

Protocol Development Summaries for the First 18 Indicators
Scheduled for Monitoring in SFAN
(V2.04 Last Update 5/29/07)

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Protocol Development Summary

Weather and Climate (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: GOGA, PINN, PORE, JOMU

Justification/Issues being addressed:

The Weather/Climate vital sign is ranked first among all of the potential vital signs evaluated by the SFAN. Knowledge about weather and climate is critical because they affect not just geophysical and biological resources but ecosystem drivers and processes. Key reasons for monitoring weather and climate in network parks are because the effects can be long-lasting on (1) plant and animal populations, some of which are listed as endangered or threatened species, (2) on air and water quality, and (3) on drought and flood cycles, fires, mass wasting and other catastrophic events. Long-term weather data can also contribute to the understanding of global climate change and its effects on Network ecosystems.

Nearly all of the Earth's biological activity occurs in the lowest part of the atmosphere. Since the meteorological conditions in this layer affect the chemical and biological processes taking place on the earth's surface, monitoring these conditions is important for environmental research. It is a major ecosystem driver, affecting all other ecosystem indicators in the SFAN conceptual model. Though our ability to "manage" weather and climate is limited (if not non-existent), it is an essential indicator for the long-term monitoring plan because its affects are short-term and long-term. An understanding of long-term climate trends and weather cycles is critical to understanding ecosystem processes and function.

Measurements of temperature and precipitation will provide information on the primary driver of an ecosystem that in turn affects all other components being monitored within the program. Measurements of wind speed, humidity, dew point, fog drip, barometric pressure, and soil temperature are standard measurements that provide information on the localized climate.

Weather data are useful for a variety of research projects including vegetation studies, avian monitoring, fire ecology, as well as management issues such as building specifications, aviation, and safety. Data will also be linked to analysis of virtually all other vital signs monitored by the San Francisco Bay Area Network.

Monitoring Questions to be addressed by the protocol:

- How are climate and weather changing over time?
- How do weather patterns vary across the network?
- What are the maximum and minimum rainfall amounts in a given year?

Specific Monitoring objectives are:

- Determine variability and long-term trends in climate through daily, monthly and annual summaries of selected weather parameters (temperature and precipitation) through fully instrumented and automated sites placed in or near the parks at representative areas.
- Record long-term trends in secondary climate drivers such as wind speed, humidity, dew point, fog drip, barometric pressure, and soil temperature.

Basic Approach:

The network has operated up to 12 full weather stations and six individual rain gauges. Some are associated with a stream monitoring station. Many of these stations have deteriorated to the point that they are no longer operational or are not collecting accurate data. Data management issues have also been a problem, many data record gaps exist within each monitoring stations database. New stations are being established at PORE and PINN through the Western Regional Climate Center.

A draft protocol has been developed by Herynk et al. (2006). The draft includes 1. detailed descriptions of NPS operated weather stations, 2. a full list of weather stations within a 50 mile radius of the parks, 2. identifies procedures to access data from NOAA and others data stations, 3. outlines processes for archiving data. A database has been developed as part of the protocol which could be used to store weather data.

Given the existence of weather stations throughout the region, network priorities are not to maintain weather stations. Instead, the focus will be to revise the draft protocol into a document that outlines how to access climate information including: 1. weather data and summaries and 2. long-term climate change data and summaries. This document will become an appendix to the networks Data Management Plan. The document how to access:

Principal Investigators and NPS Lead:

TBD.

References

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Protocol Development Summary

Invasive Species (early detection) (Updated 12/15/06; V2.04)

Parks where protocol will be implemented:

FOPO, GOGA, JOMU, MUWO, PINN, PORE, PRES

Justification/Issues being addressed:

Invasive species including plants and animals ranked second in the prioritized list of vital signs to be monitored for ecosystem changes and trends. The initial focus of protocol development is on the early detection of invasive terrestrial plant species to identify new species or populations at the establishment stage, when they are most cost-effective to treat (e.g. Rejmanek and Pitcairn 2002). This protocol provides information that can be used immediately by park managers to target new or expanding infestations. The data can also track long-term infestation patterns and trends. Invasive aquatic plant and animal species including invertebrates will be considered in the future as funding becomes available.

This protocol will build on and standardize efforts already in place in many parks including detection programs for finding invasive species with the assistance of park staff and volunteers. The protocol will outline methodologies that can be used as an opportunistic strategy with minimal staff in the field to a full volunteer/staff program with targeted and systematic efforts based on location, seasonality, ground-truthing and removal in appropriate instances. The protocol in development by SFAN will also be flexible in order to include future techniques and sampling strategies designed by USGS or other Networks working on early detection monitoring. The SFAN protocol is expected to be an exportable example of a volunteer-based early detection program.

Trend monitoring will be closely tied to plant community change monitoring; monitoring questions are not included here.

Monitoring questions to be addressed by the protocol:

1. Where are new populations of invasive plant species becoming established in SFAN parks?
2. What are the main corridors and predictors for invasive species establishment?
3. Are invasive species spreading into sensitive or critical park habitat?

Specific monitoring objectives for this indicator are:

1. Develop and maintain a list of target species that do not currently occur in the parks, occur in localized areas of parks, or are extremely rare, but that would cause major ecological or economic problems if they were to become established in SFAN parks.

2. Rank SFAN subwatersheds by management priority, risk, and current infestation level to develop priority list. Inventory all public roads and trails in the top 25% of sites annually, the next 50% of sites biennially, and the remaining 25% within 5 years (55% of all subwatersheds visited each year) noting presence and absence of priority weed species. Use visual assessment and GPS technology to detect and accurately map incipient populations of the top-priority plant species on the SFAN Invasive Plant list. Monitoring and mapping will be conducted by staff, trained volunteers and interns using the Weed Information Management System (WIMS) platform. [Revisit schedule may have to be re-evaluated based on search time from test; see also Harris et al. 2001.]
3. Every 5 years, evaluate invasive plant monitoring and mapping data collected to determine the primary pathways and predictive factors leading to new invasions in the park. Use this data to refine subwatershed rankings for search priority. Identify possible management actions to prevent new infestations.

Basic Approach:

The first priority of early detection of invasive species will be to generate lists of potentially invasive species throughout the network. The second priority is to rank subwatersheds by management priority, risk, and current infestation level in order to inform survey effort. The third priority is to generate life history information (including phenologies) for priority species in order to identify potential pathways and habitats prone to invasion.

Survey efforts will focus on the top 25% of subwatershed annually, the next 50% of subwatersheds biennially, and the remaining 25% within 5 years (55% of all subwatersheds visited each year) noting presence and absence of priority weed species. Monitoring will be conducted by trained volunteers and interns, with quality checks and additional surveys by staff. Qualitative searching is the most efficient and appropriate for early detection (Elzinga et al. 1998; Dewey and Anderson 2004), and will be supported by quantitative infestation data and status/trends monitoring to feed back into spread (prevention) models. Every 5 years, data will be analyzed to evaluate the primary pathways and predictive factors leading to new invasions in the park. The data will be used to refine subwatershed rankings for search priority and to identify possible management actions to prevent new infestations.

In addition, efforts will be made to standardize data collection, data analysis, reporting, and archiving. The overall goal is to develop different levels of intensity in early detection monitoring so that each Network park can use what is appropriate given staffing levels, volunteer interests, and the need to prevent species from establishing in especially sensitive areas (e.g. areas likely to be invaded or areas with rare or endangered species; Owen 1998). The protocols will include “passive” sampling by visitors, rangers, maintenance staff, and other field staff as well as standard operating procedures for a more intensive “directed sampling” effort using natural resource staff and trained volunteers.

Frequency:
Annually

Timing:

There is the potential for year-round sampling depending on focal species, availability of staff, outside funding and volunteer interest. The most effective time for detection depends on plant phenology, but is often February–July.

Principal Investigators and NPS Lead:

Andrea Williams, Natural Resource Specialist, 415-331-0639.

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Protocol Development Summary

Freshwater Quality (Updated 12/15/06; V2.04)

Parks Where Protocol will be Implemented:

GOGA, JOMU, MUWO, PINN, PORE

Justification/Issues being addressed:

Freshwater Quality was ranked 3rd among all of the potential vital signs evaluated by the SFAN. The SFAN has many unique aquatic resources that are significant in an ecological and economic context. Freshwater systems within the network support a variety of threatened and endangered species including the California freshwater shrimp (*Syncharis pacifica*), coho salmon (*Oncorhynchus kisutch*), steelhead trout (*Oncorhynchus mykiss*), the California red-legged frog (*Rana aurora draytonii*), and Northwest Pond Turtle (*Clemmys marmorata marmorata*). Beneficial uses of freshwater bodies include contact recreation and non-contact recreation, fish spawning and migration, agricultural water supply, and wildlife habitat. According to the San Francisco Bay Regional Water Quality Control Board, non-contact recreation includes activities like hiking and sightseeing; therefore, most streams within the parks must minimally meet the non-contact criteria for indicator bacteria. Freshwater quality also has direct impact on several other indicators including: Marine water quality, stream T&E species and fish assemblages, T&E amphibian and reptiles, riparian habitat, wetlands, and aquatic macroinvertebrates.

NPS also has a legal obligation to ensure streams meet minimum water quality standards. Through the Basin Plans the Regional Water Quality Control Boards (San Francisco Bay and Central Coast) have set numerical and narrative objectives for surface waters. There are specific numerical objectives for ammonia, pH, dissolved oxygen, and indicator bacteria listed by the Regional Water Quality Control Boards (San Francisco Bay and Central Coast; see protocol for details).

Because there are no national criteria for temperature, specific conductance, turbidity and Total Suspended Solids, individual parks will set goals based on what is known about natural ranges in these parameters or what criteria are currently under consideration.

The protocol was completed in September 2005, and underwent formal peer review in the winter of 05-06. Incorporation of submitted comments led to the official approval of the SFAN Freshwater Quality Protocol, version 2.11 in October, 2006. Implementation began in November, 2006.

Monitoring questions addressed by the protocol:

1. What are the existing chemical and biological ranges in water quality at selected sites in priority SFAN streams?
2. What are the long-term trends in water quality at selected sites in priority SFAN streams?
3. Is the water quality of selected sites in priority SFAN streams in compliance with

- designated beneficial uses?
4. What are the point and non-point pollution sources within the watersheds?
 5. Are specific management actions reducing pollution loads?

Specific monitoring objectives are:

- Determine variability and long term trends in water quality through monthly summaries of select parameters (water temperature, pH, conductivity, dissolved oxygen, total nitrogen, nitrate, ammonia, flow, fecal and total coliforms), at selected sites in priority freshwater streams within SFAN.
- Determine the existing ranges and diurnal variability of water temperature, pH, conductivity, and dissolved oxygen at selected sites in priority streams within SFAN.
- Determine the extent that selected sites in priority streams within SFAN meet federal and state water quality criteria for fecal indicator bacteria, un-ionized ammonia, dissolved oxygen, and pH through monthly sampling.
- Determine the annual, seasonal, and 30-day mean fecal coliform load to Tomales Bay (an impaired water body) from Olema Creek as required by the San Francisco Bay Regional Water Quality Control Board's Tomales Bay Pathogen TMDL Program.

Basic Approach

The approved SFAN Freshwater Quality Protocol calls for the collection of up to 542 samples from nine priority streams and their tributaries during each of the first two years of implementation. Most of these samples will be collected as part of monthly sampling visits to each priority watershed. These samples will be supplemented by the collection of a set of samples from a storm event in several priority watersheds. SFAN watersheds have been identified in the *San Francisco Bay Area Network Preliminary Water Quality Status Report* (Coopriider, 2004). Monitoring locations have been selected based upon WRD recommended priority criteria for Category 1 and Category 2 watershed, as well as review by park staff as outlined by the Freshwater Work Group Subcommittee (NPS, 2002). Category 1 waters include Section 303d listed streams and significant water bodies (in the case of the SFAN, this would include Areas of Special Biological Significance (ASBS)). Category 2 water bodies are those that 1) have established threats, 2) are subject to ecological impairment, 3) are lacking baseline data or 4) are linked to another Vital Sign having water column measurement needs.

The final protocols also indicate that a probabilistic sampling regime will be developed as the SFAN works with SFSU statisticians to establish a representative aquatic sampling regime. Co-locating water quality sites with past or current macroinvertebrate or fish monitoring sites helps ensure data linkages. Examples of how this may be employed include presence of a stream gauge or other permanent hydrologic monitoring equipment

(linkage to streamflow vital sign), and linkage to other aquatic vital signs (e.g., stream fish assemblages or streamflow).

Ideally all sites within a given watershed are sampled on the same day (and at the same time for each monthly sampling event in order to limit diurnal variation) or during the same storm event. Sites should represent inputs from all areas of the watershed (i.e., all major tributaries), capture the most downstream site within NPS property, and be permanent long-term sites (considering access). When choosing the number of sites within a watershed, we want to be as comprehensive as possible in representing the watershed while choosing a number of sites that is practical (considering laboratory and staff costs and logistics).

The Servicewide Inventory and Monitoring Program calls for required monitoring of all basic “Level 1” Water Quality Parameters. Required “Level 1” parameters include: flow, pH, specific conductance, dissolved oxygen, and temperature (NPS, 2002). Table 1.0 shows the parameters of interest for SFAN priority streams and those that will be collected from all proposed sites during the first two years of monitoring.

Table 1.0 – SFAN Water Quality Parameters

Parameter Groups	Parameters to be collected
Core	Water Temperature, Specific Conductance; Dissolved Oxygen, pH
Bacteria	Total Coliforms; Fecal Coliforms; <i>E. coli</i>
Sediment	Turbidity; Total Suspended Sediment (TSS); Suspended Sediment Concentration (SSC)
Nutrients	Total Kjeldahl Nitrogen; Nitrate; Ammonia
Discharge	Flow velocity and stream cross-sectional area

Water quality sampling methods will primarily follow the *National Field Manual for the Collection of Water Quality Data* (USGS, 1998) but EPA methods will also be consulted. Sampling involves collection of water samples in laboratory-supplied containers appropriate for the parameter being measured; for streams, samples are taken from the center of the channel and middle of the water column where possible (for flowing waters, samples are not depth integrated). Basic water quality measurements are then taken using a multiparameter probe for dissolved oxygen, temperature, specific conductance, and salinity. A separate pH meter is used. A flow measurement is taken to complete the monitoring. Flows are measured using a Flo-Mate, pygmy, or Swoffer flow meter following USGS protocol (Rantz, 1982). Monitoring will be conducted monthly with some priority sites being monitored during storm events.

Indicator bacteria are a primary concern for all SFAN parks because of the proximity of agricultural lands to contact and non-contact recreation as well as commercial shellfish operations. Details of methods and procedures for pathogen sampling can be found in SOP #6 of the SFAN protocol (Coopridge and Carson, 2006). Monitoring sediment parameters

in order to track both natural processes and the effects of agriculture and land development is important in many priority SFAN streams. Details of the collection and analyses procedures for sediment parameters can be found in SOP#8 of the SFAN freshwater quality protocol. The extent of nutrient contamination in many SFAN parks is not yet clear. An analysis of current baseline data as well as past data (see Stafford & Horne, 2004) indicated that nitrogen parameters were higher priority than phosphorus parameters. Ammonia, and other nitrogen parameters (nitrate, nitrite, and total nitrogen or total Kjeldahl nitrogen) will be measured. Details of methods and procedures for nutrient monitoring in SFAN streams can be found in SOP #7.

Macroinvertebrate sampling (for aquatic bioassessment) was completed in 2004 following the California Stream Bioassessment Protocol (Harrington & Born, 2003). Also see EPA EMAP (Environmental Monitoring and Assessment Program). Aquatic bioassessment was a lower priority on the SFAN indicator ranking list. Future sampling is uncertain at this time. Ideally, a rapid bioassessment baseline would be obtained for all Category 1 and 2 streams and other priority areas (see above).

Principal Investigators and NPS Lead:

Protocol development was completed by the SFAN Water Quality Specialist with guidance from NPS-WRD. Other guidance documents and protocols that were consulted include EPA, USGS, and Regional and local monitoring plans. NPS Lead: Rob Carson. Official approval of the SFAN freshwater quality protocol was achieved in October, 2006. Implementation of the SFAN water quality monitoring plan began in November 2006.

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Protocol Development Summary

Air Quality (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: PINN, PORE,

Justification/Issues being addressed:

Air Quality was ranked fourth among all of the potential vital signs evaluated by the SFAN. Clean unpolluted air is essential for all life on earth. Air quality is linked to many natural processes, i.e. soil and water nutrients, photosynthesis, acidification of lakes and streams. Within NPS, a majority of parks show improvements in visibility on clear days and in the concentration of sulfates present in precipitation. Nearly all parks show degradation or no change in nitrate levels in precipitation. Almost half of the parks show significant degradation in ozone levels, with only few showing an improvement. Hazy conditions persist in most parks.

PINN and PORE are rated as Class 1 areas by the Clean Air Act and are protected by strict air quality regulations. The rest of the parks in the SFAN are Class 2 areas and pollution regulations are less strict. However, in some instances federal land managers apply the “precautionary principle” and treat Class 2 areas with the same standards as Class 1 Areas.

Pinnacles National Monument: PINN is located within California’s North Central Coast Air Basin on the border of San Benito and Monterey counties. The area has experienced rapid growth in recent years, with development of the cities of Monterey, Hollister, Salinas, and the smaller cities of the Salinas Valley. The 2000 census of San Benito County showed a growth rate of 71 percent over the preceding 10 years. The principal air pollutants of concern in the monument are ozone precursors (nitrogen oxides and volatile organic compounds) from mobile sources and particulates from road dust, agricultural activities, and burning. Sulfur dioxide emissions are relatively low in the area.

As part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, visibility in Pinnacles NM has been monitored using an aerosol sampler (1998-present), a transmissometer (1988-1993) and an automatic 35mm camera (1986-1995). An analysis of 1990-1999 data from the monument indicates that visibility in the area is improving on both the clearest days and the haziest days (NPS 2006A). A more recent analysis for 1995-2004 indicates that there are no significant changes in visibility (clear days and hazy days) and particulate matter (PM_{2.5}) and slight improvement in ozone. Acid precipitation is not monitored in the park. Based on this, the park is meeting its GPRA goal (Ia3) of maintaining or improving air quality (NPS 2006B).

Point Reyes National Seashore: The parks coastal location near the northwestern edge of the air basin, combined with prevailing northwesterly winds off the Pacific Ocean, place the seashore in a generally upwind position relative to the urbanized portions of the air basin. However, during certain seasons (late summer and early fall), prevailing winds change and the seashore is often impacted by a general haze, which significantly impairs visibility. The principal air pollutants of concern in the seashore are ozone precursors

(nitrogen oxides and volatile organic compounds) from mobile sources and particulates from road dust, construction, and residential fuel combustion. Sulfur dioxide emissions are relatively low in the area.

As part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, visibility in Point Reyes NS has been monitored using an aerosol sampler (1998-present) and an automatic 35mm camera (1987-1995). An analysis of 1990-1999 data from the seashore indicates that visibility in the area is improving on both the clearest days and the haziest days. In 2002, the California Air Resources Board installed a fine particle (PM 2.5) continuous mass monitor at Point Reyes NS to serve as a coastal clean background site for the State's PM 2.5 network (NPS 2006C). A 2006 report for the period of 1999-2004 indicated that the park meets NAAQS particulate matter (PM2.5) standards (NPS 2006B). A web camera was also installed in the Point Reyes Lighthouse in January 2004. Digital photos showing visibility conditions at the seashore will be updated every 15 minutes on the NPS NatureNet Air Resources web page (<http://www2.nature.nps.gov/air/WebCams/parks/porecam/porecam.cfm>). Point Reyes National Seashore does not monitor ozone but is part of the EPA designated ozone non-attainment areas.

The Air Resources Division (ARD) synthesizes and reports results from ongoing monitoring efforts (e.g. Sullivan and Peterson 2001). Park specific information is posted to the Air Resources Information Service (ARIS) Website:
<http://www2.nature.nps.gov/air/Permits/ARIS/index.cfm>

Ozone advisories are posted to the ARD website:
<http://www2.nature.nps.gov/air/data/current/advisory.cfm>. Current ozone data is posted to:
<http://www2.nature.nps.gov/air/data/current/index.cfm>

Monitoring questions to be addressed by the protocol:

1. Is there a measurable rate of change in air quality?
2. Do SFAN park meet visibility standards as they pertain to visibility impairment and human health.

Specific monitoring objectives are:

- Report on seasonal and annual status and trends of N and S concentration and deposition in precipitation at existing monitoring stations in SFAN parks.
- Report on seasonal and annual status and trends of fine particle concentrations and composition at existing monitoring stations in SFAN parks.
- Report on seasonal and annual status and trends of ozone concentrations in SFAN parks using metrics that are indicative of human health (e.g., 8-hour average) and plant response (e.g., SUM06).

Basic Approach:

The monitoring will mainly be implemented by the NPS Air Resource Division (ARD) and U.S. Environmental Protection Agency (EPA) using their monitoring protocols. As part of the long-term monitoring program, results are reported by the ARD.

Principal Investigators and NPS Lead:

Judy Rocchio, PWR Physical Scientist – Air Resources (510 817-1431).

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Protocol Development Summary

Stream Fish Assemblages (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: GOGA, JOMU, MUWO, PORE

Justification/Issues being addressed:

Stream Fish Assemblages (Salmonids) were ranked fifth among all of the potential vital signs evaluated by the SFAN. As an indicator of ecological health of freshwater stream systems, this vital sign category includes monitoring for a suite of species and conditions within anadromous stream habitat including habitat condition, fish assemblage, population, and community structure, as well as two threatened and endangered species: coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*).

Coho salmon and steelhead are anadromous and the life stage requirements demand year-round, high-quality cold water, continuous riparian cover, and complex habitat and structure to accommodate development from egg to smolt stage. Monitoring of these species at multiple life stages is valuable to the understanding of aquatic conditions and a good measure of watershed health. Because coho salmon and steelhead live for more than a year in freshwater, and the conditions required to support them are highly restrictive, they are susceptible to anthropogenic impacts to the stream and riparian systems. Because salmonids are sensitive to watershed and habitat impacts, they are effective indicators of stream and aquatic health. Monitoring efforts have recently been focused on coho salmon due to the species recent listing as endangered at both the State and federal level, and its relatively consistent life history strategy.

Monitoring objectives and specific monitoring questions to be addressed by the protocol:

1. Determine long-term changes in coho escapement and distribution within Park watersheds using redds, live, and dead adult counts in order to determine contribution of Park waters to California Coho Recovery Plan escapement goals.
 - a) For each coho cohort, what is the long-term status and trend?
 - b) Does the distribution and density of annual redd observations (e.g., redd superimposition) within a watershed indicate the presence of barriers to adult passage, both natural or human-caused?
2. Determine survivorship of coho for all cohorts between eggs, juveniles, smolts and adults in the southern portion of the species range at Olema, Pine Gulch, and Redwood Creeks using total redd counts and length of female carcass to approximate egg production, basinwide estimates of juvenile coho, basinwide estimates of coho smolts through outmigrant trapping, and adult escapement estimates.
 - a) How does coho survivorship compare between small coastal drainages in PORE/GOGA watersheds, Central California Coast ESU, and the northern California-southern Oregon ESU?

- b) Based on existing published data, are there existing life stage bottlenecks in Olema, Pine Gulch, and Redwood Creeks? (See Recomm. for future research)
- 3. Determine presence/not detected status of salmonids within watersheds within the boundaries of GOGA/PORE/MUWO/JOMU using equal-effort sampling techniques.
 - a) Does the number of streams within GOGA/PORE/MUWO/JOMU that support coho change over time?
 - b) Does the number of streams within GOGA/PORE/MUWO/JOMU that support steelhead change over time?
- 4. Determine the annual population size of juvenile coho within Olema, Pine Gulch, and Redwood Creeks using basinwide estimates.
 - a) Is population size increasing within each coho cohort, within each watershed?
 - b) Is there change in the distribution of juvenile coho along mainstem channel over time?
- 5. Determine the composition and abundance of fish assemblage within selected streams in GOGA/PORE/MUWO using electrofishing.
 - a) What is the distribution of non-native fish?
 - b) What is the distribution of non-salmonid fish?
 - c) How does coho and steelhead abundance compare between small coastal drainages in PORE/GOGA watersheds, Central California Coast ESU, and the northern California-southern Oregon ESU?
- 6. Determine health condition factor of juvenile and smolt salmonids within Olema, Pine Gulch, and Redwood Creek
 - a) How does coho and steelhead condition factor compare between small coastal drainages in PORE/GOGA watersheds, Central California Coast ESU, and the northern California-southern Oregon ESU?
- 7. Identify gross changes in pool:riffle composition within select drainages in PORE/GOGA/MUWO.
- 8. Estimate the annual production of coho smolts within Olema, Pine Gulch, and Redwood Creeks using spring outmigration trapping.
 - a) What is the time of peak outmigration?
- 9. Determine long-term distribution in mosquitofish (non-native) and stickleback within PINN watersheds.
 - a) What are the conditions that influence the change in distribution of mosquitofish and their potential influence on native aquatic species.

Basic Approach:

The protocol includes the overall narrative document and four Standard Operating Procedure documents relating to the summer, winter, and spring monitoring protocols, as well as salmonid genetics sampling and handling procedures.

Methods are designed to monitor three crucial periods in the life cycle of coho salmon. Information will be collected both on a population and individual level in all three monitoring periods. Monitoring on the population level will be utilized to develop survival

rates between life stages while data gathered on the individual will provide information on the relative health of the population.

Adult fish: Methodology used in these protocols has been used to estimate escapement for a variety of salmonids throughout the Pacific Northwest (Johnston et al. 1987; Irvine et al. 1992; Anderson and McGuire 1994; Gallagher and Gallagher 2005).

Juvenile fish: basinwide juvenile fish production methods and analyses closely follow standard Hankin and Reeves two-stage sampling design (Doloff et. al 1993; Collins 2003); index reach fish demographics with multiple pass electrofishing procedures (Bohlin et. al. 1989) and seining.

Outmigrant smolt production: watershed smolt production will be assessed using methods developed and implemented in the north coast of California using pipe trap (Manning and Roelofs 1996) and fyke/pipe trap (Gallagher 2000; Barrineau and Gallagher 2001) methods.

Habitat condition: Index reach habitat surveys (woody debris, instream cover, habitat classification, substrate composition, and wetted channel dimensions) and Basinwide habitat surveys (habitat classification, substrate composition, and wetted channel dimensions) based on California Department of Fish and Game procedures (Flosi et. al. 1998);. Riparian habitat survey at select index stations using Coyote Creek Riparian Station procedures (Rigney et. al. 1996). Basinwide riparian habitat mapping based on aerial imagery (Grant 1988). Geomorphic surveys (profile and cross-section) for index stations (Harrelson et. al. 1994).

Index reach photos: One of the side benefits of this monitoring approach is that SFAN will be able to develop a population genetic structure and age-size relationship for salmonids through genetic sample collection and processing.

Frequency:

Annual

Timing:

Seasonal, based on life stage

Finalization of the protocols are pending consultation with SFSU statisticians to support development of a probabilistic sampling regime in lieu of the index reach methods currently used in the summer. This sampling regime would also support co-location of other vital signs sampling including water quality, etc.

Principal Investigators and NPS Lead:

Michael Reichmuth, SFAN Fisheries Biologist (425-464-5191), Brannon Ketcham, PORE Hydrologist (415-464-5192) and Darren Fong, GOGA Aquatic Ecologist (415-331-8716).

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Protocol Development Summary

Rare Plant Species (Updated 12/15/06; V2.04)

Parks where protocol will be implemented:

GOGA, PORE, PRES (PINN in later years)

Justification/Issues being addressed:

Rare plant species ranked 6th in the prioritized list of vital signs to be monitored for ecosystem changes and trends. The San Francisco Bay Area Network (SFAN) appointed a working group to develop the vegetation related indicators and protocols. PORE and GOGA have spent several years conducting inventories and censusing of their numerous rare plant populations. PORE has over 50 plant species with federal, state or local status. GOGA has over 35 plant species, including those at PRES, with federal, state or local status. The inventory for PINN needs to be refined and better documented, but there is currently evidence for over 10 species.

In the summer of 2004, a ranking system was developed to help the parks determine which species are the “most rare” within SFAN park boundaries regardless of official listing status. The matrix was tested using the PORE inventory of rare plants. Another version of the ranking matrix will be used to determine which species are the most appropriate for long-term monitoring for trends and ecosystem health. This vital sign is one in which we are striving for a true systems approach while also taking into account the management needs of the parks. This vital sign is also part of a hierarchy of vegetation monitoring developed by the working group in which some rare species will be monitored via the plant community change protocols. Rare plant occurrences will be a component of the ranking matrix for determining which plant communities should be monitored. Species with inappropriate life history or location to be monitored via plant community, but are ranked very high in the rare plant monitoring matrix, will be considered for population monitoring. Rare plant monitoring data will be used with relevant wildlife and other vital signs monitoring, such as T&E butterflies and invasive species, for assisting with trend detection and causal relationships in overall vital signs monitoring program.

Monitoring questions to be addressed by the protocol:

1. How are rare plant populations changing in terms of distribution, abundance and condition within Network parks?
2. Are invasive species infestations correlated to rare plant population decline?
3. Are management actions causing changes (positive or negative) in rare plant populations?

Specific monitoring objectives are:

- Develop and maintain a list of target rare species based on a regional rarity matrix and in order to prioritize RTE monitoring efforts.

- Determine long-term trends of population abundance by conducting species-specific surveys as needed of mapped populations.
- Identify potential threats (e.g. visitor trampling, presence and encroachment of invasive plant species, pest infestation), and estimate degree of threat to rare species at mapped locations in order to identify management needs.

Basic Approach:

The rare plant monitoring protocol will actually be comprised of an umbrella protocol, and several species-specific protocols as appendices/SOPs. Currently, PORE has draft protocols in various stages of development for 3 of the 4 federally listed species. Those species which rank high in the rarity matrix and are known to be inappropriate for monitoring via plant community protocols based on population size and habitat preference (*Alopecurus aequalis sonomensis* and *Chorizanthe valida*) will go forward with population-level I & M protocol development based on past work. All other species, including those at GOGA and PINN, will go through a rigorous ranking process in collaboration with the plant community monitoring program. Future work will focus on developing appropriate monitoring protocols for those species that rank high but will not be captured via plant community monitoring, and reviewing protocols developed by park staff. Monitoring will include surveys every 5-10 years in order to identify presence/absence of target species and incorporate them into survey design. The field crews and protocol development work will be linked for the two indicators and create a streamlined approach to vegetation monitoring within SFAN.

Frequency:

Annually to intermittent depending on species.

Timing:

To be determined by monitoring protocol.

Principal Investigators and NPS Lead:

Andrea Williams, Natural Resource Specialist, 415-331-0639.

Protocol Development Summary

Northern Spotted Owl (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: GOGA, MUWO, PORE

Justification/Issues being addressed:

Northern Spotted Owl was ranked seventh among all of the potential vital signs evaluated by the SFAN. The federally threatened status of this species requires the NPS monitor the long-term status and trends of the population and maintain stable or increasing populations of spotted owls. This monitoring program provides the data required to accurately assess the status and trend of this isolated, potentially vulnerable spotted owl population, where it occupies a land use matrix strikingly different from that found throughout most of the owl's range. Our monitoring program contributes to the Northwest Forest Plan in working to arrest the downward trend in spotted owl populations and to maintain and restore the habitat conditions necessary to support viable populations of the northern spotted owl on federally administered forest lands throughout the range of the owl. The program has an eight-year history of monitoring spotted owls in the SFAN parks, which contributes to region and range-wide monitoring programs and park management activities.

Monitoring questions to be addressed by the protocol:

1. What are the trends in productivity and activity site occupancy of Northern Spotted Owls on federal lands in Marin County?
2. What is the relative abundance and distribution of Barred Owls relative to Northern Spotted Owls?
3. Are changes in spotted owl relative abundance and reproductive success related to weather and climate patterns?
4. Are potential threats, such as the influx of barred owls, leading to changes in spotted owl habitat and nest site selection?

Specific monitoring objectives are to:

- Monitor trends in spotted owl relative abundance and reproductive success at known owl activity sites within the NPS legislated boundaries of Marin County, California.
- Determine changes in the patterns of Northern Spotted Owl habitat selection through the evaluation of habitat and/or nest site characteristics (e.g. tree species selected for nest sites, vegetation community selected for nest sites) at known activity centers.

Basic Approach:

US Forest Service Protocol (Forsman 1995) modified for Marin County (Fehring et al 2000). Annual monitoring of historic activity centers to determine occupancy, pair identification (bands) and reproductive status. Inventory suitable habitats within the

project area every 5-10 years in order to identify potential spotted owl population expansion and incorporate new detections of spotted owls into annual relative abundance estimates. Currently, monitoring is conducted from mid-March through July using a GS-7 term biotech based at PORE, existing staff at PORE, GOGA and MUWO, and various interns and volunteers. Through 2006, additional field assistance is contracted through PRBO Conservation Science (\$8K) and an additional \$5K funding from the Point Reyes National Seashore Association is contributed annually. Monitoring will be partially supported by PRBO Conservation Science, Marin Municipal Water District and Marin County Open Space District. In 2007, NPS will receive \$50,000 per year (\$150,000 total) from a Regional Block Grant for three years to inventory and determine habitat use patterns of Barred Owls in relation to Northern Spotted Owls.

Frequency:
Yearly

Timing:
During breeding season (Mar - Aug)

Principal Investigators and NPS Lead:

Dawn Adams, PORE Ecologist (415-464-5202) and Bill Merkle, GOGA Wildlife Biologist (415-331-2894).

Literature Cited:

Fehring, K.E., D. Hatch and D.B.Adams. 2000. Modified protocols for spotted owl monitoring and demographic studies in Marin County, California.

Forsman, E.D. 1995. Appendix A: Standardized protocols for gathering data on occupancy and reproduction in spotted owl demographic studies. Pp. 32 – 38 *IN* J. Lint, B. et.al. 1999. Northern Spotted Owl effectiveness monitoring plan for the Northwest Forest Plan. U.S. Forest Service Gen.Tech. Rep. PNW-GTR-440.

Protocol Development Summary

Amphibians and Reptiles (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: EUON, GOGA, JOMU, PINN, PORE

Justification/Issues being addressed:

Amphibian and reptile populations ranked eighth out of all potential vital signs in the San Francisco Bay Area Network. The protected legal status of several of these taxa (San Francisco garter snake [federally endangered], red-legged frog [federally threatened], Western pond turtle [California species of concern], and coast horned lizard [California species of concern]) require the NPS to evaluate the condition of these populations. Due to their habitat and physiology, herpetofauna are particularly sensitive to environmental degradation, such as air and water pollution. Because they are mid-level predators, population trends in these taxa may indicate trends in populations of animals at both higher and lower trophic levels.

Various related monitoring efforts are underway or recently completed, including:

- Demographic and migration studies of CA red-legged frogs at GOGA, PORE
- CA red-legged frog surveys at PINN
- General amphibian stream surveys at PINN
- Terrestrial vertebrate inventories at EUON, JOMU, PINN, PORE
- US Fish and Wildlife-sponsored study of the effects of habitat enhancement on San Francisco gartersnake at GOGA

In August and September 2005 a workshop of government and non-government herpetologists assisted network staff to identify and prioritize long-term monitoring questions for amphibians and reptiles on network park lands. The workgroup formulated a list of the six most important amphibian and reptile monitoring targets for SFAN parks:

1. Pond-breeding amphibians
2. San Francisco garter snake
3. Stream-inhabiting amphibians and reptiles
4. Terrestrial amphibians and reptiles
5. Turtles
6. Coast horned lizards

For each of these monitoring targets the group identified a) *specific monitoring questions*, b) *focal taxa to be monitored*, c) *monitoring objectives*, d) *potential monitoring techniques*, e) *monitoring locations*, f) *potential sampling design*, and g) *suggested monitoring regime*.

Monitoring questions to be addressed by the protocol:

Monitoring Target 1: Pond-breeding amphibians

1A. How are species distribution and diversity of pond-breeding amphibians changing over time at GOGA and PORE?

Associated Monitoring Objective: Detect any 25% or greater change (between an initial 3-year baseline and any year monitored) in the number of ponds occupied by selected pond-breeding amphibians at GOGA and PORE.

1B. How is abundance (as indicated by an index of egg masses and young-of-the-year) of pond-breeding California red-legged frog changing over time at PINN?

Associated Monitoring Objective: Detect any 50% or greater change in abundance (index) in young-of-the-year California red-legged frogs at Bear Gulch Reservoir at PINN.

Monitoring Target 2: San Francisco garter snake

2A. How is the San Francisco garter snake population at Mori Point changing over time?

Associated Monitoring Objective: Detect continuing presence of San Francisco garter snake at Mori Point.

Monitoring Target 3: Stream-inhabiting amphibians and reptiles

3A. How are the distribution and diversity of aquatic salamanders changing over time at GOGA and PORE?

Associated Monitoring Objective: Detect any 25% or greater habitat contraction for any aquatic salamander species at GOGA and PORE between any two sampling events.

3B. How are the distribution and diversity of stream-inhabiting herpetofauna changing over time at PINN?

Associated Monitoring Objective: Detect any 25% or greater habitat contraction for any native aquatic herpetofauna species at PINN between any two years. Detect any 25% or greater habitat expansion of any non-native stream-inhabiting vertebrate or invertebrate species between any two years.

Monitoring Target 4: Terrestrial amphibians and reptiles

4A. How are the distribution, abundance, and diversity of selected terrestrial amphibians and reptiles changing over time at GOGA, PINN, and PORE?

Associated Monitoring Objective: Detect a 25% change (between an initial 3-year baseline and any single year monitored) in the number of cover board transects occupied by the five most commonly detected amphibian and reptile species at PINN, GOGA, and PORE.

4B. Are common terrestrial amphibians and reptiles continuing to be detectable at EUON and JOMU?

Associated Monitoring Objective: Detect continuing presence (based on initial inventories) of the five most commonly detected amphibian and reptile species at JOMU and EUON.

Monitoring Target 5: Western pond turtle

5B. How are the abundance, distribution, and diversity of turtles (with a focus on Western pond turtle populations, but including observations of all turtles) changing over time at GOGA and PORE?

Associated Monitoring Objective: Detect a 25% change (between an initial 3-year baseline and any single year monitored) in number of ponds occupied by native turtles at PORE and GOGA. Detect a 50% increase (between an initial 3-year baseline and any single year monitored) in number of ponds occupied by non-native turtles at PORE and GOGA.

Monitoring Target 6: Coast horned lizard

6A. How are distribution and abundance of coast horned lizard, harvester ant, and the non-native Argentine ant changing over time at PINN?

Associated Monitoring Objective: Detect a 25% change (between an initial 3-year baseline and any single year monitored) in the number of sites occupied by coast horned lizards, harvester ants, and Argentine ants.

Basic Approach:

Standard protocols are available for monitoring some herpetofauna in the San Francisco Bay Area and can be adapted by the network. Data from the ongoing monitoring efforts in the region will be reviewed in order to inform the sampling design. Final design of the monitoring program will be based on a two-year pilot test of proposed techniques and monitoring regime.

Principal investigator and NPS lead:

Protocol development will be guided by NPS Pacific West Region Aquatic Ecologist, Marie Denn, with collaboration from the USGS Western Ecological Research Center Senior Scientist Gary Fellers, GOGA Aquatic Ecologist, Darren Fong, and PINN Biologist Paul Johnson. Potential Principal Investigators: Gary Fellers, Darren Fong, Paul Johnson.

Literature:

Fellers, G. and K.L.Freel. 1995. A Standardized Protocol for Surveying Aquatic Amphibians. National Park Service Tech.Rpt. NPS/WRUC/NRTR-95-01 and Univ.of California Tech.Rpt. UC-CPSU-TR-#58.

Fesnock, A.L. and P.G. Johnson II. 2002. Reestablishing California Red-Legged Frogs to their Historical Range Within Pinnacles National Monument. Wildlife Society, paper presented at Western Section Meeting, March 7-9, 2002, Visalia, CA.

Protocol Development Summary

Western Snowy Plover (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: GOGA, PORE, PRES

Justification/Issues being addressed:

Western Snowy Plover (*Charadrius alexandrinus nivosus*) ranked ninth out of all potential vital signs in the San Francisco Bay Area Network (SFAN). The federally threatened status of this species requires the NPS to monitor the long-term status and trends of the population and maintain stable or increasing populations of Western Snowy Plovers. Western snowy plovers are listed as federally threatened species under the Endangered Species Act, and are identified as a management priority in PORE's Resource Management Plan. They are also part of the coastal dune ecosystem, which is identified as an important habitat for conservation in the PORE's enabling legislation. Western snowy plovers are good indicators of the condition of the native coastal dunes ecosystem and are the only nesting shorebird in the coastal habitats. Several large coastal dune restoration projects benefit the plovers in the parks. When non-native plants have been removed and native plants encouraged, plovers have responded by successfully nesting or brooding young in restored areas. There is a 20-30 year history of monitoring snowy plovers at PORE and GOGA by PRBO Conservation Science, and the parks have been adaptively managing the plovers based on the results of monitoring (Hatch 1996, White and Allen 1997).

Monitoring is conducted in coordination with other agencies and groups including USFWS Wildlife Refuges (San Francisco Bay), NOAA- Marine Sanctuaries (BEACH WATCH and COAST WATCH programs); and PRBO Conservation Science. Data are used by NPS and FWS for reporting on ESA and for guiding conservation of the species with targets to delist.

Monitoring questions to be addressed by the protocol:

1. What is the distribution and relative abundance of Western Snowy Plovers at PORE and GOGA during the breeding and wintering seasons?
2. What are the short-term (<5 years) and long-term trends for relative abundance and productivity (only for breeding plovers)?
3. What is the annual fecundity (i.e. number of fledged young per male)?
4. Are human or management activities (i.e., dune restoration, recreation) affecting plover breeding sites or plover wintering activities?
5. What are the causes of mortality of eggs, young, and adults?

Specific monitoring objectives are:

- Determine trends in the estimated breeding population size, distribution, and reproductive success of snowy plovers at known breeding beaches at PORE.

- Determine changes in relative abundance and distribution of snowy plovers at known wintering beaches at GOGA and PORE and relate to the rates of recreation or management activities.
- Identify plover adult, egg and chick predators and determine trends in encounter rates during plover surveys (both winter and breeding).

Basic Approach:

Beach censuses will be conducted at GOGA and PORE during winter season (Sept – March); data collected two times per week at all GOGA sites, one time per month at PORE sites; data includes number of plovers, number and type of recreationists, number of dogs, number of predators. At PORE during the breeding season (March - Sept) surveys are conducted at least once per month at all potential breeding beaches and at least twice per week at active breeding beaches. Data collected include #eggs laid, #chicks hatched and # chick fledged, adult breeding population estimates, nest location mapping, and predator surveys. Protocols for both wintering and breeding seasons was developed by PRBO Conservation Science.

Frequency:

Yearly

Timing:

Breeding season at PORE, winter season at both

Principal Investigators and NPS Lead:

Dawn Adams, PORE Ecologist (415-464-5202) and Bill Merkle, GOGA Wildlife Biologist (415-331-2894).

Literature:

Hatch, D. A. 1996. Western Snowy Plover (a federally threatened species) wintering population and interaction with human activity on Ocean Beach, San Francisco, Golden Gate National Recreation Area, 1988 through 1996.

White, J.D., and S.G. Allen. Draft western snowy plover management plan, Point Reyes National Seashore, Point Reyes, CA.

Protocol Development Summary

Pinnipeds (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: GOGA, PORE, PRES

Justification/Issues being addressed:

Pinnipeds are apex predators of the marine ecosystem and numerous dynamic processes interacting together have the potential to affect their abundance and distribution. Changes in pinniped abundance and distribution may be caused by changes in food supply, disease, disturbance to haul-out sites by recreational or commercial users, or environmental factors on multiple scales (localized storm events, sea level rise, and decadal shifts in climate).

In central California there are six pinniped species. The species that have been documented breeding in the SFBAN include the harbor seal (*Phoca vitulina richardii*) and northern elephant seal (*Mirounga angustirostris*). The five numerically dominant species that haul-out and molt in this region include the harbor seal, northern elephant seal, California sea lion (*Zalophus californianus*), northern fur seal (*Callorhinus ursinus*), and Steller sea lion (*Eumetopias jubatus*). Guadalupe fur seals (*Arctocephalus townsendi*) have been documented at Point Reyes, although they do not occur regularly. Other species (California sea lions) may breed in the future in the parks. In 2003, one California sea lion pup was born at PORE, and the breeding range of this species has been expanding north from the Channel Islands over the past decade. The Farallon Islands is the current northern most breeding site.

Pinnipeds come under the legal mandates of the Endangered Species Act (1973) and Marine Mammal Protection Act (1972). Most pinniped populations are stable or increasing (Barlow et al. 1993, Lowry and Carretta 2003), except for the Steller sea lion (federally listed as threatened). The collective knowledge gained about the recovery of pinnipeds since passage of MMPA has been possible due to long-term monitoring programs that provide information at temporal and spatial scales and that allow accurate interpretation of measured trends and responses to environmental change. This knowledge enables the NMFS to complete stock assessments and guide protection of species. Guadalupe and northern fur seals are listed as endangered and depleted, respectively. Pinnipeds are also specifically identified in the General Management Plan, the Natural Resources Management Plan (1976 and 1999), the Marine Mammal Supplement to the Natural Resources Management Plan (1980) and the Statement for Management (1985) where management objectives of PORE under the existing Resource Management Plan for PORE are presented.

GPRG Goals specifically addressed by this indicator include

Federal T&E species (Three species)	Ia2
Species of concern populations are at scientifically acceptable levels (three species)	Ia2X
Visitor understanding (Public wants to know)	IIb1
Data systems integrated (with other agencies)	IVa1

Volunteer hours (major volunteer contribution)	IVb1
Wetlands (seal haul out sites occur in wetlands)	
Marine (seals forage in marine system and occur in intertidal area)	

Pinnipeds rank tenth out of all potential vital signs in the San Francisco Bay Area Network (SFAN). They are closely linked to aquatic and marine ecosystems and their associated indicators.

Monitoring Indicator	Agencies/partners
Water quality	NPS, State WQCB
Weather	NPS, NOAA
Wetlands	NPS, EPA
Marine Oceanography (CODAR)	UCBodega and CenCOOS
Pacific herring	CDFG
Streamfish assemblages	NPS, CDFG, NMFS

Pinnipeds are excellent indicators of the condition of the marine ecosystem because they respond quickly to changes in oceanic conditions and in food resources (Sydeman and Allen 1999, Allen 2004). Changes in pinniped population size, distribution and reproductive success can provide an early warning of abnormal conditions and impairment of the marine ecosystem. Pinnipeds are also an excellent indicator for global climate change as measured by sea level rise, because seal colonies occur in the intertidal and supratidal zones which would be directly changed by sea level rise. Pinnipeds also respond quickly to global and regional changes in sea surface temperature, acidity and salinity as seen during El Nino, warm water years when the coastal upwelling food web collapses (Sydeman et al. 1999, DeLong et al 1999). ENSO events are predicted to intensify and increase in number with global climate change, and during these events as evidenced in 1982, 1992 and 1998,) seals produce fewer pups, die from starvation, and change where they haul out. Water quality is linked to the health of marine mammals because contaminated water can affect productivity of seals and exposure to diseases (harmful algal blooms, heavy metals and PCB, DDT). Streamfish assemblages including salmonids are also tightly linked to ocean conditions and could be analyzed in conjunction with annual changes in pinnipeds. Additionally, sea lions and seals prey on salmonids that are spawning in Tomales Bay, and so documenting changes in the distribution and number of pinnipeds could provide understanding of changes in spawning fish.

Pinnipeds are of management concern because they are a heroic species group that are popular with the visiting public and easily interpreted to visitors. The public and other agencies are concerned about the status of pinnipeds; particularly related to human disturbance (Allen et al. 1985), oil spills, and fishing activities (operational and biological; Barlow et al. 1994). Additionally, other important concerns include natural and anthropogenically enhanced toxic blooms, preservation of haul-out habitats, biomagnified contaminants, and disease.

There is a long history of monitoring and adaptively managing pinnipeds in the National Park Service, and specifically at CHIS and at PORE (20-30 years) in collaboration with other agencies and organizations (DeMaster et al. 1988, Allen et al. 2005, Sydeman and Allen 1999, Stewart et al. 1994, Allen et al. 1989, Allen and Huber 1983).

Compared to other marine resources, the methods for monitoring pinnipeds are fairly simple, can be conducted onshore rather than at sea, and do not require sophisticated equipment (see draft protocol (Hester et al. draft)). The program is cost efficient by using trained volunteers (@30-40) to conduct most of the field work. The park staff contributes significant time in training volunteers, assisting in field surveys, and writing annual and five-year reports.

Monitoring is conducted using similar protocols and in coordination with other agencies and groups including USFWS Wildlife Refuges (Farallon Islands and San Francisco Bay), NOAA- Marine Sanctuaries (SiMON data, SEALS program); NOAA – Fisheries (Stock Assessments for species); NOAA – Marine Mammal Stranding Network (documenting all stranded marine mammals); California Department of Fish and Game (harbor seal annual surveys); Marine Mammal Center (health); UC Santa Cruz (elephant seal colonies). Data are shared with NOAA sanctuaries and included in a larger database and website on marine mammals. Data are used by NOAA-Fisheries for establishing stock assessments for each species (J. Barlow, NOAA-Fisheries, pers. com). The stock assessments are required under the MMPA and come out every few years depending upon the species.

Pinnipeds are also selected, or proposed indicators in other NPS networks and parks across the nation, including CHIS, GLBA, REDW, CABR, and ACAD. A monitoring protocol was developed for CHIS in the 1980s (DeMaster et al. 1988) and formed the basis of the SFAN protocol (Hester et al. draft.).

Monitoring questions to be addressed by the protocol:

1. What are the status and trend of population size and distribution of pinnipeds?.
2. What is the natural level of variation in the pinniped population size and reproductive success, as measured by the number of pups produced?
3. What is the natural level of variation in pupping phenology of harbor seals and elephant seals and does this change with changes in climate?
4. How do natural and anthropogenic disturbances affect seal haul-out use, distribution and reproductive success?
5. Is global climate change, as measured by changes in sea levels and sea surface temperature, affecting seal reproductive success, timing of breeding, and distribution?

Specific monitoring objectives are:

- Determine long-term trends in annual population size and annual and seasonal distribution of pinniped populations at PORE and GOGA.

- Determine long-term trends in reproductive success of northern elephant seal and harbor seal populations through annual estimates of productivity at PORE and GOGA.
- Identify potential or existing threats (i.e. climate change, human disturbance (presence of hikers, motor boats, or airplanes), pollutants), and estimate degree of threat at known seal haul outs in order to guide management.
- Participate with the National Marine Fisheries Service (NMFS) national stranding network to further document distribution, occurrence and health of all pinnipeds (and other marine mammals).

Basic Approach:

The sampling design is based on protocols developed over several decades by the National Marine Fisheries Service (NMFS) and modified to regional conditions and requirements (Eberhardt et al 1979, Le Boeuf and Laws 1992, Forney et al. 2002). The regional design is based on the seasonal occurrence of each species, the data required to assess population condition and the need to adaptively manage the resource. Additionally, the program limits the level of invasive methods to maintain low levels of disturbance from research activities.

To achieve these goals, there are four specific programs for pinniped monitoring:

- Harbor Seal Population,
- Elephant Seal Population,
- All Pinniped Species Habitat Use, and
- Partner of the National Marine Mammal Stranding Network (NMMSN; <http://swr.nmfs.noaa.gov/>; Twiss and Reeves 1999).

The method of survey is a census of total individuals at each terrestrial haul out site and resighting of tagged individual elephant seals (Eberhardt et al. 1977; DeMaster et al. 1988).

- Weekly surveys of colony sites during breeding seasons of northern elephant seal (December-March) and harbor seal (March-June). The number of harbor seal haul outs sites are @12 at PORE and GOGA; the number of elephant seal sites are @4 at PORE. Weekly surveys of breeding seals are necessary to capture changes in phenology and major disturbance events; annual surveys are necessary to capture changes in ocean condition (ENSO events, sea level change, management needs)
- Bi-monthly surveys at Point Reyes Headlands of all pinniped species year-round. Bi-monthly surveys of all species are necessary to measure changes in ocean condition (ENSO events, sea level change), detect mass stranding events, and meet management needs.
- Weekly surveys of tagged elephant seals during the breeding season at primary colonies. Tag resight is necessary to determine origin of breeding seals in new colonies (with growing population), and the survivorship by year class (during ENSO years, survivorship is reduced). Elephant seals are tagged at all colonies and data are shared amongst the researchers and with NMFS. A proposal has been submitted by UC Santa Cruz to NSF to analyze tag data from all colonies, including PORE.

Frequency:

Annual – to detect changes in ocean condition and management issues such as disturbance, fisheries interactions.

Timing:

Breeding seasons (November through March - northern elephant seals;
March through July – harbor seals)
Year round (all pinnipeds)

The threshold/target objectives for the pinniped guild are as follows:

- Detect any change in the number of primary colony sites of harbor seals within a year
- Detect any change in breeding/molting sites of elephant seals within a year
- Detect a 25% reduction in the productivity of harbor seals in one season
- Detect a 25% change in the productivity of northern elephant seals in one season
- Detect a 25% change in the abundance of northern elephant seals in one season
- Detect a 50% change in the abundance of California sea lions in one year
- Detect any new breeding site of Steller or California sea lions within a year
- Detect mass stranding of any marine mammals (see NMFS website http://www.nmfs.noaa.gov/prot_res/PR2/Health_and_Stranding_Response_Program/mmhsrp.html for details)

Sampling Efficiency:

A power analysis was conducted on the harbor seal data to determine minimum sample size and the power to detect change. Because the seals have been monitored for many years, the current sample size is sufficient to detect change at 25% in one season. A similar analysis is being conducted for the elephant seal breeding season.

Fewer sites of harbor seals could be surveyed to reduce cost, but management is interested in all primary pupping sites because of MMPA requirements. The weeks that the seals are surveyed during the breeding season could be reduced to just the expected peak pupping dates; however, phenology would not be documented when first pups are born and management issues potentially would be missed. Since volunteers conduct most of the surveys, reduction in number of surveys would not appreciably reduce cost, except for data entry time.

Resighting of elephant seal tags could be dropped, but data on origin of seals in new colonies in the park would be missed and information on survivorship which can be linked to understanding changes in ocean condition and climate. For example in 1998, the park was able to directly document the movement of tagged individual females from the main colony that was inundated with waves to a new colony site in Drakes Bay where they pupped.

Personnel are used efficiently with one GS-7 Biotech term who works from Dec. 10 through March 18 (7PP) on the elephant seal breeding season surveys, tagging, data management, and reporting (Dec – March) and the rest of the year on northern spotted

owls, another indicator. A Marin Conservation Corps/AmeriCorps Member is hired from September 15 through August 30 and is responsible for coordination of all harbor seal volunteer training, surveys (March through July), and data entry and error checking. In addition the Americorps member assists in elephant seal breeding season surveys and conducts year round pinniped surveys. The MMC program is very cost efficient with MCC contributing ½ the cost of the person. The project is overseen by the principal investigators with additional input from Bill Merkle, GOGA Wildlife Biologist, and Dave Press, SFAN Data Manager. The protocol was-reviewed by two scientists and is being revised.

Principal Investigators and NPS Lead:

Dr. Sarah Allen, PORE Senior Scientist (415-464-5187), and Dawn Adams, PORE Ecologist (415-464-5202).

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Protocol Development Summary

Plant Community Change (Updated 12/15/06; V2.04)

Parks where protocol will be implemented:

FOPO, JOMU, GOGA, MUWO, PINN, PORE, PRES

Justification/Issues being addressed:

Numerous biotic and abiotic factors have altered and continue to threaten plant communities within SFAN. As plant communities continue to recover from past resource extraction and grazing, face introduced pathogens and anthropogenic stressors, and respond to current restoration, fire, grazing, and other management efforts, changes in species composition and type changes must be monitored to evaluate the effectiveness of management or the need for management action. The monitoring program proposed assimilates multiple vital signs including invasive plant species, threatened and endangered plant species, wetlands, grassland plant communities, sudden oak death, oak woodlands, and plant species at the edge of their range. There are also significant ties between plant community change and almost all of the faunal indicators suggested for monitoring such as landbirds, Northern spotted owls, endangered butterflies, and amphibians and reptiles.

Monitoring questions to be addressed by the protocol:

1. Are there changes in abundance of the dominant, co-dominant and indicator species that are important components of the structure and function of the selected plant communities?
2. Are there trends in diversity metrics (native & non-native) at the plot and community level?
3. Are the long-term effects of management activities such as prescribed fire, grazing, restoration, and trail/road maintenance changing the plant communities?

Specific monitoring objectives are:

- Develop and maintain a list of priority plant communities based on their rarity and degree of protection.
- Detect long-term trends in native and non-native abundance and distribution within selected plant communities.
- Detect changes in overall vegetation cover, vegetation type and species composition of selected SFAN plant communities.

Basic Approach:

1. Create a sampling design for a network of permanent plots that efficiently detect and monitor changes in the composition and structure of selected plant communities throughout San Francisco Area Inventory and Monitoring Network of Parks. Stratify the landscape by elevation, slope position, aspect, and soil type.
2. Establish a subset of the sampling scheme created above and collect vegetation data as a pilot study.
3. Design the plant community sampling scheme to capture several of the highly ranked broad vegetation related indicators. Intensify data gathered at plots in communities of interest.
4. Design the plant community monitoring program to detect changes in abundance (at specified levels and power) for rare and non-native invasive species that are targeted to monitor at the community level.

Principal Investigators and NPS Lead:

Dave Schirokauer, GIS Specialist, 415-464-5199 and Andrea Williams, Natural Resource Specialist, 415-331-0639.

Protocol Development Summary

Landscape Dynamics (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: EUON, FOPO, JOMU, GOGA, MUWO, PINN, PORE, PRES

Justification/Issues being addressed:

Regional landscape & land use change (Landscape Dynamics) was ranked 12th among all of the potential vital signs evaluated by the SFAN. Key reasons for monitoring regional landscape & land use change are (1) the rapid development of neighboring lands (2) the fragmentation of wildlife habitat (3) the need to detect life-form change within parks, and (4) to provide early warning of large-scale community shifts.

Monitoring questions to be addressed by the protocol:

1. What is the baseline resource condition (landform habitat type)
2. Are the landforms changing?
3. Do the landform processes affect change on a natural scale?
4. How has wetland type, structure, and extent changed?
5. To what extent has development caused habitat fragmentation?
6. How are wildlife corridors changing?
7. How connected are the parks to neighboring open spaces
8. What are the effects of land use change within the region?
9. What is the effect of global climate change on a landscape level?
10. What is the status of wildlife corridors within the I & M Network?

The monitoring objectives are:

- Determine status and trends in the areal extent and configuration of land-cover types (Anderson Level II) on park lands in order to evaluate large scale changes affecting park resources.
- Determine status and trends of key landscape metrics (e.g. proportion of area in different cover types, number and density of patches, mean patch size) of park lands and a ½ mile buffer in order to determine land use patterns in the parks.

Basic Approach:

Monitoring landscape dynamics would use two basic approaches. The first approach would focus on using a retrospective analysis in order to evaluate historic changes of landscape patterns and conditions. The second would focus on current through future conditions by obtaining current satellite imagery. Minimum resolution of imagery used would be comparable to Landsat or IKONOS.

Available information concerning landuse/landscape change work already being conducted in the Bay area would be gathered prior to initiating any new work. All historic

interpretation would be conducted as funding became available. Analysis of wetlands would include change in type, structure, and extent.

Frequency:

Every 10 years analysis would be conducted for all network parks

Timing:

Seasonality of images would be selected to maximize identification of major community types.

Principal Investigators and NPS Lead:

Dave Schirokauer, PORE GIS Biologist (415-464-5199).

Protocol Development Summary

Threatened and Endangered (T & E) Butterflies (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: GOGA, PORE

Justification/Issues being addressed:

Threatened and Endangered (T & E) Butterflies were ranked 13th among all of the potential vital signs evaluated by the SFAN. The protected legal status of these taxa require the NPS to evaluate the condition of these populations. Because they are closely tied to host and nectar plants, butterfly populations are good indicators of the general health of habitat. These taxa have very specific habitat requirements during different developmental stages, including specific host and nectar plants.

Monitoring questions to be addressed by the protocol:

1. Are the distributions or relative abundances of T&E butterflies changing?
2. Are the conditions and/or distribution of butterfly habitats changing?

Specific monitoring objectives are:

- Determine the trends in population distribution and relative abundance of threatened and endangered butterflies within known habitats in GOGA and PORE.
- Detect changes in acreage of habitat available for butterfly populations at GOGA and PORE such that potential impacts on the butterfly populations may be identified.
- Predict and identify new lupine habitat annually in order to identify new butterfly populations.

Basic Approach:

Mission blue butterfly (MBB): permanent and random butterfly transects during adult flight season, vegetation monitoring of their larval host plants and nectar sources.

Myrtle's silverspot butterfly (MSB): permanent and random butterfly transects during adult flight season, larval host plant monitoring (both done every two years).

Frequency:

Annual for MBB, biannual for MSB

Timing:

Flight seasons (spring for MBB, summer for MSB)

Principal Investigators and NPS Lead:

Dawn Adams, PORE Ecologist (415-464-5202) and Bill Merkle, GOGA Wildlife Ecologist (415-331-2894).

Protocol Development Summary

Streamflow (Updated 3/22/07; V2.04)

Parks where protocol will be implemented: GOGA, JOMU, PINN, PORE

Justification/Issues being addressed:

Streamflow is ranked 14th amongst all of the potential vital signs evaluated by the SFAN. Although intending to encompass the understanding of hydrologic conditions in both flowing and standing waters, this vital sign is currently limited to streamflow dynamics because of personnel limitations, funding constraints and our Network's proximity to urban influences. Streamflow characteristics offer some of the most appropriate and useful indicators for assessing river ecosystem integrity over time. The streamflow characteristics of a watershed reflect vegetation type, land characteristics and human use, the weather and climate conditions, and soil characteristics. Streamflow characteristics are extremely sensitive to human actions. Common human activities such as increasing impervious surface area in watersheds change the timing and magnitude of peak runoff events resulting in "flashy" systems (Dunne and Leopold 1978). Hydrologic variation in turn shapes the biotic diversity within river ecosystems by controlling critical habitat conditions within the river channel, the floodplain, and hyporrheic zones. Stream hydrology data provides key "support" data for existing NPS vital sign protocols including stream threatened and endangered (T&E) species and fish assemblages, T&E amphibians and reptiles, wetlands, and riparian habitat (NPS 2005). In the future, this protocol may be revised to include procedures for monitoring surface water dynamics in wetlands and intermittent, headwater streams.

Monitoring questions to be addressed by the protocol:

1. What are the long-term hydrologic trends for stream flow and water level?
2. How has development in or near parks changed streamflow dynamics?
3. How does the climate and weather affect the hydrology on parklands?
4. Are changes in water levels within a natural range of variation?
5. What are flood recurrence levels? (*or, stated more pragmatically, 'how large a culvert should I place here?'*)
6. Are existing hydrologic conditions conducive to aquatic ecosystem sustainability?
7. How do hydrological changes affect species of interest (e.g. red-legged frogs, coho salmon, steelhead trout) at critical life stages?

Specific monitoring objectives are:

1. Monitor the variability and long-term trends in stream flow using fixed water stage recording stations by producing annual mean daily and monthly discharge estimates in GOGA, JOMU, MUWO, PRES, PINN, and PORE.

2. Monitor the frequency, magnitude and duration of peak flow events at fixed water level monitoring stations by producing peak and daily summaries of stage height and discharge in GOGA, JOMU, MUWO, and PORE.
3. Monitor the frequency, magnitude and duration of unnatural or extreme low water/low flow events in stream reaches known to support threatened and endangered aquatic species in the dry season at GOGA, PINN, and PORE.

Basic Approach:

Nine stations were selected for monitoring including two within Golden Gate National Recreation Area, one at The Presidio, two at Point Reyes National Seashore, and one at John Muir National Historic Site, and three at Pinnacles National Monument. Two of the fixed stations at PINN will consist of staff and crest gages and not include dataloggers.

Primary monitoring tasks include obtaining stream flows; developing hydrographs and other data analysis tools for each stream gauge; downloading, maintaining, and calibrating hydrologic equipment; and refining the methodology for these tasks. Duties also include conducting literature reviews on monitoring parameters, instrumentation, and protocols for hydrologic monitoring. Recommendations for equipment replacement, upgrade, and installation will be made on a regular basis.

Flow measurements will be obtained monthly during the summer (in conjunction with station maintenance and downloading) and at regular intervals during winter storms to maintain the stage-discharge rating curve. Current meters at most sites will be used to obtain discharge following the USGS standard protocol (Rantz 1982). At PRES, a calibrated flume will be used to obtain discharge. Water level monitors (pressure transducers) will be utilized as well as staff and crest gages. Data collection and management will focus on the seven automated stream gauging stations within the network. However, as the monitoring plan is implemented and streamlined there will be opportunities to include data from locations without automated stream gages (e.g., staff gages at water quality monitoring sites and fish traps).

Additional data may be obtained from groups withdrawing surface or groundwater from monitored streams (e.g., Redwood Creek) in order to understand streamflow dynamics.

Principal Investigators and NPS Lead:

Darren Fong (Lead), GOGA Aquatic Ecologist (415-331-8716), Rob Carson, SFAN (415-464-5122), Paul Johnson, SFAN (831) 389-4485 ext.270), and Brannon Ketcham, PORE Hydrologist (415-464-5192).

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Protocol Development Summary

Wetlands (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: GOGA, JOMU, MUWO, PINN, PRES, PORE

Justification/Issues being addressed:

Wetland integrity ranked 15th out of all potential vital sign indicators in the San Francisco Bay Area Network (SFAN). Wetlands are keystone ecosystems in the San Francisco Bay Area. Some ecologists call wetlands "the kidneys of the landscape" as they provide water quality protection, flood and drought mitigation, erosion control, and groundwater recharge functions. Wetlands have also been called "biological supermarkets," for supporting complex food webs, housing a rich biodiversity of wetland-endemic species, and providing habitat functions for many aquatic and terrestrial species. An estimated 46% of US endangered and threatened species and 50% of all bird species require wetland habitat (USFWS). Wetland habitats are vulnerable to alteration due to global climate change and associated potential temperature, hydrology, and salinity regime changes. Understanding the condition of wetlands in SFAN parks may be a good proxy for understanding the condition of many taxa of concern in the network.

The San Francisco Bay Area Network includes estuarine, palustrine, lacustrine, and riverine wetlands. The two coastal parks in the network, PORE and GOGA contain a combined 120 miles of coastline, with numerous small estuarine wetlands at the convergence of freshwater streams and the Pacific. In addition, these parks contain and border on some of the most pristine (Drakes Estero) and largest (San Francisco Bay) estuaries on the west coast of North America. Palustrine wetlands are found within PORE, GOGA, PINN, PRES, and MUWO. These host rare and protected plants, and provide critical habitat for migratory birds. Natural lacustrine wetlands within the network are limited to several small ponds and lakes within GOGA and PORE, while riverine wetlands are found in all SFAN parks covered by this protocol.

Parks within the SFAN have made a concentrated effort to map and characterize wetlands on park lands using the Cowardin et al. (1979) classification. All of these mapped wetlands are classified by wetland type and plant community. Many of the mapped wetland polygons have also been characterized by complexity of biotic structure, dominant hydrology, function (e.g., flood retention, wildlife habitat), and major stressor (e.g., grazing, adjacent development, invasive species).

Monitoring questions to be addressed by the protocol:

1. How is the extent, type, condition, and function of wetlands changing over time in response to anthropogenic stressors and climactic variability.
2. Example questions include:
 - Is the hydrology of these wetlands changing over time in response to grazing, development, climate change?

- Is the type of wetland changing over time, e.g. are emergent vegetation communities shifting to scrub-shrub communities?
- Is native plant/animal use of SFAN wetlands changing over time?
- Are invasive plant populations in SFAN wetlands increasing or decreasing?

The draft monitoring objective is:

- Determine if the extent, type, condition and function of wetlands is changing.

Basic approach:

The wetlands monitoring program will be built upon wetland inventories that have already been completed in SFAN parks. These inventories resulted in a map of wetland polygons. A set of polygons from this map will be selected for cyclic monitoring on a “fixed site + rotating panel” design. The network acknowledges selecting polygons only from the existing wetlands maps will result in a non-random selection of wetland polygons within the network, as wetland mapping efforts have been unevenly distributed throughout SFAN lands.

Mapped wetland polygons will be stratified first by type, then by predominant stressor type (e.g., grazing, adjacent development, invasive species, no evident threat). Wetland polygons will be sampled from the resulting data set so that each major type is well represented. Samples will not be random, but may be chosen for accessibility and representativeness. Because wetlands in Wilderness portions of SFAN parks are not expected to change as rapidly as wetlands on non-Wilderness lands, cyclic monitoring will more heavily focus on wetlands that are subjected to known stressors.

These selected wetlands will be sampled quantitatively for integrity indicators such as water quality, water quantity, channel sinuosity and entrenchment, exotic plant cover, plant diversity, and percentage of obligate wetland plants. The specific Vital Signs to be measured at each wetland polygon are to be determined. SFAN staff is working with an interagency group, based in Northern and Southern California, which is currently developing a quantitative monitoring program for assessing wetland integrity and changes. This protocol has high potential to form the foundation of a wetlands monitoring program for SFAN, the purpose of which will be to assess local-scale, rapid response of wetlands to management and land use change.

Principal investigator and NPS lead:

Protocol development will be coordinated by the NPS Pacific West Region Aquatic Ecologist, Marie Denn (415.464.5222), with collaboration PORE GIS Biologist Dave Shirokauer, PORE Wetlands Ecologist Lorraine Parsons, and GOGA Aquatic Ecologist Darren Fong. Principal Investigators: TBD. NPS Lead: Marie Denn

Proposed Development schedule, budget, and expected interim products:

Development of a wetland monitoring protocol will take place in two phases: first, draft protocol development, and second, implementation of a pilot study, and refinement of the draft protocol prior to full implementation.

Phase 1, Draft Protocol Development. Development of a draft protocol for SFAN parks is estimated to require 0.5 FTE of GS-9 Wetlands Ecologist/GIS Specialist for 12 months. This employee will compile existing data, stratify previously-mapped wetland data sets, and collaborate with interagency groups in the San Francisco Bay Area to adapt existing/in-development wetland monitoring protocols to SFAN parks. This staff person will require the use of a GIS-capable computer, and intermittent use of a park vehicle. *Interim products:* stratified map of previously-classified wetlands on SFAN lands, draft protocol for monitoring specific attributes of sampled wetlands (e.g., water quality, water quantity, channel sinuosity and entrenchment, exotic plant cover, plant diversity, percentage of obligate wetland plants).

Phase 2, Pilot Study and Protocol Finalization: Finalization of the protocol will require 0.75 FTE of GS-9 Wetlands Ecologist/GIS Specialist for 12 months, and 0.5 FTE of GS-5 Biological Science Technician for 12 months. This team will implement the draft protocol, evaluate the change detection capability of the method, revise the protocol as necessary, and produce a final protocol for approval by the network and by national I&M program coordinators. The team will require the use of a GIS-capable computer, and a shared (half-time) park vehicle for 1/2 of one calendar year. *Interim products:* a final approved protocol ready to begin full implementation of cyclic wetlands monitoring.

Literature Cited

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Protocol Development Summary

Riparian Habitat (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: GOGA, JOMU, MUWO, PINN, PORE, PRES

Justification/Issues being addressed:

Riparian Habitat was ranked 16th among all of the potential vital signs evaluated by the SFAN. Riparian habitat is closely tied to the health of both wetlands and streams, two indicators that the network has proposed for monitoring. Riparian habitat also influences stream fish assemblages. Characteristics of riparian habitat structure such as the ratio of edge to interior, the degree of canopy complexity within riparian strata (e.g., herb/forbs, shrubs, subcanopy tree, and overstory tree), and the degree of fragmentation is highly associated with amount and type wildlife use.

Monitoring questions to be addressed by the protocol:

1. Is vegetation community structure functioning within a natural range of variability (i.e. habitat for wildlife species, stabilization for the stream bank, and nutrient cycling)?
2. Is riparian habitat size or distribution changing?

Specific draft monitoring objectives are:

- Determine status and trend of riparian habitat by measuring species composition, habitat structure, and width along streams in SFAN parks.

Basic Approach:

Portions of this indicator would be covered through the monitoring of wetlands, plant communities, and landscape change. Issues not specifically addressed by these indicators would be developed for more specific riparian monitoring.

Aerial photograph interpretation:

- **Width of Riparian Zone:** width in meters of riparian habitat along either side of creek. Relates to functions such as dissipation of stormwater flows, nutrient retention/water quality improvement, and ratio of edge to interior habitat for wildlife species.
- **Width of Corridor Available for Lateral Migration:** channel migration through avulsive or accretive meandering is highly associated with riparian establishment and senescence processes. Corridor width is determined not only by geologic/topographic constraints (e.g., narrow gorge or canyon), but anthropogenic-related structures such as levees, construction of flood control channels, residential, commercial, and agricultural development adjacent to creeks, etc.

- Length of Unfragmented Riparian Corridor: length of unfragmented riparian habitat along either side of creek in meters. Averaged for both sides of creek and expressed as average per kilometers of creek. Unfragmented habitat provides more of the functions associated with riparian habitat, including better transportation corridor for wildlife.

Channel Typing: Use of Rosgen/CDFG Methodology:

- Degree of Entrenchment: The degree of channel incision. The ability of a creek to support a diverse, broad expanse of riparian habitat is related to the degree of entrenchment. The more entrenched the creek, the less potential for riparian establishment and successional processes.
- Degree of Disturbance/Functionality: Assessment for signs of disturbance such as excessive erosion, signs of rip-rap, stresses from cattle use, etc.

Vegetation Field Surveys:

- Total Percent Vegetation Cover in herb/forb, shrub, subcanopy tree, and overstory tree strata. Percent cover in the various strata as determined through releve or point-intercept methods. A diverse mixture of cover in various strata increases attractiveness of riparian habitat to wildlife species.
- Community Composition, including percentage of non-native species: Composition of species within riparian habitat, including percentage of non-native species.

Frequency:

Every 5 years

Timing:

Vegetation surveys should be timed to coincide with maximum canopy cover, probably in August-September.

Not receiving I & M funds in FY05-FY07 draft budget. The vegetation metrics will be partially covered through plant community change monitoring protocols. Some of the habitat metrics may be covered through stream fish monitoring.

Protocol Development Summary

Landbird Population Dynamics (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: GOGA, JOMU, PINN, PORE, and PRES

Justification/Issues being addressed:

Landbirds were ranked 17th among all of the potential vital signs evaluated by the SFAN. Landbird monitoring is focused in riparian and coastal scrub/chaparral habitats which were ranked as a high priority for SFAN parks. Landbirds are good indicators of terrestrial ecosystems because numerous dynamic processes interacting together have the potential to affect their abundance and distribution. Changes in species abundance, distribution, and reproductive success are critical parameters that may be caused by changes in habitat, food supply, park management strategies, disturbance to nesting areas by recreational users, or environmental factors on multiple scales (localized storm events to decadal shifts in climate). Monitoring annual adult survival is also important for understanding population trends in order to better understand the various influences on demographic patterns.

Specific monitoring questions and objectives to be addressed by the protocol:

1. What are the long-term trends in species composition and relative abundance of the landbird guild?
2. What is the natural level of variation in population distribution and relative abundance of the landbird guild?
3. What is the productivity of selected landbird species in the parks relative to other reference areas?
4. How do management activities that affect plant communities affect the composition and abundance of landbirds?
5. How are long-term climate changes affecting reproductive success, survival, and phenology of migration and productivity.

The monitoring objectives are:

- Detect a 50% change in the population size (i.e., abundance) of target species in riparian and coastal scrub/chaparral habitats during breeding season (mist-netting, point counts), fall (mist-netting, area search), and winter (mist-netting) over a 20-year period, with an 80% probability of detecting change if it occurs
- Detect a 25% change in species richness and occurrence of select landbird species in riparian and coastal scrub / chaparral habitats during breeding season (mist-netting, point counts), fall (mist-netting, area search), and winter (mist-netting) of each park over a 20 year period (target species for inclusion in analyses is in development).
-
- Determine long-term changes in productivity and annual survival for select landbird species in riparian habitat using mist nets.

Basic Approach:

The NPS Inventory and Monitoring Program has developed guidance for monitoring landbirds in national parks (Fancy and Sauer 2002). These guidelines will be used to evaluate and modify historic and on-going monitoring efforts in order to develop the SFAN Landbird Monitoring Protocol.

Sampling will involve point count surveys (variable point count distance sampling), mist-netting and banding (MAPS protocol), and periodic vegetation sampling. Sampling will be primarily on a Network-level spatial scale (within and among parks) in order to inform park managers of park-specific changes. Monitoring will be focused in two habitat types, riparian and coastal scrub/chaparral, which are priority habitats for the Network and parks involved in this monitoring. Productivity monitoring in riparian habitat will be complemented by PRBO Conservation Sciences' ongoing work in coastal scrub habitat.

Even though local changes may occur due to changes in habitat quality or quantity, effective and efficient management actions must have knowledge of larger-scale patterns. We believe our sampling will provide adequate precision at the local and regional network scales, in addition to benefiting from being part of, and informed by, larger-scale monitoring efforts (e.g., MAPS, BBIRD, Breeding Bird Survey, Christmas Bird Count). Long-term monitoring by PRBO Conservation Science in coastal scrub habitat will

Plots will be selected from stations set up during previous inventory and monitoring work at PORE, GOGA, and PINN. Specifically, at PORE and GOGA: (1) Continue mist-netting at all previously established / currently monitored mist-netting study sites year-round at Palomarin, Muddy Hollow, and Pine Gulch and only during the breeding season at Lagunitas Creek and Redwood Creek. (2) Continue nest monitoring at Palomarin (3) Conduct point count surveys annually at all previously established / currently monitored stations in coastal scrub / chaparral and riparian habitats. (4) Establish mist netting at one new coastal scrub site (likely the same as one of the proposed point count plots). (5) Establish point count surveys at two new coastal scrub sites (likely one site will be the same as the proposed mist-netting station). (6) Conduct vegetation sampling at all point count survey sites once every five years.

PINN: (1) Conduct point count surveys annually at all previously established stations. (2) Conduct vegetation sampling at all point count survey sites once every five years.

The implementation will occur with a cyclic rotation: 3 years on/ 3 years off. Although annual reports will be required during the monitoring years, every fourth year, emphasis will be placed on developing a comprehensive analysis and synthesis report. Each of these reports will provide information on long term trends and put local changes into a regional context. The emphasis may change from year to year. For example, one reporting year may just focus on productivity changes. The next report may focus on breeding populations. The cyclic strategy will allow the network to meet its overall goal of monitoring landbirds and provide for additional resources to monitor other key vital signs.

Principal Investigators and NPS Lead:

Protocol development was partially completed through a cooperative agreement with the PRBO Conservation Science. Principal Investigators will be Thomas Gardali, Grant Ballard, and Geoffrey R. Geupel from PRBO (415-868-0655), William Merkle, GOGA Wildlife Biologist (415-331-2894), Marcus Koenen (415-331-5734, and Dr. Sarah Allen, PORE Senior Scientist (415-464-5187). NPS Lead: William Merkle.

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Fancy, S.G. and J.R. Sauer. 2002. Recommendations for Inventorying and Monitoring Landbirds in National Parks. DOI, National Park Service Inventory and Monitoring Program.

Protocol Development Summary

Raptors & Condors (Updated 12/15/06; V2.04)

Parks where protocol will be implemented: PINN

Justification/Issues being addressed:

Raptors were ranked 18th among all of the potential vital signs evaluated by the SFAN. Raptors have been monitored at Pinnacles National Monument for 20 years, providing crucial data relied upon by park management to balance resource protection and compatible visitor use. The initial monitoring efforts were prompted by several lawsuits being filed when the park attempted to close portions of the High Peaks climbing area to protect nesting prairie falcons and golden eagles. A compromise was forged to avoid litigation that involved the park performing annual monitoring of raptors in the High Peaks and using the results to open up areas for climbing that were free of nesting for that season. Without the annual monitoring efforts, the park would clearly not be able to adequately manage climbing activities, and the same conflicts would resurface as before, quite likely leading to litigation again by the same climbing/access organizations.

The raptor monitoring program has become a very successful model on how to use wildlife monitoring data to better manage visitor use and is the longest term annual population monitoring program for prairie falcons in the U.S. (Emmons 2005, Reichtin 2002, Steenhof 2005). Long-term trends in the number of territorial pairs and annual productivity of prairie falcons also provide a means to evaluate the overall ecological integrity and sustainability of the rock/cliff ecosystem, and the importance of the park as a regional population source for this species. Recent information indicates that prairie falcons have been declining throughout the state and are being considered for petitioning for listing under federal protection (Fesnock, pers comm., 2006). Recent data from a radio-telemetry study of prairie falcons within PINN have shown that unlike other populations in the western US, falcons inhabiting PINN do not exhibit migratory behavior (Buranek, pers. comm. 2006). Instead, they rely on PINN and surrounding privately-held lands for foraging the entire year and are therefore particularly sensitive to changes in land use surrounding PINN.

Patterns in the number of territorial pairs and nesting success (number of fledged falcons per nest) tracked over the long-term will be compared to other long-term changes in the region including climate, effects of conversion and development of agricultural lands surrounding PINN, and visitor use.

The protocols developed through support by the Inventory and Monitoring Program will enhance the ability of the park to track long-term changes in the prairie falcon population and strengthen the validity of any management actions required to restrict visitor use to protect the falcons. Support from the I&M program will also institutionalize and secure long-term funding for the program.

Monitoring questions to be addressed by the protocol:

1. Are annual reproductive rates and numbers of nesting raptors at PINN changing over time?
2. Are there differences in annual reproductive rates and numbers of nesting raptors between climbing and non-climbing areas at PINN?
3. How can monitoring data be used to minimize/mitigate threats posed by climbing activities?

Specific monitoring objectives are:

- Track changes in the total numbers of territorial prairie falcon pairs in a. the core climbing areas and b. non-core areas.
- Track changes in average annual productivity in a. the core climbing areas and b. non-core areas.

Basic Approach:

Raptors have been monitored at the park for 20 years. Focus of protocols is on prairie falcons. Details are being further refined by park staff based on comments received from peer reviewers. Support for developing a long-term sampling strategy will be garnered through the Cooperative Ecosystem Studies Unit (CESU). Annual data collection is required because the information is necessary to determine which climbing areas can be opened for use during that nesting season. Condors may be added to the protocol if a breeding population becomes established in the future.

Frequency:

Every year

Timing:

January to March – Determine numbers of pairs exhibiting territorial behavior.

March to April – Determine numbers of nests attempted

April to May – Determine numbers of eggs laid/hatched.

May to June – Determine hatching success, pre-and post fledgling survival.

June to July - Write annual report.

Principal Investigators and NPS Lead:

Jim Petterson, PINN Wildlife Biologist (831-389-4425, x223)

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