in the park that is free from human-generated noise.

Comments on Management Concerns

Monitoring Objectives

Understand how the marine ecosystem responds to human generated sound.

Monitoring Questions

- Is the magnitude, durations, frequencies, locations or types of underwater sound changing in SEAN park waters?
- Is underwater sound masking the ability of underwater animals to find each other, breed, forage?
- Are there detrimental health effects?

- Does underwater sound effect fish disbursement to such an extent that it would make it hard for prey species to get food?

Example of Measures

- Magnitude, durations, frequencies, locations and types of sound

Possible Partners

Relevant Monitoring or Study

Comments

To date, there are no acoustic standards for unhealthy underwater sound for marine mammals.

Scott - A better indicator is the number and type of boats and their sound output rather than monitoring sound per se…

Chris G -- SITK has threats and management concerns entered, but SITK is not "checked" for this resource.

Parks Where Vital Sign will be Monitored
✓ **GLBA**
✓ **KLGO**

Comments, Possible Partners or Threats from Scoping Workshops

- GLBA - permanent (seasonal) underwater monitoring stations.
- SITK- community noise factor, monitoring around Indian River mouth?
- Important research question. Need to research cause and effect.
- Install an upbay GLBA station to complement the Bartlett Cove station?
- GLBA - USGS survey data.