Appendix V: Resources Monitoring Workshop held at Cabrillo National Monument January 2000

Final Report for Sub-agreement No. 20, Modification #5 to Cooperative Agreement No. 1443-CA9000-95-018

Vital Signs – Part I
Workshop 2000 Report
Cabrillo National Monument
and
Point Loma Ecological Reserve

January 25-27, 2000

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Introduction

Cabrillo National Monument (CNM) is one of the few in the National Park system located in coastal southern California. This park is situated on a peninsula with the Pacific Ocean to the west, and the entrance to the San Diego Bay to the east. The natural resources at this park represent an unusual collection of terrestrial and marine resources that have similar characteristics to those in other Mediterranean-like climates. While similar, this collection is also unique in its species composition, containing both those found to the south in adjacent Baja Mexico and those of more temperate climates in northern California. These unique coastal habitats, especially in southern California, are declining due to urban pressures. In order to effectively understand, manage, and preserve these resources, researchers and managers must first learn the condition and status or what is there (i.e., inventory), and also track the resources over time in order to detect potential changes (i.e., monitoring). Those resources and parameters which are considered critical to understanding the health of the ecosystem are identified as "vital signs" of that ecosystem.

Long-term monitoring of the natural resources of Cabrillo National Monument began in 1990 with the organisms and habitats of the rocky intertidal community, including shorebirds. This program was organized and implemented by Gary Davis (National Park Service [NPS]) and Jack Engle (University of California Santa Barbara), and was designed for monitoring to occur in parallel to that occurring at Channel Islands National Park as well as other regional efforts along the southern California coast.

The first effort to identify the "vital signs" for CNM was made at a workshop on February 17-18, 1993. Organized by Steve Veirs from the University of California Cooperative Park Studies, the workshop resulted in a plan for management developed by then Chief Ranger Howard Overton.

In January 2000, Cabrillo NM natural resource science staff continued on this process to identify "Vital Signs" for the park and to develop a monitoring program for those vital signs. There were several steps in this process including setting park goals for the program, identifying key resources and describing how they are ecologically related, identifying potential vital signs, and describing what needed to be done to develop monitoring protocols for those signs.

The natural resource science staff at Cabrillo NM decided that convening a group of experts could be used to effectively facilitate this process. The workshop was designed to bring together scientists and researchers from a wide variety of natural resource disciplines to brainstorm on a list of natural resources for the monument that could potentially be vital signs. Most of the participants were scientists involved in research in CNM or a similar ecosystem. Participants had a wide range of experience and expertise in a variety of disciplines and came from local, state, federal and private organizations.

At the workshop, a qualitative description (including a tour) was presented of the natural resources of the park and adjacent Point Loma Ecological Reserve (PLER). South of the urbanized area of Point Loma, the 640-acre PLER was created in 1993 to protect and manage the native terrestrial habitat on the peninsula. This partnership effort was established between five governmental agencies. These partners are, in order of land ownership size, the U.S. Navy, National Park Service, U.S. Department of Veterans Affairs, City of San Diego, and the U.S. Coast Guard. In addition, another partner, the U.S. Fish and Wildlife Service is a non-voting member of the board, providing scientific recommendations and guidance. The Reserve lands were included in the identification of the resources because these lands are integral to the ecosystem.

A facilitator was designated to improve efficiency, keep workshop discussions focused, and ensure consistent output among workgroups. Gary Davis, NPS Senior Scientist at Channel Islands National Park, facilitated the workshop, including providing an overview of the vital signs concept and identification process. During the workshop, attendees were divided into working groups to identify natural resource inventory and monitoring needs for Cabrillo National Monument and Point Loma Ecological Reserve. A future workshop is planned; the list of resources will be further evaluated to prioritize the potential vital signs that were identified.

Concurrently and in association with this process, the National Park Service implemented a strategy designed to institutionalize natural resource inventory and monitoring on a programmatic basis throughout the agency. Funding for this initiative came from the Natural Resource Challenge – an action plan for preserving natural resources. The Natural Resource Challenge (1999) provided funding to Networks of parks to expand existing and develop new inventory programs and develop efficient ways to monitor the vital signs of natural systems. These networks of parks were tasked with conducting long-term ecological monitoring for selected critical parameters, or "vital signs". Cabrillo National Monument is a member of the Mediterranean Coast Network, along with Channel Islands National Park (CHIS) and Santa Monica Mountains National Recreation Area (SAMO).

This process has been integrated into the Government Performance and Results Act (GPRA). Congress passed this law in 1993 that required Federal agencies to develop a strategic plan, annual performance plans, and annual performance reports in order to more effectively and efficiently manage their activities to achieve their missions, and to more effectively communicate with the Congress and the American people. One of the GPRA goals set by the park was that by September 30, 2005 Cabrillo NM would have identified its vital signs for natural resource monitoring (Goal Ib3 Vital Signs).

What Are Vital Signs?

Vital Signs are key elements that indicate the health of an ecosystem. Vital signs may occur at any level of organization including landscape, community, population, or genetic levels. They may be compositional (referring to the variety of elements in the system), structural (referring to the organization or pattern of the system), or functional (referring to ecological processes). Vital signs can be any measurable feature of the environment that provides insights into the state of the ecosystem. The term is synonymous with "ecological indicator", but use of the term and the analogy to an individual's health helps the NPS to explain the need for monitoring to managers, Congress, and the public.

The National Park Service needs a clear simple way to account for how it is preserving the nation's natural heritage. The Service needs to identify and monitor the vital signs of environmental health in parks, just as physicians monitor their patients' vital signs, as a means of sustaining the health of park resources, diagnosing threats to their well being, and mitigating those threats. Monitoring park vital signs provides the foundation for this accountability by evaluating efficacy of restoration and other management actions and by warning of impending threats to the natural resources of the parks. The concept of ecosystem health is not dissimilar to that for individual health. A healthy individual's vital signs remain within a normal, dynamic range and return to a nominal level quickly after disturbance. Damage to structural elements, when promptly and accurately diagnosed, is quickly and effectively repaired to sustain normal functions (restoration and maintenance). Infections (alien species) can be eliminated or contained when their nature and extent are identified in a timely manner. The same attributes pertain to wild populations, communities, and ecosystems in parks. While vital signs for these higher levels of ecological organization are not yet known with certainty, experience in many parks indicates that basic measures of physical and chemical environmental factors and population dynamics of selected species serve this role well. Just as early physicians discovered the value of body temperature, respiratory rate, and blood pressure in assessing patient health by measuring them in many patients, today's park managers need to begin measuring dynamic ecosystem parameters to identify environmental 'vital signs' for parks and to establish their normal variation.

The monitoring of vital signs is an important component of the Service's need to maintain ecological integrity of park ecosystems. Ecosystems with high ecological integrity continue to express the evolutionary and biogeographic processes that gave rise to the current biota, and they have a species composition, diversity, and functional organization expected from natural

habitats of the region. Systems with ecological integrity are resilient to environmental disturbance within a natural range of variability. Thus, an ecological system has integrity when it maintains its characteristic compositions, structures, and processes against a background of anthropogenic disturbance.
(http://www.nature.nps.gov/im/monitor/#VitalSigns)

Vital Signs Workshop 2000

Workshop Schedule

During January 25-27, 2000, a Vital Signs Workshop was held at Cabrillo National Monument. The goals of this workshop were to:

review the general ecosystem of the park (i.e., basic qualitative descriptions of the monument's natural resources, including a tour),
identify the key natural resources of the park, and
develop Resource Management Project Statements which describe efforts needed to develop inventories and monitoring protocols for these key natural resources as potential vital sign indicators.

NPS personnel devoted the first day of the workshop to introductions of participants (Appendix A), explanations of vital signs, and the NPS natural resource program. Some of the topics covered during day one include: "What are Vital Signs?", What is Point Loma?" (i.e., the components and elements of), and background information about the natural resource program at Cabrillo NM (Appendix B). Background information included information on species of special concern (Appendix C) and past inventory and monitoring projects at the monument (Appendix D). Workshop participants toured the Point Loma Ecological Reserve in the afternoon.

On the second day of the workshop, the group divided into work groups. Each work group served to focus expertise: Marine Resources, Physical Resources, Terrestrial Vegetation, and Terrestrial Wildlife. Participants joined one of these groups, and work groups first identified broad categories, concerns and issues within these broad categories (Appendix F, G, H, and I). From these broad, brainstorming efforts, work group members were then tasked with identifying key natural resources of the area and methods to inventory and monitor these resources.

Each group was tasked with completing Project Statements to describe the natural resource of concern. The questions of the Project Statements serve as guidance to develop inventory and monitoring needs for each of the natural resources identified:

Title (i.e., topic of concern)
Problem Statement – What is the problem/issue to be addressed?
Objectives
What do we know/have done already?
Descriptions of Recommended Activity
What are the Deliverables? Products?
Proposed Budget (e.g., number of personnel, contractor(s), equipment, travel, transportation, number of years, and all other components needed for the efforts).

Workshop Results

The workshop identified the following as potential vital signs for inventories and monitoring. Those identified in normal font indicate those resources for which inventories are first needed to collect additional baseline information to better understand basic information about the resources. Those categories in italics identify those resources, given current information, for which a monitoring effort is needed in the future or for which a monitoring plan should be developed based on the Project Statements.

Terrestrial Resources (in alphabetical order) (Appendices J through T):
Bats – Presence, distribution, and diversity changes from historic records
Birds – Population trends and habitat associations by group (e.g., breeders, raptors, migrants, shore birds, diving species)
Herpetofauna (Reptiles and Amphibians) – Population trends and species richness
Mammalian Carnivores – Long-term population trends
Small Mammals and Meso-Herbivores – Distribution and abundances
Small Mammals and Meso-Herbivores – Population trends
Small Mammal – Pacific Pocket Mouse presence
Terrestrial Invertebrates (Insects and Arthropods) – Diversity and densities
Terrestrial Invertebrates (Insects and Arthropods) – Diversity and abundances
Terrestrial Vegetation (Rare and Sensitive Species) – Plant and habitat distributions
Terrestrial Vegetation (including Alien Species) – Plant distributions and population dynamics

Physical Resources that include both terrestrial and marine aspects (in alphabetical order) (Appendices U through W):
Physical Resources (Erosion) – Rates, events, and impacts (including sedimentation in intertidal zone)
Physical Resources (Fresh Water Resources) – Inventory
Physical Resources (Geological Resources) - Inventory

The marine resources group incorporated a habitat type and community niche approach to identify the following potential vital signs.

Marine Resources (Appendix F):
Cabrillo National Monument Rocky Intertidal Monitoring Program - Performance analysis
Rocky Intertidal Resources – Population dynamics (abundance and distribution) of birds, people, and selected species of invertebrates and plants
Rocky Intertidal Resources – Biodiversity changes
Intertidal Habitat – Evaluating influences
Water Quality – Effects of the San Diego Bay outflow
Intertidal Habitats on the San Diego Bay side
Subtidal Habitats - Inventory

Future Objectives

The Project Statements that were developed can be used to direct upcoming inventory and monitoring efforts. The statements provide a solid base from which to pursue partnerships and grants in order to accomplish the goals of understanding the natural resources of CNM and the PLER.

Two future workshops will focus on specific aspects of these recommendations. At the time of the writing for this report (2003), two additional workshops have occurred. First, a workshop was held in November of 2001 focusing on the first priority of the marine resources group – a review of the first 10 years of the Cabrillo National Monument Rocky Intertidal Monitoring Program. This review included contracting with a University of California Santa Barbara faculty member to conduct a power analysis of the sampling methodology (Becker 2003).

The second workshop was held in the spring of 2003 (March 28). This workshop also involved regional biologist, ecologists, partners and researchers. The objectives of this workshop were to evaluate the list of resources provided here, as well as some additional components, and prioritize the natural resources of Cabrillo in order to develop an ordered list of vital signs for the park. Results from that workshop are submitted in a separate report (Cameron 2003). The results of that workshop will be used to establish monitoring goals and objectives.

Acknowledgements

A special thank you is extended to Gary Davis for his support with this workshop, for his review and input of this report, and for his on-going role in the development of monitoring programs at Cabrillo National Monument and the Mediterranean Coast Network.

Appendix V-a. Participants

Vital Signs Workshop 2000, January 25-27, Cabrillo National Monument and Point Loma Ecological Reserve

Name	Expertise/Position	Organization*
Joy Bannerman	Tidal life	Independent
Bonnie Becker	Rocky intertidal	UCSD/NPS
Tammy Conkle	Wildlife	USN
Kevin Crooks	Mammals	UC Santa Cruz
Craig Dalby	GIS	NPS
Gary E. Davis	Marine ecology	NPS
Terry DiMattio	Superintendent	NPS - CABR
Shana Dodd	Small mammals	SC Dodd Biology
Kate Faulkner	Chief, Natural Resources	NPS - CHIS
Robert Fisher	Reserve design	SDSU/USGS
Jay Goldsmith	Plants/planner	NPS - PGBSO
William Haas	Birds	Varanus Biological Services
Pierce Harris	Geology	SDCCD
Lisa Hefferman	Soil ecology/restoration	USIU
Carol Knipper	Chief, Resource Management	NPS - CABR
Mietek Kolipinski	Water resources	NPS – San Francisco
Jan Larson	Natural Resource Management	USN
Tom Link		Independent
Steve Montgomery	Mammals	SJM Biological
Krista Pease	Insects/terrestrial ecology	NPS Volunteer
Mitch Perdue	GIS/PLER history	USN
Karl Pierce	Chief, Interpretation	NPS - CABR
David Pivorunas	Botany/restoration	USN
Mary Platter-Rieger	Biologist	USN
Jerry Powell	Insect Inventory	UC Berkeley
Ingri Quon	Birds	Varanus Biological Services
Kristin Riser	Kelp forest ecology	UCSD
Judy Rocchio	Air quality, noise, geology	NPS
Dan Rubinoff	Insects/coastal sage scrub	UC Berkeley
Juda Sakrison	Botany/rare species	SDSU
Jennifer Stone	Vegetation	USN
Andy Suarez	Ants	UCSD
Samantha Weber	Chief, Natural Resource Science	NPS - CABR

*Acronyms:

CABR	Cabrillo National Monument
CHIS	Channel Islands National Park
NPS	National Park Service
PGBSO	Pacific Great Basin Support Office
SDCCD	San Diego Community College District
SDSU	San Diego State University
UC Berkeley	University of California, Berkeley
UCSD	University of California San Diego
UC Santa Cruz	University of California Santa Cruz
USGS	U.S. Geological Survey
USIU	United States International University
USN	U.S. Navy

Appendix V-b. Workshop Agenda

Vital Signs Workshop 2000, January 25-27, Cabrillo National Monument and Point Loma Ecological Reserve

Tuesday, January 25, 2000

8:00-8:15 AM	Welcome – Terry DiMattio (Cabrillo NM Superintendent)
8:15-8:30	Greetings – Samantha Weber (Cabrillo Chief Natural Resource Science Division)
8:30-8:45	Introduction, Vital Signs, Goals for this workshop – Gary Davis (NPS Senior Scientist, Channel Islands National Park)
8:45-9:00	Participant introductions
9:00-10:30	The design process in a workgroup format, with examples from Channel Islands – Gary Davis
10:30-10:45	Break
10:45-12:00	Description of Cabrillo and environs - Samantha Weber, Bonnie Becker (University of California San Diego and NPS), and Robert Fisher (U.S. Geological Survey). How we see Point Loma, the park's boundaries, elements within, etc.
12:00-1:00 PM	Lunch
1:00-3:00	Tour of Point Loma Ecological Reserve and Cabrillo National Monument
3:00-4:30	What is Point Loma? Groups work together to formally define our "environs" and the elements within.
4:30-4:50	"What to think about tomorrow"—Gary Davis
4:50-5:00	How can we help you this week, any special needs, requests, etc.—Samantha Weber
5:30-7:00	Evening social at Cabrillo National Monument

Wednesday, January 26, 2000

8:00-8:30	Morning review: what we've done, what's next, what's the process. Whom among workgroups is the moderator; that person's role, team goals - Gary Davis.
8:30-8:45	[If needed] Any additional discussion; clarification of goals, etc.-group.
8:45-10:30	Break into teams, work on Vital Signs
10:30-10:45	Break
10:45-12:00	Work in teams.
12:00-1:00 PM	Lunch
1:00-3:00	Work in teams

3:00-3:15	Break
3:15-4:15	Continue to work in teams
4:15-4:30	Groups review progress for 5 minute report what's done so far, what's remaining
4:30-4:55	Each group presents 5 minute report
4:55-5:00	Remarks re: progress, what's next - Gary Davis

Thursday, January 27, 2000

8:00-8:30 AM	Greeting and update re: progress, priorities, strategy, goals
8:30-10:30	Work in teams.
10:30-10:45	Break
10:45-12:00	Work in teams.
12:00-1:00 PM	Lunch
1:00-1:15	Welcome back and advice regarding remaining time – Gary Davis
1:15-3:15	Work in teams.
3:15-3:30	Break
3:30-4:00	Groups conclude and prepare 10-minute presentation.
4:00-4:45	Groups present work products.
4:45–5:00	Concluding remarks – Gary Davis, Samantha Weber, Terry DiMattio

Appendix V-c. Species of Special Concern

Cabrillo National Monument and Point Loma Ecological Reserve

Species of Concern

There are many plant, reptile, bird and mammal species at Cabrillo National Monument that are listed as either endangered, or sensitive. The following list includes those species:

Plants	
Endangered	
Chorizanthe orcuttiana	Orcutt's spineflower
Suaeda californica	California seablite
Sensitive	
Agave shawii	Shaw's agave
Aphanisma blitoides	San Diego coastal creeper
Atriplex coulteri	Coulter's saltbush
Bergerocactus emoryi	Golden-spined cereus
Calindrina maritime	Sea kisses
Camissonia lewisii	Lewis's evening primrose
Ceanothus verrecosus	Wart-stemmed ceanothus
Chorizanthe fimbriata var. fimbriata	Fringed spineflower
Chorizanthe procumbem var. procumbens	Pala spineflower
Coreopsis maritime	Sea dahlia
Corethrogyne filaginifolia var. incana	San Diego sand aster
Dichondra occidentalis	Western ponyfoot
Erysimum ammophilum	Coast wallflower
Euphorbia misera	Cliff spurge
Ferocactus viridescens	San Diego barrel cactus
Frankenia palmeri	Palmer's frankenia
Fritillaria biflora	Chocolate lily
Jepsonia parryi	Coast jepsonia
Lotus nuttallianus	Nuttall's lotus
Microseris douglasii ssp. Platycarppha	Small-flowered microseris
Nemacaulis denudata var. denudata	Coast wooly-heads
Opuntia parryi var. serpentina	Snake cholla
Orobanche parishii ssp. Brachyloba	Short-lobed broomrape
Piperia cooperi	Cooper's rein orchid
Quercus dumosa	Coastal scrub oak
Selaginella cinerascens	Ashy-spike-moss
Vigueria lacinata	San Diego sunflower

Amphibians and Reptiles

Sensitive	
Anniela pulchra pulchra	Silvery legless lizard
Cnemidophorus hyperythrus	Orange-throated whiptail
Phrynosoma coronatum	Coast horned lizard
Crotalus ruber ruber	Northern red diamond rattlesnake
Diadophis punctatus similis	San Diego ringneck snake
Eumeces skiltonianus interparietalis	Coronado skink

Note: Italics means historically on Point Loma but not found in recent history.

Birds

Endangered

Empidonax traillii extimus	Southwestern willow flycatcher
Pelecanus occidentalis californicus	California brown pelican
Sterna antillarum browni	California least tern
Vireo bellii pusillus	Least bell's vireo

Threatened

Charadrius alexandrinus nivosus	Western snowy plover
Haliaeetus leucocephalus	Bald eagle
Polioptila californica californica	Coastal California gnatcatcher

Sensitive

Accipiter cooperii	Cooper's hawk
Accipiter striatus	Sharp-shinned hawk
Agelaius tricolor	Tricolored blackbird
Aimophila ruficeps canescens	Southern Calif. rufous-crowned sparrow
Amphispiza belli	Sage sparrow
Athene cunicularia hypugea	Western burrowing owl
Buteo regalis	Ferruginous hawk
Buteo swainsoni	Swainson's hawk
Campylorhynchus brunneicapillus couesi	San Diego cactus wren
Cerorhina monocerata	Rhinoceros auklet
Circus cyaneus	Northern harrier
Cypseloides niger	Black swift
Elanus caeruleus	Black-shouldered kite
Eremophila alpestris actia	California horned lark
Falco columbarius	Merlin
Falco mexicanus	Prairie falcon
Falco peregrinus anatum	American peregrine falcon
Gavia immer	Common loon
Icteria virens	Yellow-breasted chat
Lanius ludovicianus migrans	Loggerhead shrike (migrant)
Larus californicus	California gull
Laterallus jamaicensis corturniculus	California black rail
Numenius americanus	Long-billed curlew
Nycricorax nycticorax	Black-crowned night heron
Oceanodroma homochroa	Ashy storm-petrel
Oceanodroma melania	Black storm-petrel
Pandion haliaetus	Osprey
Phalacrocorax auritus	Double-crested cormorant
Piranga flava hepatica	Hepatic tanager
Piranga rubra rubra	Summer tanager
Progne subis	Purple martin
Rinchops niger	Black skimmer
Riparia riparia	Bank swallow
Sterna elegans	Elegant tern
Synthliboramphus hypoleucus scrippsi	Xantus' murrelet
Toxostoma bendirei	Bendire's thrasher
Vermivorta virginae	Virginia's warbler

Mammals

Sensitive

Eumops perotis	Western mastiff bat
Nyctinomops femorosaccus	Pocketed free-tailed bat
Nyctinomops macrotis	Big free-tailed bat

Neotoma lepida intermedia	San Diego desert woodrat
Perognathus (Chaetodipus) fallax fallax	San Diego pocket mouse

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Appendix V-e. Current Monitoring Programs at Cabrillo National Monument

Rocky Intertidal: Twice yearly surveys of marine invertebrates, algae and one vascular plant (surf grass) plus shorebird/people counts whenever low tide is 0 ft or lower between 10:00am and 4:00pm. Begun 1990, completed each year in the spring and fall. Fixed plots (99): 2 replicates in each of 3 zones [1] red algae (turf) [high], [2] surf grass [medium], and [3] kelp [low], 63 photo point plots, 18 owl limpet plots.

Terrestrial Vegetation: Monitoring done in 1993, 1998, and the spring of year every 3-5 years. Procedures include random plots, sampling every ½ meter along 50-m transects, and additional sampling in wet years.

Herpetology: Reptiles and amphibians monitored from 1995. 17 arrays on Point Loma, 9 of which are in the park. Arrays are Y-shaped drift fence configuration with seven 5-gallon buckets plus snake traps. Sampling for 10 days, every 6 weeks. Have monitoring protocols for snakes and lizards, includes toe clipping, scale clipping, and collection of samples for DNA analysis.

Air Visibility: Camera site north of Visitor Center, takes photo 3 times per day (9:00am/12:00pm/3:00pm). Started in 1996. Slides could be analyzed by National Park Service Air Resources Division for air quality/visibility.

Appendix V-f. Marine Work Group Notes

Broad concepts to consider, issues of concern, Vital Signs Workshop 2000, January 25-27, Cabrillo National Monument and Point Loma Ecological Reserve

Present
January 26: Bonnie Becker (NPS/SIO), Kristen Riser (SIO), Gary Davis (UCD/NPS), Krista Pease (NPS-VIP)
January 27: Bonnie Becker (NPS/SIO)

Notes
Thoughts we/I had, thing to consider:

- Connectivity—Seagrass, Kelp, Bay, Rocky Intertidal
- Abalone restoration
- Physics
- Chemistry—who has what? Navy, F&G, NOAA mussel watch, can it be combined into a single database, at what scale?
- Sedimentation
- Visitor impacts-impacts, public outreach
- Public outreach
- Ephemerals
- Rocky intertidal scale—moving up the coast
- GPS/GIS
- Statistical issues
- Dive program
- Fitting into MMS program
- Supply-side ecology
- Aerial photos to see mussel bands
- Shorebirds
- Inventory—rocky, subtidal, bayside, infauna
- High tide studies
- Next time, a study of effects of dead whale
- Reintroduction of Pisaster to the intertidal
- Can go back to photos and get size frequencies of mussels
- Some measure of number of visitors and what are they doing?

Discussion with Patty Vainik—Sr. Marine Biologist, Ocean Monitoring Program with Waste Water Treatment Plant. They have a bunch of sampling stations, one is at the S end of the point, most off shore. Do sediments as well as invertebrates.

Southern California Coastal Water Resources Project (SCCWRP)—sewage discharge related issues, inter-calibrated for S. California Bight, moving into storm drain/runoff issues, a shift from compliance monitoring to understanding systems, a shift from sewage to runoff in terms of general blame. Steve Weisberg (Executive Director, SCCWRP) would host a database. Their statistician is Mollyl@sccwrp.org. Where are the stations? What scale is possible? Temporal variation too

Discussion with Mary Platter-Reiger at SPAWAR—Jeff Grovhoug does all marine environmental stuff. Mussels as biomarkers study by Scott Steinard, Dave Lapota has a quick bioassay with dinoflagellates, Ken Richter has a good SD Bay hydrodynamic model.

- Kate Faulkner's Basic Units of Proposals
    - Issues to be addresses
    - Objectives
    - What do we already know/have?
    - What do we propose to do?

- Deliverables
- Budget
- Personnel, contract/cooperators, equipment, travel, transportation

Consider: what parameters are important to sample? How to analyze them? How to report? What recommendations? What questions do we have?

- List of Projects (in order of Priority)
  - Performance Analysis of Existing Programs
  - Status and Trends on the first 10 Years of Rocky Intertidal Monitoring
  - Species Inventory—Rocky Intertidal Only
  - Environmental Monitoring—gave to the physical group to look at marine "weather", sedimentation. I will work with them directly on this.
  - Linkages—decided to split out the bay influences
  - Bayside
  - Subtidal Inventory

- Newest List of Projects
  - Performance Analysis of the Cabrillo National Monument Rocky Intertidal Monitoring Program
  - Status and Trends of Cabrillo National Monument Rocky Intertidal Resources
  - Evaluating Changes in Biodiversity in the Cabrillo National Monument Rocky Intertidal from 1978 to the present
  - Evaluating Influences of Surrounding Ecosystems on Cabrillo National Monument Rocky Intertidal Habitat
  - Effects of the SD Bay outflow and water quality on a 1 km scale
  - Inventory of intertidal habitats of the bayside of Point Loma and determination of potential monitoring needs
  - Inventory of subtidal habitats off of the west coast of Cabrillo National Monument and determination of potential monitoring needs

- Title: Performance Analysis of the Cabrillo National Monument Rocky Intertidal Monitoring Program
  - Notes: We've been doing this for 10 years now, it is time to evaluate, Fixed plots vs random plots—an experimental component. Statistical details (power analysis, replication) An independent review? Contracted out? Send product to reviewers. Compatibility issues. Deliverable = a revised monitoring protocol. What about fish? High tide? Terrestrial mammals as predators? Keep initial goals in mind.
    1. Issues to be addressed?
    2. Representativeness—are fixed plots representative of larger zones?
    3. Power analysis—what is the power of these plots to resolve change?
    4. What can we do better or differently?
    5. Review decisions about taxa selection
    6. Is there a different way to pool plots?
  - What do we have already?
    1. The existing monitoring protocol
    2. Annual reports
    3. Zedler studies
  - What do we propose to do?
    1. Experimental study of fixed vs. random plots
    2. Power analysis
    3. Comparative analysis (with other similar programs)
    4. Evaluate technology and new thinking
  - Deliverables
    1. A revised monitoring protocol that is calibrated to the original in some way
    2. A technical report/publications on both the experimental work and the power analysis
  - Budget

- Title: Status and Trends of Cabrillo National Monument Rocky Intertidal Resources
  - Issues to be addressed?
    1. Are the changes we are seeing different from natural variation in space and time?
    2. Why are why not? Are there correlations to human activities or large-scale physical changes?
    3. What is our baseline, what is "normal" variation? (historical, anecdotal, theses)
    4. Are there pieces missing or extra pieces?
    5. Public outreach/WWW (world wide web)
  - What do we have?
    1. 10 years of monitoring data, including photographs
    2. Zedler 1976, 1978
    3. Anecdotal information: Leighton, Davis, Basch
    4. 5 year report and annual reports
    5. analyses carried out so far
    6. Beginnings of GPS information of plots
  - What do we propose to do?
    1. Organize and maintain data in a database
    2. Synthesize current information with past publications/studies
    3. A definition of "natural variation"
    4. Look for long term trends and explicate the dynamics
    5. Complete collection of geographic data and create a number of GIS layers for the intertidal
  - Deliverables
    1. 10 year report
    2. publications

- Title: Evaluating Changes in Biodiversity in the Cabrillo National Monument Rocky Intertidal from 1978 to the present
  - Issues to be addressed?
    1. Have there been changes in biodiversity (species richness) since 1978?
    2. How does this repeated inventories method compare with population dynamics-type monitoring strategies?
    3. An archive of voucher studies, photo documentation and genetic information for future reference
    4. Natives vs. non natives
    5. Public outreach/www
  - What do we know?
    1. Zedler 1976, 1978
    2. Bonnie and Chris Janousek's partial lists with photos
    3. Anecdotal
  - What do we propose to do?
    1. Identify appropriate taxonomic experts and contact them
    2. Use original Zedler lists as a guide/checklist to determine species presence/absence changes
    3. Collect voucher specimens
    4. Collect genetic specimens
    5. Collect photo documentation (in situ when possible)
    6. Synthesize existing information (anecdotal, popular literature)
    7. WWW and public outreach
    8. Boundaries: within the three zones, splash zone to lowest low.
    9. Include information on tidal level, usual habitat, size scale, relative abundance, zonal distribution
  - Deliverables
    1. A new species list
    2. A comparison of species richness between now and 1978
    3. Voucher and genetic samples, photos

4. Publications
5. Technical report on evaluation of repeated inventories as a monitoring technique
6. WWW

- Title: Evaluating Influences of Surrounding Ecosystems on Cabrillo National Monument Rocky Intertidal Habitat
  - Issues to be addressed?
    1. Outflow of SD Bay (make own project)
    2. Terrestrial runoff (sent to freshwater project)
    3. Kelp forest
    4. Migrants, predators, life history habitat changes
    5. Other rocky intertidal
    6. Anthropogenic
    7. Erosion (sent to physical group)
    8. Planktonic communities (food and larvae)
  - What do we know?
    1. Kelp monitoring (SIO)

- Title: Effects of the SD Bay outflow and water quality on a 1 km scale
  - Issues to be addressed?
    1. Are there effects of SD Bay pollutants on the rocky intertidal of Cabrillo National Monument?
    2. Does the SD Bay water reach the tidepools?
       - If so, does it affect marine organisms?
       - If so, is that effect different in space across the area? Essentially, is there a spatial gradient in pollutant level across the three zones?
  - What do we know?
    1. Southern California Coastal Water Resources Project (SCCWRP) is sampling on a larger scale across the Bight
    2. Wastewater Treatment Plant is testing offshore
    3. Navy has a mussel and dinoflagellate assay to look at pollution
    4. Monitoring data on population dynamics of the area
    5. NOAA mussel watch program
    6. Navy modeling of Bay hydrodynamics
  - What do we propose to do?
  - Synthesize existing information on water quality monitoring to attempt to create a single database (a GIS level?) on regional water quality. What is the smallest scale resolution possible from this data? Identify the relevant organizations that do this work.
  - Determine the approximate local hydrodynamics of SD Bay outflow
  - If necessary, sample the water in the tidepools on a smaller scale (1km).
  - Conduct bioassays of appropriate organisms (mussels?). Use the gradient of the northeastern coast to the northwestern coast of Pt. Loma.
  - Analyze data and look for correlations between organism population dynamics and SD Bay Outflow
  - Deliverables
    1. A technical report of the physical information—a GIS level of pollutants on a scale of kilometers, an approximation of water flow.
    2. A technical report on the effects of water quality on intertidal organisms in Cabrillo National Monument on a gradient from the northeastern to the northwestern shore.
    3. Appropriate publications

- Title: Inventory of intertidal habitats of the bayside of Point Loma and determination of potential monitoring needs.
  - Issues to be addressed?
    1. Little is known about the East coast of Point Loma, an area with eelgrass beds and mudflats.

   2. This area is highly influenced by SD Bay and could probably benefit from a monitoring program
- What do we know?
   1. Not much. Perhaps SPAWAR has some information
- What do we propose to do?
   1. Contact other Point Loma groups to synthesize existing information on east coast.
   2. Conduct an inventory program of the area:
      - Identify appropriate taxonomic experts and contact them
      - Collect voucher specimens
      - Collect genetic specimens
      - Collect photo documentation (in situ when possible)
      - Boundaries: To Ballast Point, from the splash zone to lowest low. Include infauna
      - Include information on tidal level, usual habitat, size scale, relative abundance, whether it is found within park boundaries, native/non-native
      - Synthesize inventory information into rocky intertidal species list and WWW (make compatible)
   3. Determine future monitoring needs, including opportunities to collaborate with SPAWAR.
- Deliverables
   1. A species list of the Bayside of Point Loma, added onto the Rocky Intertidal database and WWW pages.
   2. Voucher specimens, genetic specimens, photos (in situ)
   3. A technical report on the future monitoring needs of the bayside.

- Title: Inventory of subtidal habitats off of the west coast of Cabrillo National Monument and determination of potential monitoring needs
  - Issues to be addressed?
     1. Little is known about the subtidal habitat within the park boundaries.
     2. Additionally, outside the park boundaries considerable subtidal habitat can affect the park through predation, migration, and competition.
  - What do we know?
     1. Tegner program in the kelp forest, with fairly accurate species lists. The existence of voucher specimens is not known.
  - What do we propose to do?
     1. Contact other groups, such as SIO, to synthesize existing information on subtidal habitats.
     2. Create a map of the intertidal, shallow subtidal, and kelp forest, up to the seaward boundary of the forest.
     3. (Establish a dive program?)
     4. Conduct an inventory program of the area not already known (e.g. between the kelp forest and the rocky intertidal):
        - Identify appropriate taxonomic experts and contact them
        - Collect voucher specimens
        - Collect genetic specimens
        - Collect photo documentation (in situ when possible)
        - Include information on approximate depth range, usual habitat, size scale, relative abundance, whether it is found within park boundaries, native/non-native
     5. Synthesize inventory information into rocky intertidal species list and WWW (make compatible)
     6. Determine future monitoring needs, including opportunities to collaborate with SIO.
  - Deliverables
     1. A species list of the subtidal of Point Loma, including the shallow subtidal and kelp forest, added onto the Rocky Intertidal database and WWW pages.
     2. Voucher specimens, genetic specimens, photos (in situ)
     3. A technical report on the future monitoring needs of the Point Loma subtidal.

Ogden 1990’s: seabirds in SD Bay
Fishes included
Marine Mammals?
Exotics/Alien Plants on the Bayside
Add data management as 35-40%

Appendix V-g. Physical Resources Work Group Notes

Broad concepts to consider, issues of concern, Vital Signs Workshop 2000, January 25-27, Cabrillo National Monument and Point Loma Ecological Reserve

Present: Mietek Kolipinski, Judy Rocchio, John Pierce Harris

Water Resources
Ground water seeps – dramatic in spring

- ephemeral
- associated plants: Giant wild rye, milkmaid
- in Cabrillo formation, between contacts
- 325 feet above sea level, Bayside trail
- identify seeps and their links with geology

Geologic link to water source for animals
Sediment interfaces are important – sandstone
13 million year gap (Cretaceous interface missing)
95 million years
Horizontal cracks – aquifers
Point Loma formation is highly permeable
Coal mine on NRAD property San Diego Historical Society (amber), aigin damp terrestrial environment – Cretaceous
Fossil resources covered with roads
2 ponds existed until 1950s filled, Famosa slough
granitic rock base

intriguing geology → soils
coastal processes monitoring
Identify landslide potential areas
1995 landslide map exists
Sediment impacts on land, plants, and in water, intertidal
-water quality
-benthic communities
Educational components
USGS coastal and marine geology – see Asseateague workshop recommendations
Monitor lizard Mosesaurus vertebrae
Duckbill dinosaur
Large fern at CABR
Trace fossils
Linda Vista mostly gone
PALEO survey needed
Point Loma was an island
Soils map needed
1/3 of meter lost per year of Point Loma formation
Active faults
Earthquake hazard map needed
1:24,000 geologic map exists
1:12,000 scale map needed
Marsha Davis or other to prepare
Volcanics present – large boulders (house-sized)

1. ORIGIN? MYSTERY
2. Marine origin? Or from Mexico 30 millions years ago? (romantic hypotheses)
3. Brought by water?

Air Quality

Diel (diurnal) winds

Point Loma has 5 mph winds from W (sea) air is salty and oily but clean → alkaline soils, 1 mph from E at night - nasty air

Lichens +/- 50 spp.
Mosses – check with Jim Shevock
Jet fuel (kerosene) lose 50 gals. Into air at take off

Fire Management

Smoke?

Appendix V-h. Terrestrial Vegetation Work Group Notes

Broad concepts to consider, issues of concern, Vital Signs Workshop 2000, January 25-27, Cabrillo National Monument and Point Loma Ecological Reserve

What to Monitor
1. Rare plants
2. Rare plants
3. Federally listed
4. Other “sensitive”

Non-native invasive species
1. Native plant communities
2. Landscape level

Inventories Needed
Non-native
1. Fennel – top concern as being invasive
2. Plus ranking for corrective action (areas/species)
3. Focus on old disturbed sites
4. Rare plants
5. Need to compete inventories/maps
6. Compare existing maps with habitat requirements – identify potential habitat

Sampling Parameters
1. Need to reach consensus on system of classifying plant communities
2. Determine if new map needed
3. Need for consistent protocols for entire study area
4. Landscape level
5. Need for consistent protocol
6. What done: July 1994 report
7. Zedler report
8. Aerial photos – ground truthing
    - look into balloon option
    - Navy photo department Jerry Mosley
    - Frequency
9. Review accuracy every 5 years to determine need for partial revisions (get aerial photos – do some random checks to determine need for revising certain areas or entire study areas)

Plant Communities
1. Stratified random sampling of communities based on ground-truthed landscape level map
2. Review McEachern’s protocols and adopt or revise 3-5 years or when rains and assess appropriate frequency

Non-native Invasives
1. Monitor disturbed sites, areas which are threats (tlp slope of natives intact areas, sensitive species along road corridors, trails, other vectors) , annually at first
2. Monitor certain species with potential for significant harm everywhere including intact areas at least annually
3. Seek assistance from Navy/park staff and the public to identify non-natives (ongoing)
4. Monitor history of treatment (ongoing)
5. Special emphasis on maintaining intact areas

New construction areas - monitor endangered and threatened

Rare or Sensitive Species
1. Perennials

2. Map changes in distribution
   - If small number, measure each individuals
   - If larger number, consider using as one factor in selecting stratified sample of native plant communities
3. Consider monitoring recruitment, mortality
4. Need species-specific plans
5. Federally listed Orcutt's spine flower
6. Transect-frame every 2 meters
7. Count individuals, noted associate species

Could monitor potential habitat sites periodically (not necessarily annually) other annuals – consider every 3-5 years or more frequently if it rains

Landscape Scale

How to analyze

GIS analysis to compare current map to previous maps

Analysis of areas of change to assess which are naturally occurring changes and which are man-caused (consider if new disturbances/stressors are coincident with changes)

Appendix V-i. Terrestrial Wildlife Work Group Notes

Broad concepts to consider, issues of concern, Vital Signs Workshop 2000, January 25-27, Cabrillo National Monument and Point Loma Ecological Reserve

Vertebrate/Invertebrate Complex

Compelling Problem – Goal – Needs
Historic ecosystem inventory – literature search
Current inventory needs (not birds…)
- All mammals (large, medium, small, bats)
- All inverts

Monitoring Needs

1. Birds
2. Herps
3. Mammals
    - a) carnivores
4. Insecta/Arthropoda
    - a) butterflies
    - b) ants
    - c) carabids
    - d) earwigs, roaches, isopods
    - e) crickets
    - f) mutelids (velvet ants)
    - g) scorpions

NB – Focus on chaparral habitats/fragments

5. Gastropods
    - snails to ?

Inventory Needs
1. Mammals
    - a) bats
    - b) small mammals
2. Insecta
    - a) general, multiple methods
    - b) analysis of Robert Fisher's insect captures
3. Arthropods, esp. spiders, millipedes
    - a) general, multiple methods
    - b) need input from marine specialists
4. Fishes
    - Need input from marine specialists

Special Focus Species (INVENTORY OR MONITORING)

TAXA	MONITOR	INVENTORY
Birds	RC sparrow, CA thrasher, raptors, neotropical migrants, rails, CA gnatcatcher, pelicans, great blue heron	Roadrunner (=teeth) cactus wren (poster species!)
Mammals	Deer mice (re hanta virus), Ca ground squirrel, shrews, Mus musculus, Rattus sp., urban meso-predators, coyote, Neotoma lepida, bats	Bats, S. bachmanni (?), long-tailed weasel, Pacific kangaroo rat, bobcat, Jacumba pocket mouse
Insects	Argentine ant, wandering skipper, Electra buckmoth, Bernadino blue, army ants, Jerusalem crickets (new species)	Fire ants, tiger beetles
Arthropods		millipedes
Reptiles	Rosy boa, legless lizard, ring-neck snake, sea turtles (our link to marine group), orange-throat whiptail lizard, southern Pacific rattlesnake	
Amphibians	X	Arboreal salamander?, Pacific tree frog, California toad (on Navy land by SUBASE where fresh water sources are located)
Gastropods	Land snails (exotic/alien)	Land snails (native)

Guidelines, suggestions for wildlife studies

Use standardized, reproducible methods
Investigate poorly studies habitats – especially chaparral
The monitoring list is dynamic and should evolve in relation to inventory findings
Some overlap of study sites, others specific to needs/occurrence (establish some new sites for existing studies?)
Use monitoring/sampling gradient from North to South
    more to least developed (edge, to interior)
Monitoring should be “question” driven. The “question” should relate to “How to these data represent the health (change in health) of the reserve?”
Coordinate with other (potential) cooperators

Appendix V-j. Bat Project Statement - Inventory

Contact: Drew Stokes and Karen Miner (?)

PROBLEM: Species list unknowns but there is some historic data and regional information

OBJECTIVE: Look for recent abundance and historic changes in diversity

WHAT IS KNOWN:
- Historic Point Loma study on bats (30-50%) ?? or , maybe "circa 1930-1950" (FIND!)
- Recent study by Navy (Brown 1994-96)
- Museum records – incidental observations

METHODS:
- 20 sites use Anabat
- subset of 10 sites where use netting with Anabat
- each site 3 visits within a season
- each sampling twice each year
- 2-3 years

DELIVERABLES:
- Species list and missing species list
- Report on abundance across habitats
- Map and website updates

BUDGET:
Field work:
$14/hour, 6 hours/night, 30 nights + 60 nights = 90 nights per year = 540 hours per year = 8100
Report:
$5,000

Total: $13,100 per year for 3 years

Appendix V-k. Bird Project Statement - Monitor

Contacts: Bill Haas, Ingri Quon
Problem/Issue:
Assess the current health of the reserve and monitor overtime its status. Point Loma is a small, isolated fragment of several native habitats that may be subject to impacts from a host of sources and uses.

Objective:
To provide long-term data that exhibits population trends that can be analyzed in context of a suite of related conditions and information (e.g., weather patterns, other species population trends, land use patterns and changes in use patterns). The information should be representative of the site as a whole, repeatable and cost effective.

What do we know:
Adequate historic and current data exist to provide the basis for an excellent picture of the current species composition. (*Christmas bird counts, previous studies, historic documentation) We can proceed from this point forward with an adequate baseline to interpret changes when examined in context with additional information (species arrays, weather data, comparison with other sites).

What do we need to know:
Climatological data, habitat history and progress (some migrants may be lost (?) And some natives may increase with removal of non-natives and restoration), access to overall species trends – i.e., can't be done in a vacuum.

Special Issues that Need to be Addressed:
1) Document roost sites for
a) endangered brown pelican
b) other sensitive species including
   cormorants
   herons

2) Assess usage of roost sites (regular counts)

3) Public information (2 way information) on the monitoring (assessment program, i.e., need to inform, need information input.)

What to do:
1) Obtain and critically examine all historic bird data (museum specimen lists, publications, Christmas bird count data, San Diego County Bird Atlas data, etc.)

2) Establish integrated monitoring plan to include (i.e. , coordinate with other studies)
Prioritized
a) Resident (and Migrant) Breeders
- Point counts during breeding season annually
- Monitoring Avian Productivity and Survivorship (MAPS) (NOT recommended but standard method)
- nest searches
b) Raptors
- Breeding surveys (periodic 3 yr.? 5 yr.?)

c) Migrants
- compile anecdotal information from various sources (rare bird alert, public reporting station, local experts)
- establish migrant banding station
- weekly surveys

d) shore birds (tidal/shore use)
- continue existing monitoring program
- work with existing monitoring crew to enhance ID skills or regular monitoring program (e.g. expand time, examine incoming vs. outgoing tides, etc.)

e) diving species
- establish survey area (set distance from the coast)
- conduct regular surveys to document use (e.g., # dives, success, species #s, composition)
- surveys should be conducted regularly
- migrant passage (conduct fall and spring surveys of fly-bys)

* document rookeries, do roost counts seasonally
* document roosting areas, do roost counts seasonally

Standardized Database

Advantages:
- cost effective
- relatively non-invasive (some techniques more than others)
- universal (maybe not the best, but …) indicator of overall health
- data comparable with trends recorded at more sites than any other group

Deliverables:
1. Regular input database, Annual Reports

2. Poster, informational output in some format that illustrates connectivity (or lack thereof) for birds in general, and specifically for such species as California gnatcatcher, brown pelican, cormorants, migrants.

3. Importance of Point Loma as a migrant stopover point (kiosk).

4. Interesting trends explained or questioned or investigated (losses? gains?) funding required (on disk)

5. Spot marker explaining the program in the field

6. Interpretive “center” for the Vital Signs synthesis (in Visitor Center? In special facility that is a working lab on a small scale (computer, work benches, measuring equipment, data volumes, etc.)

Appendix V-I. Herpetology Project Statement – Monitor

Contact: Robert Fisher, U.S. Geological Survey

1. MONITORING HERPS ON POINT LOMA (a.k.a. "Population trends and species richness monitoring"),

2. Objectives: analyze the power of existing data to detect trends, design long-term monitoring program (scale-down)

3. What do we know?
Some information on species richness:
some abundances
missing species
which species are under-sampled

4. Recommended actions:
Use pit-fall traps, but reduce # of sites consist with objective
Add more cover boards (place in grids) for legless lizards
Data analysis (baseline)

5. Deliverables:
Finish herp poster
update herp website
Annual report

6. Budget:
$60/day sampling, travel "in-house"
$500 supplies/year
number of days (20-30)
data analysis
8 arrays
$12-1800/year sampling
$5000/year data analysis

Appendix V-m. Large Carnivore Project Statement - Monitor

Contact: Kevin Crooks

1. Assess long term population trends in carnivore communities

2. Objective: develop and implement long-term monitoring plan
   Maintain top down effects
   Aesthetic/wilderness value
   Charismatic
   Long-tailed weasel? Bobcat? Are they there?

3. What do we know?

Crooks study: track surveys remotely triggered camera surveys, scat surveys
   but only 3 transects on Point Loma, sampled quarterly?

   Anecdotal observations

4. Recommended activities

Establish track surveys—6 – 10 transects (1 km long), 5-10 cons nights, 2 times per year (stations)

   Camera surveys – 6 cameras (1/transect)
      Minimum 1 month/year
      Rotate cameras spatially and temporally

   5 consecutive years, then every 2-3 years

5. Deliverables

Annual Report
   Pictures
   Web-based GFS connection

6. Budget

$14/hour, 8 hours/day, all 6 transects, 10-20 days/year = $1200 – 2400 per year
   6 cameras ($500 each) = $3000, film purchase and development $1000
   data analysis $5000

   Total Cost $10,000 per year on average.

Appendix V-n. Small Mammals and Meso-Herbivores Project Statement - Inventory

Contact: Steve Montgomery

PROBLEM/ISSUE: Presence/absence, distribution, and abundance of small mammals across PLER unknown

Why is current inventory incomplete?
- species omissions from current list
- previous sampling restricted to CSS
- no surveys for rabbits and squirrels

OBJECTIVE: Complete inventory of distribution, abundance, and diversity of small mammals of the Point Loma peninsula.

WHAT HAS BEEN DONE:
- UCR surveys
- Fisher pitfall data
- Early surveys
- Museum records
- Incidental observations

WHAT WILL BE DONE:
- Live-trapping across N-S gradient, including all major habitat types (chaparral was not sampled in UCR work)
- Transect surveys for rabbits and squirrels
- Continue pitfall mammal surveys as part of herp monitoring
- literature review of previous surveys to compile species list

DELIVERABLES:
- Inventory report
-complete literature review
-complete species list (with vouchers?)
-ID information gaps
-recommendations for future studies

COSTS:
Labor - $500-600/night, about 200 trap nights (once or twice a night)
- 30 grids (10 traps/grid)
- hourly rates: $30-100/hour, $60 is average
- 2-4 trap sessions per year
- 2-3 years

Miscellaneous
- Reports, bait, gas, trap replacement, data processing, report writing

Appendix V-o. Small Mammals and Meso-Herbivores Project Statement - Monitoring

PROBLEM/ISSUE: Population trends of small mammal community unknown on Point Loma peninsula.
Questions to be addressed:
- Edge effects (non-native invasions)
- Interior versus edge habitats
- Impacts of visitors/trails/roads (measurement of visitation rate – usage –surveys)
- Relation between predators (raptors/carnivores) and small mammal dynamics

OBJECTIVE: Develop and implement long-term monitoring plan for small mammals on Point Loma

WHAT HAS BEEN DONE:
- Inventory study (first)
- Pitfall study monitoring (Dr. Robert Fisher)

WHAT WILL BE DONE:
- Design monitoring study
- Modify (reduce) inventory sampling design to tailor to long-term monitoring
- Refine questions, stresses, and vitals signs

DELIVERABLES:
- Annual monitoring report
- Digitize results, put them up on park web-site
- Education/outreach

COSTS:
Small-mammal live-trapping
- 15 grids, 40 traps/grid, 5 consecutive nights
- 3 people 20 K Total per year
- Sample every year for 5 years
  - pilot data
  - variation
- After pilot study, every 2-3 years

Rabbit and squirrel transects
- 6-10 transects (1 km long)
- 4 times per year ?
* Methodology – literature review needed

Appendix V-p. Small Mammal Project Statement – Pacific Pocket Mouse – Inventory

Objective
Determine presence or absence of the Federally Endangered Pacific pocket mouse (Perognathus longimembrus pacificus) on Point Loma, the peninsula where Cabrillo National Monument is found.

Importance
Very little is known about this animal and its basic life history. Recently rediscovered (1993), this species had not been recorded for the previous 20 years. Current combined occupied habitat for the Pacific pocket mouse is estimated to be fewer than 400 hectares (1,000 acres) at the three known localities (USFWS 1998). Recently Orcutt's spineflower (Chorizanthe orcuttiana), a Federally Endangered plant, was rediscovered on Point Loma on habitat very similar to that which the PPM requires. The Orcutt's populations here are by far the largest and best protected of the two sites where this plant exists. The high level of quality and protection for Point Loma habitat increases the importance of any PPM populations found here.

Over 600 acres on Point Loma are in the Point Loma Ecological Reserve (PLER), a reserve created by the five land owners on the Point Loma federal complex, which is co-managed by Cabrillo National Monument. This land is set aside for habitat preservation in perpetuity, and specific land parcels can added if important populations are discovered outside the preserve, as was done for the Orcutt's spineflower. The physical area in which the PPM might occur is relatively small, making a very thorough survey logistically simple.

Continuing to manage the Point Loma Ecological Reserve, making decisions about additions to, subtractions from, and activities within the reserve without knowing the status of the Pacific pocket mouse is an unacceptable risk, and is easily rectified by this survey. If the animal is found here, then basic research can be conducted to help elucidate its distribution, habitat requirements, movement, demographics, life-history strategies, etc. The US Fish and Wildlife Service would be consulted on all aspects of this project and would receive copies of all resulting products.

Previous Surveys
The University of Riverside conducted surveys for small mammals on Point Loma (1996), but did not set up traps in all sites which are potentially good habitat for the Pacific pocket mouse. Currently USGS and the NPS are conducting a reptile and amphibian study using trapping arrays which incidentally capture small mammals but have not yet captured a Pacific pocket mouse. Neither of these studies were designed to detect the presence of the Pacific pocket mouse.

Background information
The pacific pocket mouse was federally listed as endangered in 1994. This subspecies historically occurred on the immediate coast of southern California from Marina del Rey and El Segundo in Los Angeles County, south to the Mexican border in San Diego County. All records of this species have occurred within 2.5 miles of the coast. Rediscovered in 1993, having not been recorded in previous 20 years, the subspecies is currently known to occur at the Dana Point Headlands, Orange County, and two locations on the Marine corps Base, Camp Pendleton in San Diego County. Current occupied habitat for the Pacific pocket mouse is estimated to be fewer than 400 hectares (1,000 acres) at the three known localities combined (USFWS 1998).

The Pacific pocket mouse has occurred on fine-grain, sandy substrates in open coastal sage scrub, coastal strand, coastal dune, and river alluvium habitats. The extant populations at the three known locales occur within open coastal sage scrub habitats. The subspecies is imminently threatened by habitat destruction and fragmentation, documented depredation by domestic cats, and recreational activities (USFWS 1998).

Sampling Design for Point Loma Survey

The following protocol was developed through consultation with Steve Montgomery, of SJM Biological Consultants, and Shana Dodd, of SC Dodd Biological. Mr. Montgomery and Ms. Dodd have been working with the Pacific Pocket Mouse both directly and indirectly for years and are currently working on a Pacific pocket mouse project for the USFWS. Given the potential variability of rodent population sizes, a survey needs to be conducted during two different years to decrease the chances of not detecting populations in a "bad" year.

Conduct field work twice a year, in May and July.
Set traps in any existing suitable sandy-soil habitat on Point Loma, nor more than about 225 traps set per night per biologist.
Hire two biologists so about 500 traps can be set.
Five nights of consecutive trapping, setting traps in the late afternoon (dusk) and checking them at night or in the very early morning.
Run this survey for two years to account for seasonal and annual variability in species abundance and activity levels.
Brief, post field work "field notes" will be sent to the park superintendent, and final report will be submitted within 6 months of the last trapping night. The park and the USFWS will be notified immediately if a Pacific pocket mouse is discovered.

Costs

Field work:	\$600/night x 5 nights x 2 biologists = \$6k = 1 session 2 sessions/yr x 2 yrs = \$24,000	\$24,000
	Reports, mileage, incidental expenses, trap replacement	6,000
Total cost for 2 year survey		\$30,000

Park contributions/partnerships
The Natural Resource Science Chief, Samantha Weber, will be the project manager and as such would help the researchers with project logistics, including obtaining badges to access restricted areas, providing any volunteer or NRS staff time necessary for the field work, and data and reports.

Literature cited:
U.S. Fish and Wildlife Service. 1998. Pacific Pocket Mouse (Perognathus longimembris pacificus) Recovery Plan. Portland, OR. 112 pp.

Appendix V-q. Terrestrial Invertebrates – Inventory

Title: Terrestrial arthropod biodiversity of the Point Loma Ecological Reserve

Problem/Issues: Unlike vertebrates, little to nothing is known about arthropod diversity and densities in the reserve. Arthropods influence all components of ecosystems; can be great indicators of ecosystem health or disturbance.

Objectives: 1. Thoroughly and competently survey and identify arthropod fauna of the reserve. 2. Identify sensitive or rare taxa to be used for monitoring program. 3. Identify problematic invasive or disturbance dependent species and their distribution in the park.

Previous work/background: Literature review and preliminary surveys already done (see reports). Robert Fisher and Andy Suarez have small collections. This work provides a great foundation for more "complete" or comprehensive study. One aspect of previous work that is lacking is estimates of diversity (species number per taxa – family or genera). Need to contact (collaborate with) previous studies/inventories in order to take advantage of this information. (Bruyea Bio. Consulting, Moreno Valley)

What to do: Three year major inventory of all taxa. Different sampling regimes including: pitfall traps, light traps, vegetation sweeps or beating, litter sampling. Need to sample all vegetation types and sample across seasons. Need to contact taxonomic specialists for identification of groups (orders or families) to species or genera.

Deliverables: 1. Where species specialists are available, species level resolution or genera level resolution with estimates of species number. Where specialists are not available, family level resolution with estimates of species number (morphospecies). 2. Determine appropriate invertebrate species/taxa for long term monitoring program. 3. Identify problematic invasive species or native species that thrive in disturbed/edge habitats that may have severe impacts. 4. Develop an interpretive display (ant colony, spiders, scorpions) for visitor center. 5. Include data in GIS data base with other info for park.

Budget: Salary – one full time and one half time employee. ($50,000/yr for 3 years)
Hiring expert taxonomists for species identifications ($50,000)
Travel/mailing specimens ($5,000 yr for 3 years)
Equipment for sampling (traps, jars, vouchering) ($5,000 + $1000 yr for 2 yrs)
Total : $220,000 over three years.

Appendix V.r. Terrestrial Invertebrates –Monitoring

Title: Terrestrial Arthropods as Bioindicators of Ecosystem Integrity in the Point Loma Ecological Reserve

Objectives:
Establish long-term monitoring program of key invertebrates to evaluate:
Long-term trends in diversity and abundance for species that vary in fragility and sensitivity.
Use abundance and diversity of specific native and non-native taxa to evaluate ecosystem integrity (health in relation to disturbance, edge, native/alien vegetation).
Use above to evaluate effectiveness of vegetation restoration efforts (insects respond almost immediately). Contrast degradations versus recovery.

Background:
Focal species/taxa:

NATIVE	EXOTIC/ALIEN
Ants	Earwigs
Carabid beetles	Roaches
Mutillids (velvet ants)	Isopods
Tiger beetles	Argentine ants
Scorpions	Fire ants*
Crickets	
Land snails	

Already known from previous surveys
Andy and Robert's Collections

****

I. Objective: Use long-term trends in butterfly species composition and abundance as indication of changes (and normal variation) in habitat.
Tie in w/ annual butterfly counts for comparison
Use bird transects for comparative aspects, but also cover all habitat types (i.e., saltgrass, chaparral, etc.)
Flag for plant changes – host specific
May serve as early warning system (or part of one) for alterations in park

Background:
Give or take 2-3 species, fauna is known and easily, cheaply monitored
Expertise is common

What to do:
Jan to July – 1 survey, 2 weeks – species and numbers seen
Aug to Dec – 1 survey per month. Use bird transects and unique habitats.
8 exotic/alien, some specific (e.g., cabbage butterfly – exotic mustard)
Voucher collection (can be displayed), use vouchers to supplement
Focus on species of concern, such as wandering skipper, Bernardino Blue

Budget:
19 surveys per year – 8 hours/day - $50/hr
+ 4 prep days

Salary - $10,000/yr
Equipment - $1,000
Travel - $2,000

TOTAL: $15,000

****

II. Propose to do:
Long-term monitoring with pitfall trap arrays (can be herp/mammal sites and others to represent all vegetation types and distance to edge transects [edge/interior])
At least 3-5 times per year (seasonal), each 2-week period
Light traps and litter sampling may be required for complete ant list and others (mutilleds, tiger beetles)
Compliment with visual surveys (at time of trapping)

Deliverables:
Long-term diversity/abundance data for species that vary in degree of fragility and sensitivity (compare with butterfly)
Use to assess different levels of threat/health
Native to exotic ratios allow quantitative measure of ecosystem integrity/impact of disturbance
Assess success of restorative projects
Displays at Visitor Center
Early warning system for fire ants! (prevent defense)

Budget:

Salary – Trapping, sorting, identifying	$30,000/yr	(1 full time person estimate)
Specimen ID's/Museum Travel	$5,000/yr	for 1-5 yrs?
Travel – to and from park	$1,000-$2,000/yr	
Equipment – jars (traps), vouchering material, vials	$2,000 initial - $1,000/yr after first year	
ESTIMATE TOTAL	$40,000 / yr?	

Appendix V-s. Terrestrial Vegetation – Rare and Sensitive Species – Inventory

What is the problem/issue to be addressed?
Comply with endangered species act and protect and enhance listed species and other species of concern that may be listed in the future.

Objectives:
Identify potential habitat and new populations of rare and endangered species. Verify known populations and document changes in area and health of plant species.

What do we know/have we done already?
Ogden GIS maps in 1992-1994 (report 1994).
WCC report 1981. Ellen Bauder's surveys 1998/ 1999.
Fish and Wildlife Surveys around 1997 and 1999.
Literature searches for current species including CHOR. (Bauder)

What do you propose to do?
Review existing herbarium search and expand if necessary
Database search and communication with agencies
Identify potential unknown locations of species by habitat (soil types, exposure, slope, plant community)
Groundtruth previously mapped locations of plants and possible new locations.
GPS sightings and area of populations
Update GIS maps

Deliverables
Report
Introduction
Materials and methods
Species list
Results-text including maps, color photos and/or drawings
Discussion
Management recommendations
Monitoring recommendations

Budget
$50k non profit letter of agreement

	Year 1	Year 2	Year 3	Total
Personnel				
Contractor/Cooperator				
Equipment				
Travel				
Transportation				
Total				

Appendix V-t. Terrestrial Vegetation – Alien Species – Inventory and Monitor

What is the problem/issue to be addressed?

There are aggressive non-native plant species that pose a high level of threat to the native plant communities of Point Loma. The native plant communities of Point Loma are rare remnants of coastal sage scrub and chaparral in southern California.

Objectives

Establish a baseline for the distribution of the selected aggressive non-native plant species so that land managers can improve control plans for control or eradication of each species.

Identify species. List to be determined by National Park Service and Navy Natural Resource Offices.

Continue to remove noxious weed populations from Pt. Loma.

Develop protocols for treatment of each noxious weed species.

What do we know/have we done already?

The park and the Navy have identified a list of highly invasive non-native plant species which are of particular concern on Point Loma. These species include Acacia trees, Tree Tobacco, Fennel, Caster Bean, Eucalyptus, Carpobrotus Iceplant, Mesembranthemum Iceplant, Yellow Star thistle/Tecalote, Garland chrysanthemum, and Pampas grass. The list should be reviewed every two or three years or as necessary by Navy and National Park Service Personnel to add, remove or prioritize species for treatment. Navy Botanists, USGS personnel such as Dr. Kathryn McEachern, National Park Service Botanists, and the state of California Department of Agriculture may have suggestions about what species to prioritize for treatment.

Weed control eradication is currently ongoing. There is a map of weed locations known through this effort. The navy also has historic weed maps from earlier periods of treatment.

Mary Platter-Rieger's "Weeds of Pt. Loma" (John and Carf)

Jennifer Stone's YCC Weed Map

Check for other historic weed maps

What do you propose to do?

Develop list of weeds to be monitored cooperatively by National Park Service and Navy.

Inventory and monitor disturbed sites that tend to be the port of entry for non-native plant species. This includes roads, trails, landslides, construction sites. Special emphasis on maintaining intact areas. Upslope of native intact areas would be important to monitor.

Monitor new construction sites. Monitor near rare plant species.

Seek assistance from Navy/Park staff to assist with identification of non-native invasions.

One way of getting additional data would come through weed eradication efforts. Personnel already engaged in weed control would document sites of new weed populations. They would also better document sites they are treating. Each weed site treated would be documented and tracked. From this a database would be developed which tracked individual weed sites each time they were treated or yearly for untreated sites.

Previously treated sites should be monitored and treated yearly.

Develop protocols for treatment of individual noxious weed populations. This information would include treatment options for each species and correct time of year for most effective treatment.

Create a database to track weed populations—data would be collected on a weed monitoring form and would include information such as name of species, site location data, and number of individuals. The database would track populations thru time as well as treatment history data for each individual site. Park and Navy staff could contribute to this database.

Weeds should be monitored and treated throughout the Point Loma area. This will require coordination with various private and public landowners. It is important to discover and eradicate newly arriving species quickly before they become well established in the local area.

Deliverables

Annual report detailing methods of weed treatment by species.

Database of weed locations, treated sites and eradication, population numbers for each weed species of concern.

Distribution map of weed species, including treatment sites.

Document with protocols for treatment of each species.

Sign for the public explaining why control of noxious weeds is important and what steps they can take to prevent their spread.

Budget

$89 / yr for YCC

	Year 1	Year 2	Year 3	Total
Personnel				
Contractor/Cooperator				
Equipment				
Travel				
Transportation				
Total				

Appendix V-u. Physical Resources - Erosion

Draft prepared by Mietek Kolipinski

Monitoring coastal and oceanside erosion at Cabrillo NM and impacts on intertidal and near-shore marine communities

Problem: High erosive rates of friable sandstone and other geologic strata at Point Loma Natural (PLNR) including Cabrillo NM, are both natural and accelerated due to human activities (roads and buildings, etc. at Point Loma, storm water drains, dredging, etc. in San Diego Bay, etc.) Erosion results in loss of terrestrial plant communities with their associated animal components. Habitat alteration includes opportunities for invasion of non-native plants and animals.

In intertidal and near shore marine communities coastal erosion increases water turbidity and changes in marine benthic substrates and the plants and animals inhabiting bottom communities. Swimming and planktonic species are also impacted negatively . Natural processes are altered.

It is important to distinguish between cyclic sediment enrichment and sediment enrichment processes and sediment from land erosion.

Smothering and scouring of organisms and loss of filter feeding organisms (clogging) leads to community changes.

Proposal: Based on thorough literature review and analysis and on discussions with local geologists and scientists develop a monitoring program. This program will include monitoring in selected key locations erosion events, erosion rates, sedimentary changes and cycles in intertidal and near shore substrates. Bonnie Becker (personal communication, 2000) mentions anecdotal information that the amount of sand has increased in recent years in tidepools. These are increases recognizing that seasonal changes occur. Pools are shallower and algal turfs are thicker than in previous years.

What is known and what has been done already: Slope movement is being monitored near the "tank farm" on the bay side of Point Loma. Considerable information on water quality, including turbidity, has been collected in San Diego Bay and possibly in kelp beds on the ocean side. "San Diego Bay has been the subject of environmental monitoring activities by numerous groups over the past few decades." (Quoted from : San Diego Bay, 1992 Annual Report, June 1994, Prepared by San Diego Interagency Water Quality Panel, Editors: Jon Vari Rhyn and Ron Gauthier).

In designing this monitoring program within PLER, on-going monitoring program leaders should be contacted for current information. Gaps can then be filled for monitoring needs within PLNR. Protocols and methods used by scientists in these other monitoring programs may be applied to the PLNR program.

Objectives: Develop a system for summarizing, analyzing and interpreting data, so that scientists can provide managers with information needed to make management decisions, such as habitat restoration, erosion control measures, etc.

Appendix V.v. Physical Resources – Freshwater Resources - Inventory

Contact: Mietek Kolipinski

Title: Inventory and Analysis of the limited fresh water resources at Cabrillo National Monument and Point Loma Ecological Reserve

Problem Statement:
Little is known or has been reported on the limited fresh water resources at the Point Loma Ecological Reserve (PLER), which includes 130 acres of Cabrillo National Monument. No records exist about ground water or wells on Point Loma. So far, several fresh water seeps have been located at Point Loma (Pierce Harris, personal communication). These provide habitat for rare plant assemblages, including milkmaid and giant perennial rye, and animals such as salamanders. Historically, Point Loma likely had vernal pools and probably associated plants and animals that have been destroyed through human developments. It is important to conduct a water resources inventory to locate these limited hydrobiological resources and to develop a resources management strategy to protect and if necessary, restore these resources.

Objectives:
Conduct a survey of surface fresh water, seeps, and associated structural geology in 640 acres that comprise the PLER. This includes seasonal and perennial seeps.
Conduct a survey of associated wetlands, plants, and animals.
Prepare a detailed location map of seeps with text about geological features and species lists of plants and animals in and near thie habitat.
Collect and record basic water quantity and water quality information at all located seeps.
Provide this information to the Park Superintendent and other managers within the PLER.

What do we know/what was done already?
Pierce Harris has identified and located three seeps on Point Loma. He found these by chance during field trips but did not conduct a thorough survey for this purpose. Historically, Point Loma likely had vernal pools and associated riparian plants and animals. Literature exists about fresh water resources of Point Loma. Harris believes there are no wells on Point Loma. This needs to be verified.

Proposed Work:
Contact Dr. Pat Abbott, San Diego State University, Department of Geology to determine the most cost effective way to conduct the survey for seeps and associated geological features. He might recommend a graduate student, who has a background in hydrology and structural geology. This evaluation could be conducted as part of a M.A. thesis or Ph.D. dissertation. Alternatively, a class of students in field geology could carry out t his project with guidance of a University Principal Investigator. A third alternative is to request NPS Water Resources Division in Fort Collins to conduct this evaluation or provide funding for a contract.

Some questions exist about excessive use of fertilizers on the cemetery and past use of Pb, Zn, etc. in coffins of over 50,000 buried humans. Also, current and past hazardous waste sites may have contributed toxic compounds and chemicals in fresh water.

Deliverables:
Final report on seeps and relevant explanation of pertinent structural geological features. Discussion of plants and animals living in or using these restricted habitats.
Report to include management recommendations.
Principal Investigator to provide Park Superintendent and staff with seminar/presentation at the end of the inventory.
Enter baseline water information for CABR on the NPS “SYNTHESIS”.
Provide information from this inventory and analysis to CABR interpreters for educational and interpretive purposes.

Budget:

Hydrologist (GS-11 with structural geology) to conduct search of relevant literature and interview local geologists (2 weeks)	$3,000
Synthesis of pertinent information (1 week)	$1,500
Map and report preparation	$3,000
Plant (1) and animal (1) ecologist survey mapped seeps from above and complete inventories of aquatic plants and animals. Prepare field maps with locations of any sensitive or special status species.	$1,000
Principal Investigator (1) – Project Overview, guidance and completion of final report and maps (1 week)	$1,500
TOTAL ESTIMATE:	$10,000

Above costs include salaries, administration costs, per diem, lodging, travel, printing costs, etc. This total includes project costs for entire 640 acres of PLER. If NPS funds are available for only the 130 acres of CABR NM, project costs will be reduced for field work (less acres to inventory). However, other costs, such as literature review and report and map preparation will require nearly the same effort. So a CABR only project will cost about $5,000.

Appendix V.w. Physical Resources – Geological Resources

Contact: Pierce Harris

Title: Identification and Assessment of Potentially Lethal Geological Hazardous and Invaluable Geological Resources – Requiring immediate or future mitigation or conservation within the Point Loma Ecological Reserve and Cabrillo National Monument

Problem Statement:

There exists within the Point Loma Ecological Reserve and Cabrillo National Monument potentially lethal geological hazardous and invaluable geological resources. Some of these hazards and resources are know to the individual agencies, which are responsible for the management of their portion of the reserve but are unknown to other agencies within the reserve.

Some of the hazards such as landslide areas and unstable cliffs may pose a serious threat to the safety of staff and visitors to the reserve.

Many of the geologic resources that have great aesthetic or educational value are at risk of loss by erosion, slumps, landslides, and seismic activity.

Many geologic and engineering studies have been done or are being undertaken by the various agencies in the reserve in connection with construction activities, archaeological research and seismic hazard assessments. These studies are not currently in the possession of all the agencies involved in resource and risk management within the Reserve.

Proposal:

Locate known repositories of literature and reports on Point Loma geology.

Conduct a comprehensive literature search to identify and located existing geological literature on the Point Loma peninsula. Search shall include geologic maps, photographs, books, journal articles, geologic reports and engineering studies related to Point Loma geologic hazards and resources.

Contact the various agencies within the reserve to identify geologic studies in progress and completed studies in the possession of those agencies.

Objective:

Create an electronic and paper database and publish an inventory of all available literature, which will be accessible to all resource managers and authorized researchers.

Acquire hard and/or electronic copies of all relevant documents and generate a master map reflecting the location of all known geologic hazards and resources.

Prepare a report reflecting the data available.

Report:

The report shall be a comprehensive inventory and databank of maps and literature which will allow all risk and resource managers within the reserve to:

Identify known hazards and resources throughout the reserve.

Avoid unnecessary expense of duplication in research by identifying work in progress by the various agencies and studies already completed.

Identify areas where there are serious gaps in knowledge of hazards and resources, which should be addressed with future surveys and studies.

Budget:

Personnel	To conduct literature search 3 month summer seasonal Graduate Geologist	$3,000 – 6,000
Computer hardware and software		$1,500
Transportation	USD, UCSD, SDSU, etc.	$500

Printing and publishing	Report	$150
Distribution	Report	$50
Storage	Books, reports, maps, disks, photos	$100
ESTIMATED TOTAL		$5,300 - $8,300

Some known repositories of literature and reports on Point Loma geology:
SANDAG – San Diego Area Governments
University of San Diego
University of California San Diego, Scripps Institution of Oceanography
San Diego State University
San Diego Museum of Natural History
San Diego Historical Society
Agencies within the Reserve
U.S. Geological Survey
National Park Service

What fossils have already been collected and where are they now?
Should there be a public display?
What should be the disposition of future finds?

Appendix VI: Vital Signs Workshop held at Cabrillo National Monument and Point Loma Ecological Reserve, March 2003

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I. Introduction

Cabrillo National Monument (CNM) is a 160-acre unit of the National Park system located in San Diego, California at the entrance to San Diego harbor. The majority of the park facilities are located on the southern end of a peninsula on a 420-foot elevation ridgeline with the Pacific Ocean to the west, and the San Diego harbor to the east. The town of Point Loma is located north of the peninsula. South of this urbanized area of Point Loma is the 640-acre Point Loma Ecological Reserve (PLER), a partnership effort established in 1993 among five governmental agencies to preserve and manage the native terrestrial habitat on the peninsula. These partners are, in order of land ownership size, the U.S. Navy, National Park Service (NPS), U.S. Department of Veterans Affairs, City of San Diego, and the U.S. Coast Guard. In addition, another partner, the U.S. Fish and Wildlife Service is a non-voting member of the board, providing scientific recommendations and guidance.

Cabrillo National Monument and the PLER contain unique marine and terrestrial natural resources. These include rocky intertidal areas that attract almost 100,000 visitors annually, and native coastal sage scrub habitats that due to urbanization and development are rapidly decreasing elsewhere. In addition, this park is an intersection of biodiversity: some of the species located in the park reach their northern-most distribution here, while for others, their southern-most. Because of this combination of variables, the natural resources and native habitats in this southern California ecosystem are becoming increasingly valuable and of interest to the public and to researchers alike. Being able to understand and detect changes in this ecosystem are critical to its preservation.

To understand and effectively manage the monument's resources, the NPS, through the Natural Resource Challenge (NRC), has embarked on a process to identify key indicators of ecosystem health and similarly, to prioritize the natural resources of the parks. The NRC (1999) provided funding to networks of parks to expand existing inventory programs and develop efficient ways to monitor the vital signs of natural systems. These networks were tasked with conducting long-term ecological monitoring for selected critical parameters, or "vital signs". Cabrillo National Monument is part of the Mediterranean Coast Network, along with Channel Islands National Park and Santa Monica Mountains National Recreation Area.

Through the NRC, all of the natural resources (biotic and abiotic) are being identified for each park. This is accomplished by working with regional experts and by developing conceptual ecosystem models that identify the critical interactive factors and natural resources in a park. Through a variety of methods and approaches, the natural resources are ranked according to objective criteria. These processes vary substantially from park to park, and from region to region. The overall process is being evaluated and revised as each network and park proceeds with this effort. The objective of this process is to develop a prioritized list, based on ecological principles, which will assist with developing long-term monitoring plans.

Workshop 2000

Cabrillo National Monument natural resource science staff embarked on a process to identify “Vital Signs” for the park in January 2000 (Compton et. al. 2003) with a workshop that included regional and local NPS personnel, university scientists and researchers, other agency land managers and landowners, and other partners with a wide range of experience and expertise in Mediterranean-type and marine ecosystems. During the workshop, a list of critical natural resource issues for the park was prepared, and plans were developed that outlined the efforts needed and estimated costs to inventory each of those natural resources. This was a broad effort to look at most of the major natural resources of the park; no priorities were established. The expertise of the attendees was used to develop practical methods of implementing inventory projects for each of the key resources identified.

This workshop subdivided the natural resources of CNM and the PLER into four broad categories: Marine Resources, Physical Resources, Terrestrial Vegetation, and Terrestrial Wildlife. Working groups developed project statements to address inventory and monitoring needs for fourteen specific terrestrial resource categories and seven marine resource categories. The terrestrial resource categories include (in alphabetical order):

- Bats – Presence, distribution, and diversity changes from historic records
- *Birds* – Population trends and habitat associations by group (e.g., breeders, raptors, migrants, shore birds, diving species)
- *Carnivore Communities* – Long-term population trends
- *Herpetology (Reptiles and Amphibians)* – Population trends and species richness monitoring
- Small Mammals and Meso-Herbivores – Distribution and abundance
- *Small Mammals and Meso-Herbivores* – Population trends
- Small Mammal – Pacific Pocket Mouse presence
- Physical Resources (Erosion) – Rates and impacts
- Physical Resources (Fresh Water Resources) – Inventory
- Physical Resources (Geological Resources) - Inventory
- Terrestrial Invertebrates (Insects and Arthropods) – Diversity and densities
- *Terrestrial Invertebrates (Insects and Arthropods)* – Diversity and abundance changes
- Terrestrial Vegetation (Rare and Sensitive Species) – Plant and habitat distributions
- *Terrestrial Vegetation (Alien Species)* – Plant distributions and population changes

Categories in italics identify those resources for which project statements recommended a monitoring effort was needed or for which a monitoring plan should be developed.

The marine resources group, following a habitat type and community niche approach, identified the following topics as critical for evaluating the effectiveness of the marine monitoring program:

- Cabrillo National Monument Rocky Intertidal Monitoring Program - Performance analysis
- *Intertidal Resources* – Status and trends
- *Intertidal Resources* – Biodiversity changes
- Intertidal Habitat – Evaluating influences
- Water Quality – Effects of the San Diego Bay outflow
- Intertidal Habitats on the San Diego Bay side
- Subtidal Habitats - Inventory

Inventory and Monitoring Efforts at Cabrillo National Monument

Subsequent to the 2000 Workshop, numerous inventories were undertaken to more effectively understand the natural components of the Point Loma peninsula (Appendix A). Some of these efforts supplemented prior inventories and some were new projects. The following is a general summary of the inventory and monitoring activities currently occurring at CNM and the PLER.

Herpetological surveys and sampling as initiated in 1995 by the U.S. Geological Survey (USGS) (Robert Fisher) continue by the NPS. This work has been funded by the USGS, Canon, and most recently, the network Inventory and Monitoring program. Terrestrial invertebrates are collected from the herpetological traps and a species list is being developed with the assistance of USGS.

Small mammals caught in the herpetological traps are recorded as well. Information on species presence from these traps has been supplemented by a 1996-97 University of California Riverside (John Rotenberry) study, and by a 2002 San Diego State University (Jay Diffendorfer) project funded by Canon.

In 2002, Canon and the Mediterranean Coast Network funded a bat inventory by the USGS (Drew Stokes).

A project to determine the presence of meso-carnivores was undertaken by the USGS (Kevin Crooks) in 1996.

Since 1994, plant surveys have occurred at several different levels: rare, threatened, endangered, and sensitive species; exotic or alien species; and long-term trends in communities. These efforts have occurred through a combination of programs with the U.S. Navy, San Diego State University (Mike Simpson), and the USGS (Kathryn McEachern).

Resident breeding birds (i.e., passerines) were surveyed in a USGS (Barbara Kus) project in 2000. Shorebirds continue to be sampled in association with the tidepool monitoring efforts.

Another of CNM's longest survey efforts is that of the rocky intertidal zone. Biannual surveys have occurred there since 1990 and continue to provide insight into the health of this environment. A species list of marine invertebrates is being developed through a recent effort (started in 2002) by the University of California San Diego (Kaustav Roy).

Cabrillo NM is also collecting data on viewshed and air quality with a static camera that has been taking photographs on a predetermined schedule and of one specific viewpoint since 1996.

Another key partner in funding inventory projects has been the Cabrillo National Monument Foundation. This non-profit cooperating association regularly provides support for personnel and supplies for the herpetology, terrestrial invertebrates, small mammals, birds, plants, and marine studies.

Exotic vegetation removal and restoration replanting with native species is an ongoing resource management program that is part of the normal park operations at Cabrillo.

II. Workshop 2003 Overview

In order to prioritize monitoring activities at Cabrillo National Monument and the PLER an indicator selection workshop was held in March of 2003 at Cabrillo (Appendix B). At this workshop, participants (Appendix C) reviewed a series of ecosystem conceptual models to isolate and prioritize key ecosystem components or processes that could be classified as vital indicators of ecosystem health (Vital Signs). The key components of these models included drivers, stressors, and ecological effects that influence the ecosystem (Table 1, Appendix D).

Table 1. Cabrillo National Monument, Proposed drivers, stressors, and ecological effects for the ecosystem.

Ecosystem Drivers	Ecosystem Stressors (Agents of Change)	Ecological Effects (Response)
Parent Materials (Geology)		
• Geology • Soils • Topography • Erosion • Shoreline Instability	♦ Land Use Conversion ♦ Erosion ♦ Land Form Changes	▪ Sediment & Nutrient Transport ▪ Toxic Materials Accumulation ▪ Water Budget ▪ Water Quality ▪ Mass Wasting ▪ Geologic Stability ▪ Altered Soils ▪ Vegetation Community Structure
Climate (Weather)		
• Precipitation • El Niño • Climate (Temperature) Change • Fog • Ocean Currents	♦ Extreme Storm Events ♦ Winds ♦ Solar Radiation ♦ Erosion ♦ Temperature Change	▪ Mass Wasting ▪ Altered Soils ▪ Habitat Type Conversion ▪ Exotic Propagule Transport

		▪ Habitat Loss
Anthropogenic Impacts		
• Land Use Conversion • Urbanization • Direct Human Contact	♦ Recreational Use ♦ Resource Management ♦ Consumptive Use ♦ Light Pollution ♦ Water Pollution ♦ Air Pollution ♦ Introduction of Horticultural & non-Horticultural Exotics ♦ Habitat Fragmentation ♦ Pesticide & Fertilizer Use ♦ Hydrologic Changes ♦ Habitat Disturbance ♦ Roadway Mortality ♦ Noise/Disturbance from Aircraft ♦ Domestic Animals ♦ Animal Control	▪ Community Structure ▪ Colonization & Dispersal of Exotics ▪ Genetics ▪ Water Budget ▪ Toxic Materials Accumulation ▪ Habitat Structure & Composition ▪ Habitat Type Conversion ▪ Habitat Loss ▪ Migration & Dispersal ▪ Water Quality ▪ Air Quality ▪ Visibility ▪ Wildlife Reproductive Success ▪ Species Loss ▪ Disease ▪ Wildlife Behavioral Changes ▪ Resource (Food) Availability
Biological		
• Succession • Evolution • Species Range Dynamics	♦ Invasion ♦ Hybridization ♦ Natural Selection ♦ Extirpation ♦ Disease	▪ Habitat Type Conversion ▪ Genetic Change ▪ Community Structure ▪ Predator/Prey Dynamics ▪ Populations Dynamics ▪ Native Richness & Diversity ▪ Exotic Richness & Diversity

In association with these ecosystem drivers, stressors, and ecological effects, participants were also presented with a list of key natural resource issues that were developed from the results of the 2000 Cabrillo workshop and in discussion with park natural resource managers.

These natural resource issues are broadly described in the following categories:

- Air chemistry
- Climate/weather
- Succession
- Biomagnification/bioaccumulation
- Nutrient dynamics
- Habitat fragmentation
- Disturbance events
- Sound
- Light pollution
- Autecology
- Synecology
- Hillslope features and processes
- Soil quality
- Fluvial features and processes
- Coastal features and processes
- Water quality (marine and freshwater)

Participants were then presented with a computer-based exercise to objectively prioritize the natural resource issues as proposed vital signs, and were instructed on the criteria to be used to rank the proposed vital signs. A complete listing of all candidate vital signs is given in Appendix E.

The computer exercise was a modified version of a database exercise developed by the Cumberland/Piedmont Inventory and Monitoring Network and distributed to networks by the national Inventory and Monitoring (I&M) program (Steve Fancy). This database ranked proposed vital signs based upon their:

1. Ecological Significance,
2. Management Significance, and
3. Legal or Policy Mandate.

The Management Significance refers to those resources for which value is ascribed for additional reasons. For example, does the public value those resources and it is important to conduct monitoring for those reasons?

The Legal or Policy Mandate refers to the park's role and legal protection for a resource that has significant and sometimes major influences on the management of that species. For example, is the species a threatened or endangered one and would require specific surveying approaches? Is the species listed as part of the park management goals?

The Ecological Significance covers the linkage between the resource and the ecological function of that resource. Participants were to evaluate the candidate vital signs for their Ecological Significance only. The variety of expertise represented could provide ecological information for these species regardless of the management or legal directives that could affect NPS actions. The NPS staff completed the Management Significance and Legal Mandate pages for input into the model.

Each of the candidate vital signs was to be ranked from "No significance" to "High significance" on a scale of five in response to answers varying from five to nine objective statements (Appendix E) that qualified the ranking category. In this exercise for instance a candidate vital sign was presented such as "Air Chemistry, Ozone" or "Habitat Fragmentation, Connectivity" or "Ecology/Biology, Intertidal Invertebrates." These proposed vital signs would then be ranked based upon the scorer's positive evaluation of the ecological significance of a vital sign as related to some or all of these statements:

1. There is a strong, defensible linkage between the attribute and the ecological function or critical resource it is intended to represent.
2. The resource being represented by the attribute has high ecological importance based upon the conceptual model of the system and the supporting ecological literature.
3. The attribute characterizes the state of unmeasured structural and compositional resources and system processes.
4. The attribute provides early warning of undesirable changes to important resources. It can signify an impending change in the ecological system.
5. The attribute reflects the functional status of one or more key ecosystem processes or the status of ecosystem processes.
6. The attribute reflects the capacity of key ecosystem processes to resist or recover from change induced by exposure to natural disturbance and/or anthropogenic stressors.
7. No opinion: did not score this attribute.

To expedite the ranking process each participant was given a hardcopy matrix (spreadsheet) listing the candidate vital signs across the top and the evaluating statements down the left of the matrix. Participants were then asked to mark each vital sign where they felt the evaluating statement was true. False statements were to be left blank.

The spreadsheets were to be gathered and the results summed and entered into the database during the lunch break. Once entered, the results could be tabulated and a prioritized listing of vital signs was to be developed for group evaluation and review.

The database could weight the ranking criteria from 0 to 100 % with the weights for the three broad criteria totaling no more than 100%. For this exercise, Ecological Significance was weighted at 40% with the other two criteria weighed at 30% each.

III. Recommendations and Actions

A lively discussion on the proposed conceptual model suggested that the ecosystem model would be improved by:

1. Defining the spatial limits of the model more precisely
2. Include geomorphology, i.e. topography and hydrology
3. Accounting for the differences in east-facing versus west-facing sides of the park
4. Expanding anthropogenic impacts to include park buildings and facilities, facilities management activities, and resource management activities
5. Marine aspects of model need to be included at a much greater detail than as presented.

These recommendations will be incorporated into the next round of modeling.

During the course of the workshop, many questions were raised about the meaning of the ranking statements and the context of the candidate vital signs. Participants had difficulty interpreting the ranking statements, understanding the full context of the candidate vital signs, and evaluating the two together from the information provided and within the time frame allotted. Linking the vital signs to the conceptual model did not occur during the workshop as the models were inclusive enough to encompass all of the proposed vital signs.

The participants' efforts to conduct the vital signs rankings quickly converted to discussion. A significant discussion ensued during which it was suggested that the process could be made more reliable with additional clarification of the statements to qualify the ranking. The comments also centered on presenting sufficient information on the candidate vital signs in the ranking process that the participants could evaluate each candidate vital sign within the context of its presentation.

The computer based prioritization process will be re-evaluated based upon the recommendations of the participants and the candidate vital indicators will be arranged in a hierarchy of increasing complexity so that sufficient information is presented to those ranking the vital signs that their ecological context is understood and the specific measure suggested for a given candidate vital sign is known. The statements will be reevaluated and defined more specifically. The revised ranking process will be distributed to a broader audience (including those who were unable to attend this workshop) via an inter-net based database.

IV. Literature Cited

Compton, A., J. Coyner, L. Garrett, and S. Weber. 2004. Vital Signs – Part I, Workshop 2000 Report Cabrillo National Monument and Point Loma Ecological Reserve, January 25-27, 2000. National Park Service, Final Report for Subagreement No. 20, Modification #5 to Cooperative Agreement No. 1443-CA9000-95-018. 59pp.

Appendix VI-a. Current Inventory and Monitoring Programs at Cabrillo NM

Topic	Year Conducted/Completed	Partners/Cooperators with CABR NPS*
Rocky intertidal zone	1990/on-going	MCN
Herpetology	1995/on-going	MCN-USGS
Marine invertebrates	2002/on-going	UCSD
Terrestrial invertebrates - including gastropods, arthropods	1997/on-going	USGS
Air visibility and quality	1996/on-going	-
Plants - vegetation transects	1994, 1998, 2003	USGS
Plants - rare, TES	1994/2003	MCN-Navy-SDSU-USGS
Plants – exotic	1994/2003	MCN-Navy
Mammals – small	2002	SDSU-UCR-USGS
Bats	2002/-on-going	MCN-USGS
Mammals – carnivores	1996	USGS
Birds - residents (breeding passerines)	2000	USGS
Birds – shorebirds	1990/on-going	MCN

*Funding provided by National Park Service, Mediterranean Coast Network (Natural Resource Challenge Funds), Cabrillo National Monument Foundation, Canon, and in-kind services by partners.

Acronyms:

Acronyms:	CABR	Cabrillo National Monument
	MCN	Mediterranean Coast Network
	NPS	National Park Service
	SDSU	San Diego State University
	SIO	Scripps Institute of Oceanography, UCSD
	UCSD	University of California, San Diego
	UCR	University of California, Riverside
	USGS	U.S. Geological Survey

Appendix VI-b. Workshop Agenda

"Identifying and Prioritizing Indicators of Ecosystem Health", Vital Signs Workshop 2003, March 28, Cabrillo National Monument (CABR) and Point Loma Ecological Reserve

Time	Item	Who	Organization
8:30-9:00	Continental Breakfast Mixer		
9:00-9:15	Welcome	Terry DiMattio	Park Superintendent, CABR
9:15-9:30	Introductions of participants	Andrea Compton	Chief, Natural Resource Science Division, CABR
9:30-10:15	Cabrillo National Monument - Park overview - Vital Signs Park I summary (January 2000) - Status of inventory and monitoring projects: terrestrial, marine, biotic and abiotic	Andrea Compton Bonnie Becker	 Marine Biologist, Natural Resource Science Division, CABR
10:15-10:30	Break		
	Inventory and Monitoring Program – Overview, Objectives, and Goals	Lane Cameron	Inventory & Monitoring Coordinator, Mediterranean Coast Network
11:00-12:00	Conceptual Ecosystem Model – Introduction and Group Review	Lane Cameron	
12:00-1:00	Lunch		
1:00-1:45	Conceptual Ecosystem Model –Continued Review and Comments	Lane Cameron	
1:45-2:00	Mediterranean Ecosystems – their uniqueness and Cabrillo's location	Phil Rundel	University of California, Los Angeles
2:00-3:00	Prioritization of Resources – the process Group Discussion – Review of Resources and Attributes	Lane Cameron	
3:00-3:15	Break		
3:15-3:30	List of Prioritized Resources – presentation	Lane Cameron	
3:30-4:30	Group Discussion – Review and Edits to Prioritized List		
4:30-5:00	Conclusion – What's Next	Lane Cameron Andrea Compton	

Appendix VI-c. Participants

Vital Signs Workshop 2003, March 28, Cabrillo National Monument and Point Loma Ecological Reserve

Name	Organization*
Andrea Atkinson	USGS
Bonnie Becker	NPS - CABR/SIO
Chris Brown	USGS
Lane Cameron	NPS – SAMO/I&M
Samantha Canterberry	SDSU – NPS volunteer
Andrea Compton	NPS - CABR
Gary Davis	NPS - CHIS
Terry DiMattio	NPS - CABR
Ely Edquid	NPS - CABR
Matt Edwards	SDSU
Dina Estrella	SDSU
Penny Latham	NPS - I&M
Tiffany Luas	NPS - CABR
Kim McCrary	NPS volunteer - CABR
Karl Pierce	NPS - CABR
David Pivorunas	USN
Kaustav Roy	UCSD
Phil Rundel	UCLA
Terry Scherkenbach	NPS - CABR
Leslie Seiger	SDCCD - Mesa College
John Tizler	NPS – SAMO
Samanta Weber	NPS – YOSE/I&M
Clark Winchell	USFWS

*Acronyms:	CABR	Cabrillo National Monument
	CHIS	Channel Islands National Park
	I&M	Regional Inventory and Monitoring Program
	NPS	National Park Service
	SAMO	Santa Monica Mountains National Recreation Area
	SDCCD	San Diego Community College District
	SDSU	San Diego State University
	SIO	Scripps Institute of Oceanography, UCSD
	UCSD	University of California, San Diego
	USGS	U.S. Geological Survey
	USN	U.S. Navy
	USFWS	U.S. Fish and Wildlife Service
	YOSE	Yosemite National Park

Appendix VI-d. Conceptual Models

Cabrillo National Monument Ecosystems Conceptual Model

One of the primary activities of the proposed vital signs workshop for Cabrillo National Monument (CABR) is to review of a series of conceptual models of ecosystem structure and function, and to solicit comments on the models as a backdrop to identifying vital indicators of ecosystem health.

Background

The distinguishing characteristics of the Southern and Central California Chaparral and Oak Woodlands Common Ecological Region[1] include its Mediterranean climate and associated chaparral, oak woodlands, grasslands, and coastal sage scrub. Mediterranean-type Ecosystems are distributed among five distinct geographical zones located worldwide along continental coastlines between 30º and 45º latitude. These include the Mediterranean Basin, the Cape region of South Africa, Central Chile, South and Southwestern Australia, and California. Hot dry summers and cool rainy winters typically represent the climate in these areas. Vegetation communities in Mediterranean-type ecosystems are moisture and elevation dependent, and vary along a continuum from desert and semi-desert shrubs through savannas and grasslands, sclerophyllous woodlands, to coniferous and deciduous forests (Rundel, 1998). Mediterranean-type ecosystems host a disproportionate share in the number of plant species worldwide in both the number of species and the number of rare or locally endemic species (Cowling & McDonald, 1998). All five Mediterranean-type regions support similar communities of broadleaf (sclerophyllous) evergreen shrubs and dwarf trees known in North America as chaparral. Shrub oaks and chamise dominate California chaparral. California chaparral grades to coastal sage scrub dominated by drought deciduous shrubs at arid inland margins and along drier coastal areas. The vegetation community on Pt. Loma is comprised of Coastal Sage Scrub, Maritime Succulent Scrub, Southern Maritime Chaparral, and Southern Coastal Bluff Scrub.

Mediterranean-type ecosystems are among the most disturbed ecosystems in the world (*cf*. Samways, 1998). Primary disturbances resulting from human habitation include changes in fire frequency and intensity, grazing of introduced species, urbanization, agricultural expansion, deforestation, and the introduction of exotic species (Rundel, 1998). Groves (1998) has identified seven indicators of landscape degradation in Mediterranean-type ecosystems. These are:

1. A decrease in the rate of vegetative litter accumulation,
2. An increase in the rate of soil erosion,
3. Invasion of light-demanding exotic plants,
4. A decrease in the cover of perennial native vegetation and an increase in the cover of exotic annual plants,
5. Changes in the general phenology of vegetation communities,
6. An increase in fire frequency, and
7. An increase in the woody elements of vegetation or the proportion of post fire plants that recover by resprouting.

Managing public lands for conservation of resources is not only an ecological process but more often as not a political one as well, with the ecological aspects of resource management often taking second place to a political or social agenda (*cf.* Davis & Wyberg, 1998). For resource managers to play a meaningful role in the process of institutionalizing the collection of baseline ecological information that will justify one course of management action over another it is essential to formulate long-term environmental management plans based upon scientifically sound data and models of ecosystem function (*cf.* Davis & Wyberg, 1998).

[1] http://soils.usda.gov/soil_survey/geography/eco_regions/journal.htm

The intent of the Vital Signs Monitoring program with the National Park Service is to institutionalize long-term monitoring of selected ecosystems components or processes that are determined to be vital indicators of ecosystem health. Monitoring may also include specific natural resources of unique concern within a given park or region, or may include natural resources with significant social or political interest. The success of vital signs monitoring (VSM) will in large part be dependent upon the process used to identify the vital indicators and natural resources that are to be monitored. Ecosystem indicators must be based upon a "well-understood and generally accepted conceptual model of the system to which (they are) applied" (National Research Council, 2000, *cf.* Jackson *et al.*, 2000). Proposed indicators of ecosystem health should be responsive to the assessment question they are intended to answer, and should provide information useful to resource managers. They should be conceptually linked to the ecological function of concern. They must be feasible and practical from a methods, logistics, costs, and analysis perspective. And it is essential that the components of variability within the indicator be understood in order to distinguish among extraneous factors and the environmental signal to be detected (Jackson *et al.*, 2000). Identifying vital indicators of ecosystem health for National Park Units and developing an objective conceptual model of ecosystem function is a primary goal of the Vital Signs Monitoring program. Guidance on developing a network ecosystem conceptual model suggests that:

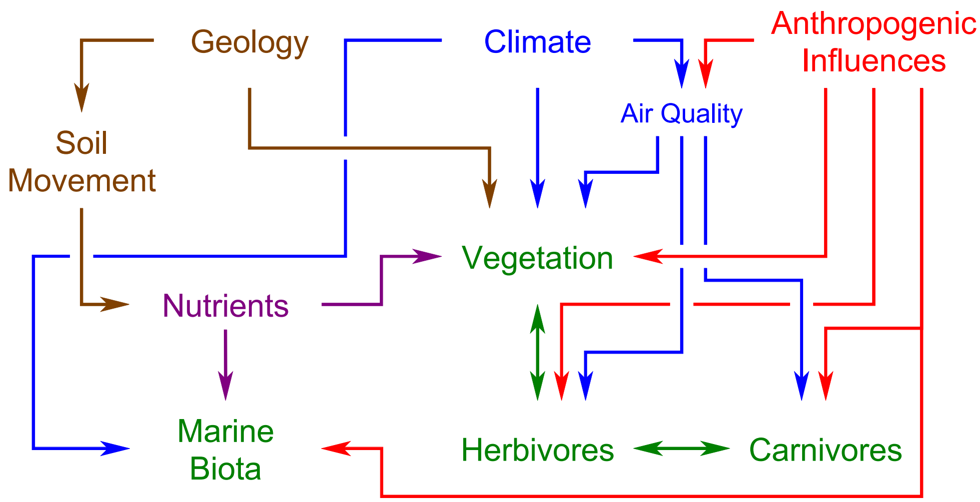
> A conceptual model is a visual or narrative summary that describes the important components of the ecosystem and the interactions among them. Development of a conceptual model helps in understanding how the diverse components of a monitoring program interact, and promotes integration and communication among scientists and managers from different disciplines.[2]

Four primary drivers for Cabrillo National Monument were identified. Each of these was in turn subdivided into specific elements that were considered to be significant aspects of the drivers that noticeably contribute to ecosystem function. Ecosystem stressors as identified in this process were considered to be significant activities, actions, events, or processes that can alter the organization or stability of the ecosystems in question. Ecological effects were those processes or components of park ecosystems that were most responsive to the effect of the stressors and would point towards specific attributes of the ecosystems that could be quantified and monitored over time. From this suite of drivers, stressors, and ecological effects future discussion will lead to the selection of ecosystem elements that can be considered vital indicators of ecosystem health.

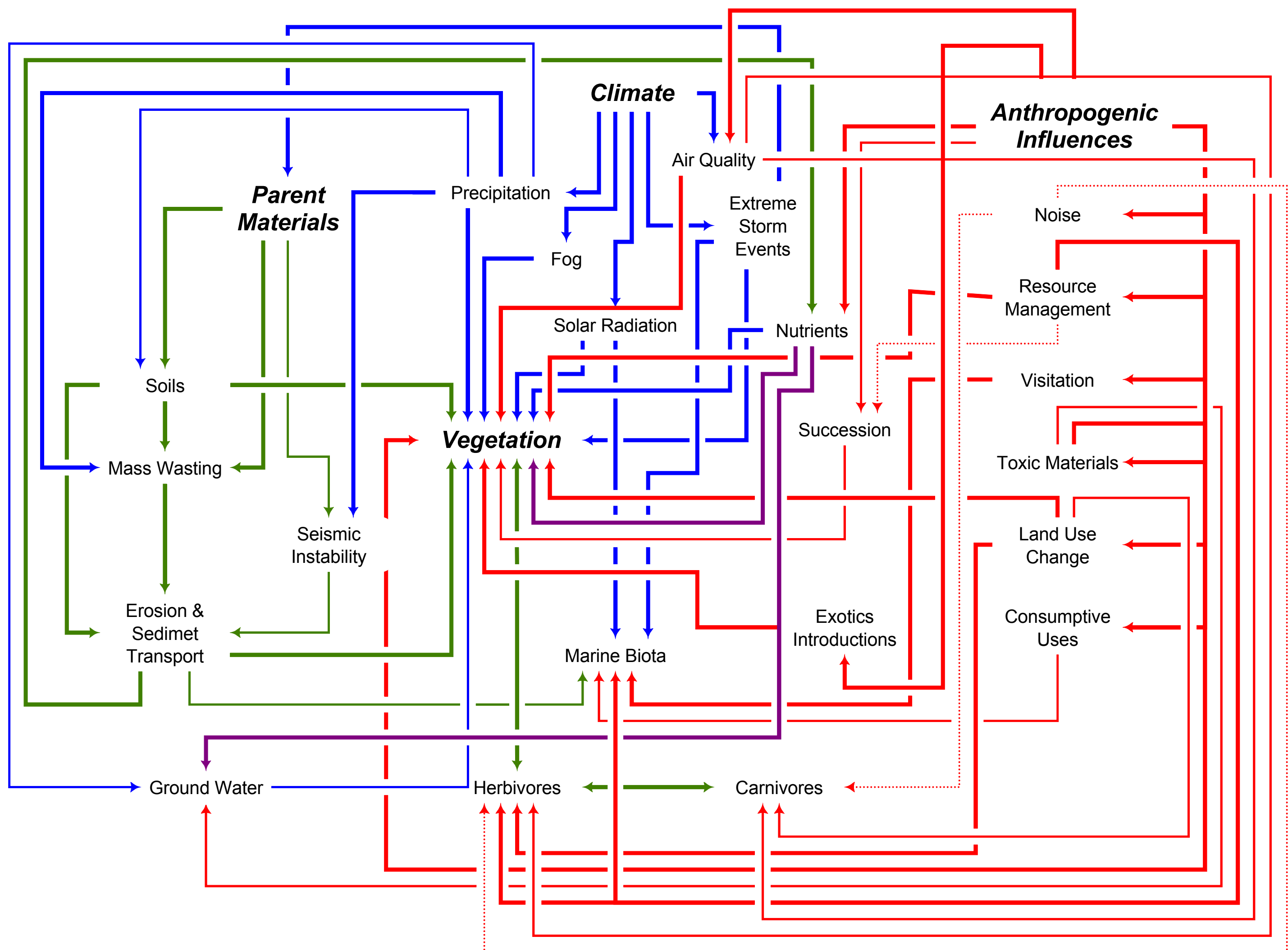
A generalized graphical representation of the major ecosystem elements of the southern California Mediterranean-type Ecosystem was prepared and then expanded into a more detailed conceptual model for CABR. These models were constructed from accounts of Mediterranean-type ecosystem structure and function, published accounts of the relationships and interactions of the biotic, physical, and chemical components of Mediterranean-type ecosystems.

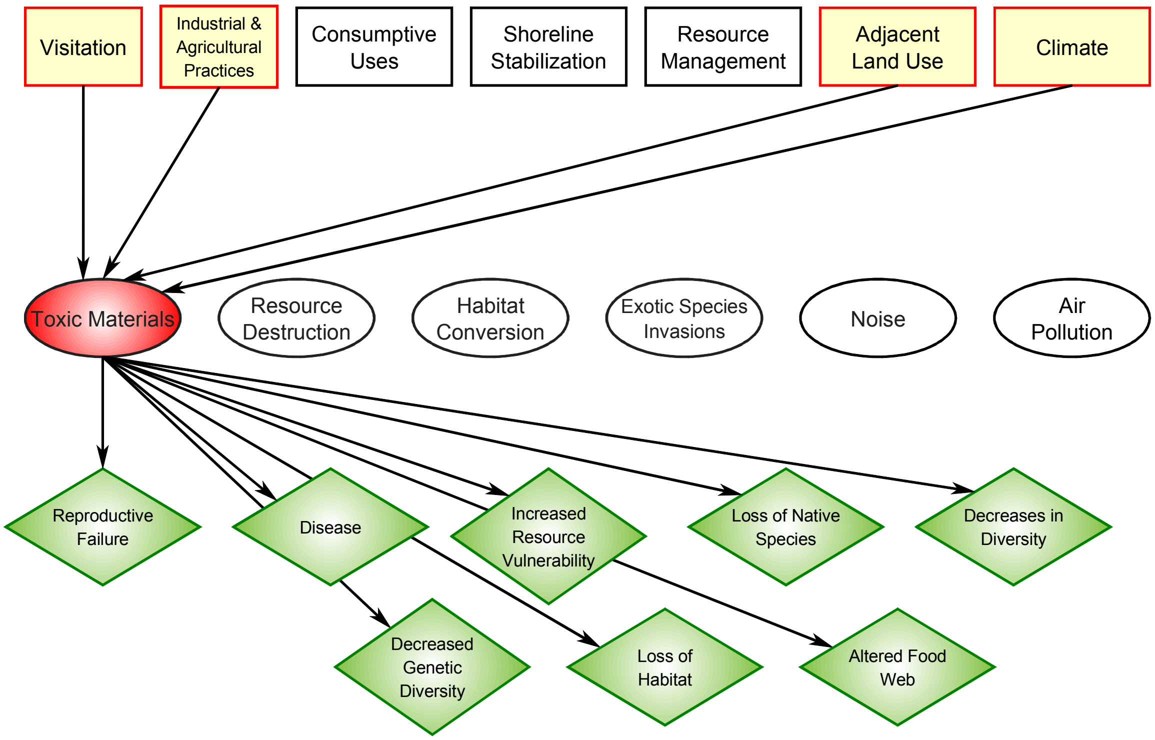
[2] http://www.nature.nps.gov/im/monitor/index.htm#Conmodel

Major Ecosystem Elements at Cabrillo National Monument



Ecosystem Conceptual Model Cabrillo National Monument

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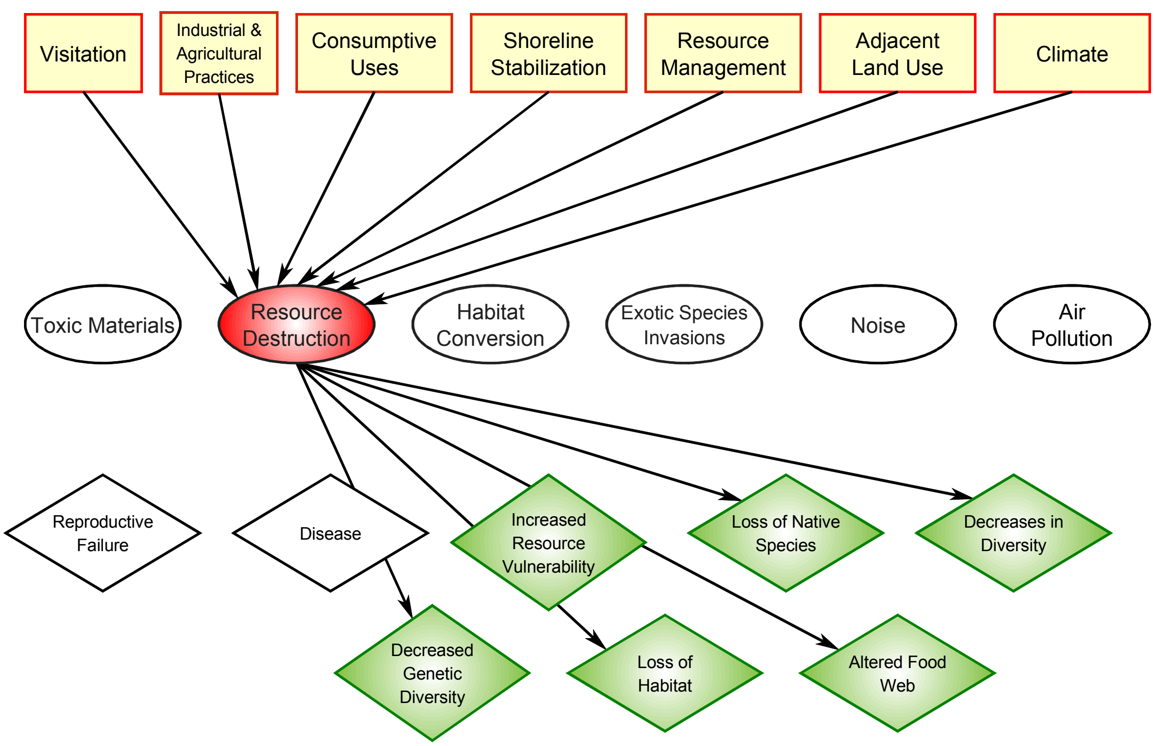
Consumptive Uses
Shoreline Stabilization
Resource Management
Adjacent Land Use
Climate
Toxic Materials
Resource Destruction
Habitat Conversion
Exotic Species Invasions
Noise
Air Pollution
Reproductive Failure
Disease
Increased Resource Vulnerability
Loss of Native Species
Decreases in Diversity
Decreased Genetic Diversity
Loss of Habitat
Altered Food Web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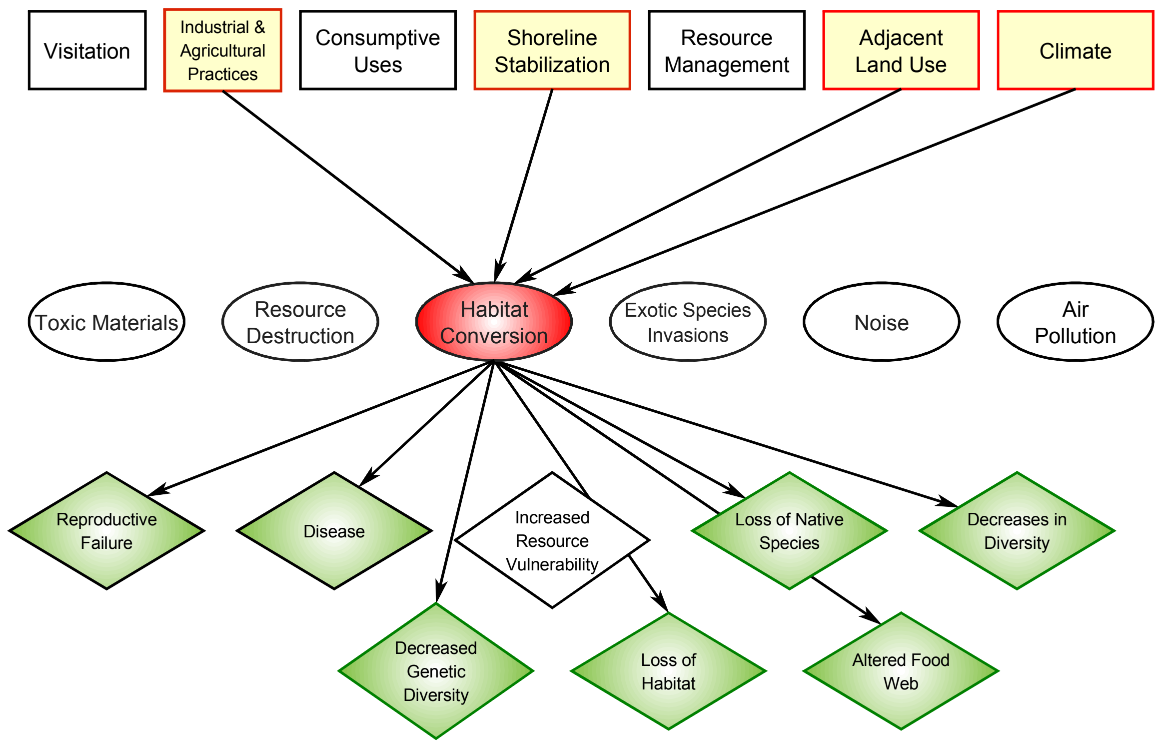
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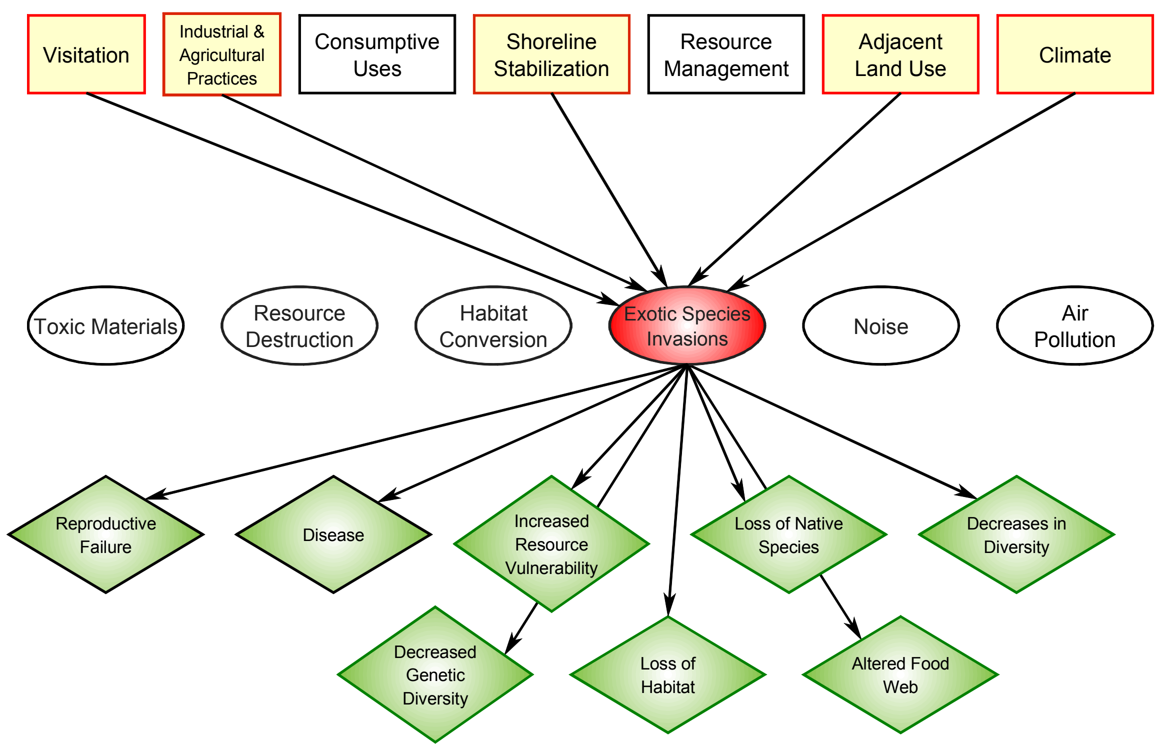
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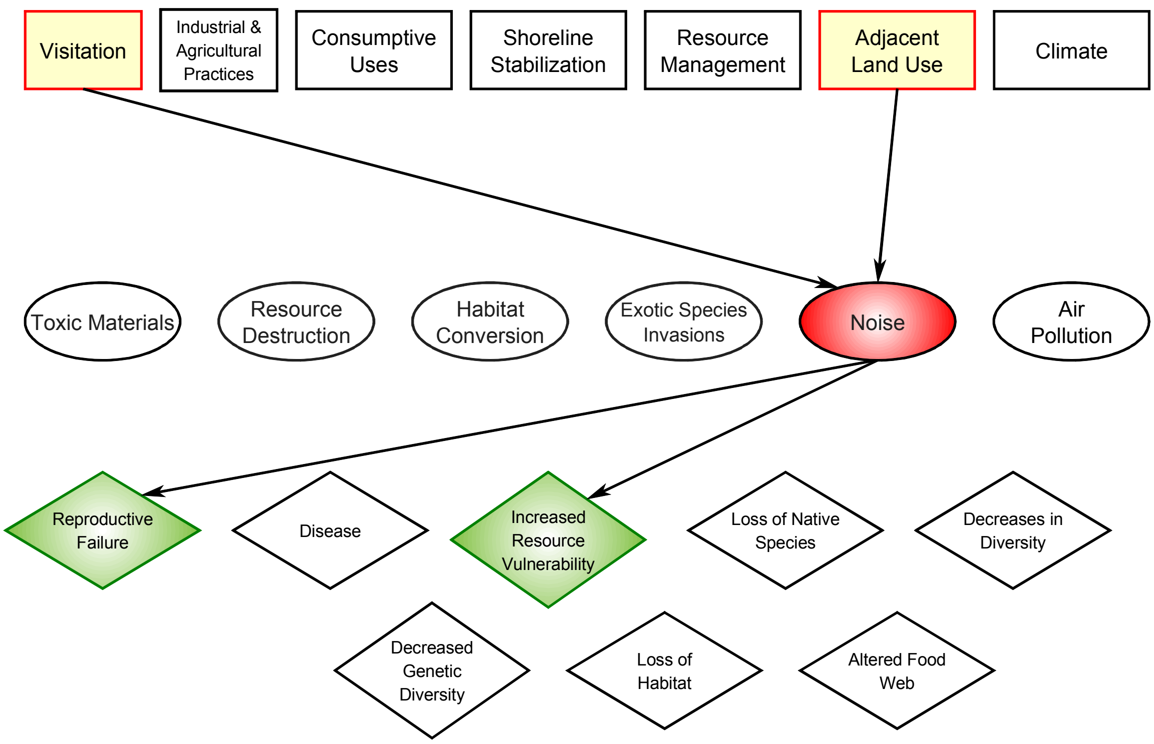
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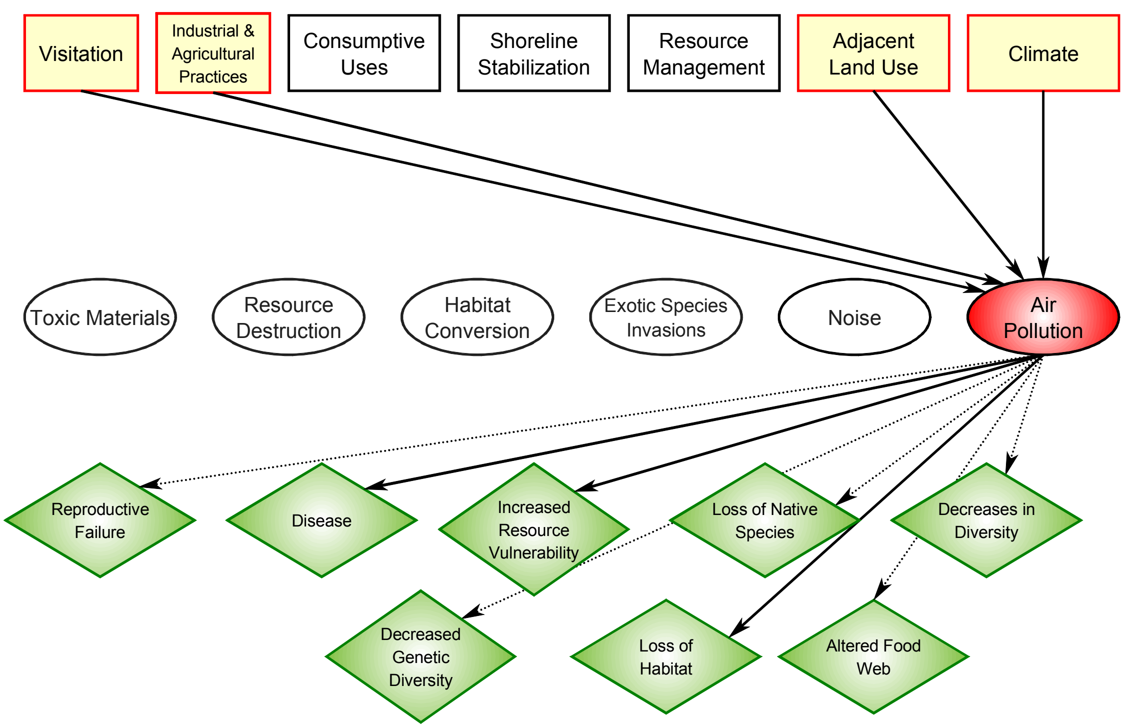
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Appendix E. List of Resources and Criteria Worksheets

Ecological Significance

		AQ-01, Air Chemistry, Ozone	AQ-02, Air Chemistry, Nitrogen/sulfur	AQ-03, Air Chemistry, Fine particles	AQ-04, Air Chemistry, Contaminants	EP-01, Weather, Humidity, Rainfall, Temperature, Wind, Fog	EP-02, Succession, Community structure	EP-03, Biomagnification/bioaccumulation, Contaminants	EP-04, Nutrient dynamics, Nutrient cycling	EP-05, Habitat Fragmentation, Connectivity	EP-06, Disturbance Events, Habitat Integrity, Land Use	EP-07, Sound, Natural sound levels	EP-08, Light pollution, Dark night sky	EP-09, Climate, Solar Radiation	FA-01, Ecology/Biology, Bats	FA-02, Ecology/Biology, Birds - migrants, raptors, residents, shore, TES, rare	FA-03, Ecology/Biology, Carnivores	FA-04, Ecology/Biology, Invertebrates - Native, Exotic, TES, Rare	FA-05, Ecology/Biology, Medium-sized Mammals	FA-06, Ecology/Biology, Reptiles and Amphibians	FA-07, Ecology/Biology, Small Mammals	GR-01, Hillslope Features and Processes, Seismic instability, Slope Stability	GR-02, Fluvial Features and Processes, Intermittent discharge channels	GR-03, Coastal Features and Processes, Beaches, bluffs, rocky coasts, tide pools, inlets	MB-01, Ecology/Biology, Intertidal Invertebrates	MB-02, Ecology/Biology, Intertidal Flora	MB-03, Ecology/Biology, Vertebrates	MB-04, Ecology/Biology, Intertidal Invertebrates - Molluscs	SQ-01, Soil Quality, Soil aggregate stability	SQ-02, Soil Quality, Soil erosion by water, wind	TF-01, Ecology/Biology, Vascular Plants (Native)	TF-02, Ecology/Biology, Vascular Plants (Exotic)	TF-03, Ecology/Biology, Non-vascular Plants	TF-04, Ecology/Biology, Threatened, endangered, sensitive, rare	TF-05, Ecology/Biology, Restoration	WQ-01, Water Quality - Marine, Intertidal Water Quality	WQ-02, Water Quality - Freshwater, Seep Water Quality	Wquan-01, Water quantity - Freshwater, Water Quantity - Distribution (seeps) & Quantity	Comments
1	There is a strong, defensible linkage between the attribute and the ecological function or critical resource it is intended to represent.																																						
2	The resource being represented by the attribute has high ecological importance based on the conceptual model of the system and the supporting ecological literature.																																						
3	The attribute characterizes the state of unmeasured structural and compositional resources and system processes.																																						
4	The attribute provides early warning of undesirable changes to important resources. It can signify an impending change in the ecological system.																																						
5	The attribute reflects the functional status of one or more key ecosystem processes or the status of ecosystem properties that are clearly related to these ecosystem processes. [Note: replace the term ecosystem with landscape or population, as appropriate.]																																						
6	The attribute reflects the capacity of key ecosystem processes to resist or recover from change induced by exposure to natural disturbances and/or anthropogenic stressors. [Note: replace the term ecosystem with landscape or population, as appropriate.]																																						
7	No opinion, or did not score this attribute																																						
	Total Score																																						

Management Significance

		AQ-01, Air Chemistry, Ozone	AQ-02, Air Chemistry, Nitrogen/sulfur	AQ-03, Air Chemistry, Fine particles	AQ-04, Air Chemistry, Contaminants	EP-01, Weather, Humidity, Rainfall, Temperature, Wind, Fog	EP-02, Succession, Community structure	EP-03, Biomagnification/bioaccumulation, Contaminants	EP-04, Nutrient dynamics, Nutrient cycling	EP-05, Habitat Fragmentation, Connectivity	EP-06, Disturbance Events, Habitat Integrity, Land Use	EP-07, Sound, Natural sound levels	EP-08, Light pollution, Dark night sky	EP-09, Climate, Solar Radiation	FA-01, Ecology/Biology, Bats	FA-02, Ecology/Biology, Birds - migrants, raptors, residents, shore, TES, rare	FA-03, Ecology/Biology, Carnivores	FA-04, Ecology/Biology, Invertebrates - Native, Exotic, TES, Rare	FA-05, Ecology/Biology, Medium-sized Mammals	FA-06, Ecology/Biology, Reptiles and Amphibians	FA-07, Ecology/Biology, Small Mammals	GR-01, Hillslope Features and Processes, Seismic Instability, Slope Stability	GR-02, Fluvial Features and Processes, Intermittent discharge channels	GR-03, Coastal Features and Processes, Beaches, bluffs, rocky coasts, tide pools, Inlets	MB-01, Ecology/Biology, Intertidal Invertebrates	MB-02, Ecology/Biology, Intertidal Flora	MB-03, Ecology/Biology, Vertebrates	MB-04, Ecology/Biology, Intertidal Invertebrates - Molluscs	SQ-01, Soil Quality, Soil aggregate stability	SQ-02, Soil Quality, Soil erosion by water, wind	TF-01, Ecology/Biology, Vascular Plants (Native)	TF-02, Ecology/Biology, Vascular Plants (Exotic)	TF-03, Ecology/Biology, Non-vascular Plants	TF-04, Ecology/Biology, Threatened, endangered, sensitive, rare	TF-05, Ecology/Biology, Restoration	WQ-01, Water Quality - Marine, Intertidal Water Quality	WQ-02, Water Quality - Freshwater, Seep Water Quality	Wquan-01, Water quantity - Freshwater, Water Quantity - Distribution (seeps) & Quantity	Comments
1	There is an obvious, direct application of the data to a key management decision, or for evaluating the effectiveness of past management decisions.																																						
2	The attribute/indicator will produce results that are clearly understood and accepted by park managers, other policy makers, research scientists, and the general public, all of whom should be able to recognize the implications of the indicator's results for protecting and managing the park's natural resources.																																						
3	Monitoring results are likely to provide early warning of resource impairment, and will save park resources and money if a problem is discovered early.																																						
4	In cases where data will be used primarily to influence external decisions, the decisions will affect key resources in the park, and there is a great potential for the park to influence the external decisions.																																						
5	Data are of high interest to the public.																																						
6	For species-level monitoring, involves species that are harvested, endemic, alien, species of special interest, or T&E																																						
7	There is an obvious, direct application of the data to performance (GPRA) goals.																																						
8	Contributes to increased understanding that ultimately leads to better management																																						
9	No opinion, or did not score this attribute																																						
	Total Score																																						

Legal/Policy Mandate

		AQ-01, Air Chemistry, Ozone	AQ-02, Air Chemistry, Nitrogen/sulfur	AQ-03, Air Chemistry, Fine particles	AQ-04, Air Chemistry, Contaminants	EP-01, Weather, Humidity, Rainfall, Temperature, Wind, Fog	EP-02, Succession, Community structure	EP-03, Biomagnification/bioaccumulation, Contaminants	EP-04, Nutrient dynamics, Nutrient cycling	EP-05, Habitat Fragmentation, Connectivity	EP-06, Disturbance Events, Habitat Integrity, Land Use	EP-07, Sound, Natural sound levels	EP-08, Light pollution, Dark night sky	EP-09, Climate, Solar Radiation	FA-01 Ecology/Biology, Bats	FA-02 Ecology/Biology, Birds - migrants, raptors, residents, shore, TES, rare	FA-03 Ecology/Biology, Carnivores	FA-04 Ecology/Biology, Invertebrates - Native, Exotic, TES, Rare	FA-05 Ecology/Biology, Medium-sized Mammals	FA-06 Ecology/Biology, Reptiles and Amphibians	FA-07 Ecology/Biology, Small Mammals	GR-01, Hillslope Features and Processes, Seismic instability, Slope Stability	GR-02, Fluvial Features and Processes, Intermittent discharge channels	GR-03, Coastal Features and Processes, Beaches, bluffs, rocky coasts, tide pools, inlets	MB-01, Ecology/Biology, Intertidal Invertebrates	MB-02, Ecology/Biology, Intertidal Flora	MB-03, Ecology/Biology, Vertebrates	MB-04, Ecology/Biology, Intertidal Invertebrates - Molluscs	SQ-01, Soil Quality, Soil aggregate stability	SQ-02, Soil Quality, Soil erosion by water, wind	TF-01, Ecology/Biology, Vascular Plants (Native)	TF-02, Ecology/Biology, Vascular Plants (Exotic)	TF-03, Ecology/Biology, Non-vascular Plants	TF-04, Ecology/Biology, Threatened, endangered, sensitive, rare	TF-05, Ecology/Biology, Restoration	WQ-01, Water Quality, Marine, Intertidal Water Quality	WQ-02, Water Quality - Freshwater, Seep Water Quality	Wquan-01, Water quantity - Freshwater, Water Quantity - Distribution (seeps) & Quantity	Comments
1	The park is **required** to monitor this resource by some specific, binding, legal mandate (e.g., Endangered Species Act for an endangered species, Clean Air Act for Class 1 airsheds), or park enabling legislation that mentions a specific resource to be monitored.																																						
2	The resource/attribute is specifically covered by an Executive Order (e.g., invasive plants, wetlands) or a specific Memorandum of Understanding signed by the NPS (e.g., bird monitoring), as well as by the Organic Act, other general legislative or Congressional mandates, and NPS Management Policies.																																						
3	There is a GPRA goal specifically mentioned for the resource being monitored, or the need to monitor the resource is indicated by some type of federal or state law as well as by the Organic Act and other general legislative mandates and NPS Management Policies, but there is no specific legal mandate for this particular resource.																																						
4	The resource/attribute is covered by the Organic Act and other general legislative or Congressional mandates such as the Omnibus Park Management Act and GPRA, and by NPS Management Policies, but there is no specific legal mandate for this particular resource.																																						
5	No opinion, or did not score this attribute [default; null]																																						
	Total Score																																						

Appendix VII: Report on the Workshop to Develop a Conceptual Model and to Select Vital Signs for Santa Monica Mountains National Recreation Area Mediterranean Coast Network

J. Lane Cameron, PhD
Mediterranean Coast Network
401 W. Hillcrest Dr.
Thousand Oaks, CA 91360

Appendix VII: Report on the Workshop to Develop a Conceptual Model and to Select Vital Signs for Santa Monica Mountains National Recreation Area Mediterranean Coast Network

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Introduction

In December 2002, a two-day conceptual modeling and vital signs development workshop was held for the Santa Monica Mountains National Recreation Area. Some 60 participants from academia, state and federal resource management agencies, and private industry spent two days in general meetings and specialist breakout sessions discussing the draft conceptual model and proposing candidate indicators of ecosystem health (Vital Signs).

Participants were provided with background materials on the conceptual model process and vital signs development, draft conceptual models of the Santa Monica Mountains ecosystem, species lists for the National Recreation Area, and information on current and past monitoring within the mountains. Over 20 posters detailing resource issues and ongoing research and monitoring were on display throughout the workshop. Natural resource management staff from Santa Monica Mountains National Recreation Area was on hand to discuss their work in the park. Copies of background materials provided to participants are attached at the end of this report. A hard copy of the slides used in the introductory power point presentation is also included.

Work Groups

The three breakout sessions (Vegetation, Terrestrial Fauna, and Rocks, Water, & Mud) provided significant comments on the conceptual model and proposed five sub-models to capture significant aspects of the functioning of the Mediterranean-type ecosystem of southern California. These five sub-models are:

1. Geology/Soils/Vegetation
2. Climate/Cryptobiotic Crusts/Vegetation
3. Fire/Exotics/Vegetation
4. Fauna/Vegetation
5. Terrestrial Vertebrates.

Each of the working groups were given copies of a Vital Signs Indictor worksheet (see attachments) to be completed for each candidate vital sign that hey developed. The rocks, water, and mud group completed 15 these worksheets (see results in attached table). Neither of the other groups completed any of the worksheets.

Monitoring Questions

The following 34 monitoring questions were extracted from the completed worksheets and group discussion notes.

1. How is spatial/temporal variation in stream flow changing?
2. How is spatial/temporal variation in hillslope flow changing?
3. What is the spatial and temporal variability in sediment yield from streams and is it changing?
4. How are roads influencing the frequency and severity of debris flows, and how is stream condition affected by debris flows?
5. What is stream condition based on stream morphology?
6. What is the condition of SAMO lagoon systems and what are the implications for restoration?
7. What is the status and distribution of vertebrates and crayfish in SAMO streams?
8. What are the status and trends in populations of aquatic invertebrates in mountain streams?
9. What is the trend in water chemistry (contaminates) in streams?
10. How are size, timing, and distribution of fires changing over time in SAMO?
11. How has habitat fragmentation changed over time?
12. What is the change in land cover over time in SAMO?
13. What are the status and trends in basic climatic parameters?
14. What effect are extreme storm events having on hill-slope and coastal erosion, and is this process changing the structure of coastal lagoons.

15. What are the status and trends in native plant population dynamics?
16. What are the status and trends in exotic plants species population dynamics?
17. What are the status and trends in riparian community dynamics?
18. How is habitat structure changing?
19. How is habitat connectivity changing?
20. What are the status and trends in habitat fragmentation dynamics?
21. What are the status and trends in the ratio of non-native grasses to native forbs?
22. What are the status and trends in seed bank dynamics?
23. What are the status and trends in litter accumulation with SAMO?
24. What are the status and trends in rare species population and community dynamics?
25. What are the status and trends in plant community structure and cover?
26. How are scenic landscapes changing over time?
27. What are the status and trends in post-fire plant community recovery?
28. What are the status and trends in the distribution and abundance of cryptobiotic crusts?
29. What are the status and trends in population and community structure in focal, at-risk, and functional species of importance in SAMO?
30. What are the status and trends in species richness in SAMO?
31. What are the status and trends in pollinator population and community dynamics?
32. What are the trends in visitor use statistics and how are visitor use impacting trails in SAMO?
33. What are the status and trends in Lichen population and community dynamics?
34. What are the status and trends in Ambient Air Quality?

Candidate Vital Signs

The following 55 candidate vital signs were proposed by the three discussion groups.

1. Feature Attribute
2. Air Quality, Air Pollution - fine particles
3. Air Quality, Air Pollution - nitrogen/sulfur
4. Air Quality, Air Pollution - ozone
5. Air Quality, Air Pollution - photochemical toxins
6. Anthropogenic Light, Dark Night Sky
7. Anthropogenic Noise, Natural Soundscape
8. Climate, El Niño
9. Climate, Weather - extreme storm events
10. Climate, Weather - fog
11. Climate, Weather - humidity
12. Climate, Weather - precipitation
13. Climate, Weather - temperature
14. Climate, Weather - wind
15. Exotic Species Introductions
16. Habitat Conversion
17. Habitat Fragmentation, Connectivity
18. Urbanization, Development
19. Urbanization, Land Use
20. Birds - focal species
21. Birds - migrants
22. Birds - raptors
23. Birds - rare
24. Birds - residents
25. Birds - Threatened, Endangered, & Sensitive
26. Focal Species - Fauna
27. Large Carnivores
28. Medium-sized mammals
29. Meso-carnivores
30. Rare Animals

31. Reptile & Amphibians
32. Small Mammals
33. Terrestrial Invertebrates
34. Threatened, Endangered, & Sensitive Fauna
35. Focal Species - Flora
36. Rare Plants
37. Threatened, Endangered, & Sensitive Plants
38. Water Quality - Core Variables (pH, conductivity, temperature, turbidity)
39. Water Quality - Macro-invertebrates
40. Water Quality - Microbiology
41. Water Quality - Nutrients
42. Water Quality - Organic & Inorganic Toxins
43. Geomorphology - Erosion/Sediment Transport
44. Geomorphology - Fluvial Features & Processes
45. Geomorphology - Ground Water
46. Geomorphology - Intermittent Discharge Channels
47. Geomorphology - Mass Wasting (Land Slides)
48. Geomorphology - Seismic Instability
49. Geomorphology - Slope/Aspect
50. Geomorphology - Stream Morphology
51. Geomorphology - Topography
52. Nutrient Processes - Nutrient Dynamics
53. Vegetation Processes, Community Dynamics
54. Soil Integrity
55. Water Quantity - Stream Flow

Discussion Group Notes

Rocks, Water & Mud

The Rocks, Water & Mud discussion group had difficulty working with the idea of a conceptual model. Geology and Climate were the only natural drivers considered by this group. There was some concern that monitoring background processes would prove of little value as the most important changes were caused by anthropogenic or non-natural drivers. Acute impacts from human activity were probably not predictable and, therefore, difficult to monitor except as isolated post-impact events. A three-layer approach was suggested for conceptualizing the ecosystem, a natural system layer, a human system layer, and a disturbance layer. Drainage basins or watersheds are the fundamental unit of concern from a geomorphological perspective and a primary consideration should be given to complete characterization of these features.

The following outlines for each of the three layers were proposed:

1 Natural System (Is hydrologic behavior of the system changing?)
- 1.1 Fundamental behavior of the hydrologic system (Climate & Water)
  - 1.1.1 Precipitation-discharge relationships
    - 1.1.1.1 Baseflow
    - 1.1.1.2 Stormflow
- 1.2 Quality (What is in a stream? And what can end up in a stream after a disturbance event?)
  - 1.2.1 Biologic
  - 1.2.2 Chemical
  - 1.2.3 Physical (i.e. sediment)
- 1.3 Physical/geological system (What is the erodibility of the stream system?)
  - 1.3.1 Infiltration capacity
    - 1.3.1.1 Varies with fire and vegetation
    - 1.3.1.2 Varies in space
- 1.4 Biotic system

1.4.1 Biodiversity
1.4.2 Species composition and distribution
1.4.3 Pattern
1.4.4 Structure
1.5 Sediment Transport System
1.5.1 Slopes
1.5.2 Streams
1.5.3 Cover & root density
1.6 Coastal Processes
2 Human System
2.1 Hydrologic system
2.1.1 Imported water (irrigation & sewage)
2.1.2 Impervious surfaces
2.1.3 Pipes/septic tanks
2.1.4 Vegetation disturbance, land use, vegetation clearance
2.2 Biotic System
2.2.1 Disturbance (pattern)
2.2.2 Fragmentation
2.2.3 Vegetation
2.2.3.1 Cover
2.2.3.2 Pattern
2.2.3.3 Composition
2.2.4 Alien species
2.2.5 Domestic animals
2.3 Water Quality
2.4 Physical
2.4.1 Light pollution
2.4.2 Noise pollution
2.4.3 Trash
2.5 Land cover
2.5.1 Trails
2.5.2 Roads

The group did not develop an outline for disturbance. Disturbance factors were incorporated somewhat into the outlines for the natural layer and the human layer.

Wildlife

The Wildlife Discussion Group developed a list of priorities that should be considered when selecting candidate indicators of ecosystem health.

Priorities for developing vital sign indicators:

1. Plants
2. Combine efforts and study sites
3. Determine what we have control over
4. Follow restoration efforts
5. Monitor increasing impacts from vitiation
6. Determine and incorporate NPS priorities
7. Determine feasibility and cost of implementing a particular indicator
8. Determine repeatability and interpretability of selected indicators

The wildlife consideration of the conceptual model focused on two primary system drivers: Anthropogenic Impacts and the Biology and Ecology of native and alien wildlife within the Santa Monica Mountains. The results of this discussion are captured in the Terrestrial Invertebrates sub-model of Appendix I.

The group also prepared a list of ecosystem drivers and stressors that they felt were important factors in structuring wildlife populations and communities. They then suggested possible metrics for monitoring the health of the particular groups or species of wildlife whose demographics could provide information on their health in response to the drivers or stressors identified.

Table 1 Wildlife groups recommendations for developing a conceptual model of the wildlife component of the Santa Monica Mountains.

Ecosystem Driver or Stressor	Wildlife Impacted
Pesticide or Fertilizer Use	Carnivores, Bats, Amphibians, & Birds
Pollution: Air, Water, Light & Noise	Reptiles, Birds, & Bats
Land Use or Habitat Conversion	Butterflies, Birds, Bats, Amphibians, Steelhead, & Small Mammals
Changes in Hydrology	Bats, Amphibians, & Steelhead
Roadway Mortality	Reptiles & Carnivores
Habitat Fragmentation	Reptiles, Carnivores, Bats, Steelhead, Birds, Small Mammals, & Butterflies
Alien (Exotic) Animals	Carnivores, Amphibians, & Small Mammals
Habitat Loss	Carnivores & Birds
Edge Effects	Birds & Small Mammals
Recreational Use	Carnivores & Birds
Harvest	Reptiles
Fire	Birds, Small Mammals, & Reptiles
Succession	
Evolution	
Species Range Dynamics	
Alien (Exotic) Plants	Birds & Butterflies

Table 2 Metrics recommended by the wildlife group for monitoring selected wildlife as vital indicators of ecosystem health.

Resource to Be Monitored	Suggested Metric for Monitoring
Bats	Distribution, Abundance, & Diversity
Fish (Steelhead)	Distribution & Abundance
Amphibians (Alien Fishes & Crayfish)	Distribution, Abundance, & Diversity
Reptiles	Diversity & Abundance
Small Mammals	Diversity & Abundance
Other Mammals & Carnivores	Distribution
Terrestrial Invertebrates (Butterflies & Argentine Ants)	Distribution
Birds	Distribution & Abundance
Native Aquatic Invertebrates	Distribution & Abundance

Vegetation

The Vegetation Group produced the most detailed notes on their discussions. This group spent the first day of discussions establishing ecological linkages. The intent is to analyze the connections between ecosystem components. What is the best approach? Should we analyze inputs and outputs of each element f the model? The conceptual model doesn't have to be precise. There's a tendency to bring the picture down to a minute detail but it's harder to know the economic limitations that meet the park's needs. Today we should just establish the ecological connections.

The first question is what is this model going to be used for? You need to look at what you could measure that would have impact on linkages — for now, we're supposed to model the ecosystem without worrying about identifying vital signs. Vegetation is just a small thing in the model presented for our review. Let's devise our own model at this time with the vegetation in the center and identify what linkages come in and out of it

Vegetation type conversion is an example of how the model was developed:

Fire frequency ↓ Fire intensity ↑ → creates open space for exotic plant invasions → effects vegetation types = Type Conversion. The model presented is a casual approach and is just something to look at, to get us thinking.

We should start looking at linkages and determine what they contain. Arrows should somehow indicate stronger or weaker linkages. Let's look at what is missing. There are no impacts from air pollution on anything? And there is no link to vegetation from fire.

Specific Elements of a vegetation model should contain the following:

Air pollution as a product of urbanization is a stressor. Everywhere in nature it reduces primary productivity and overall efficiency. Ozone, nitrates, sulfates… link to carbon fixation…effects plants differentially…will change them competitively…Atmospheric nitrates give significant differential advantage to certain organisms.

1. There should be a direct link between air pollution and nutrition to vegetation communities.
2. Then there's feedback…when you change the community composition it feedsback to the ecosystem dynamics…
3. Air pollution model…Can you define it so that there's an indirect link…A change in nutrients and O_3 leads to change in vegetation.
4. Air pollution also impacts amphibians…Air pollution up, amphibians down…

Do the **mammals** impact the vegetation in the Santa Monica Mountains? In chaparral recovery after fire there's a definite difference if mule deer are present or absent…They eat the seedlings and sprouts.

Rodents

There are examples from prescribed burns which result in unstable conditions and every species of small mammal in the local environment sweeps in. There are clear preferences on what they eat:

1. Seed bank herbivory → reduced seed rain
2. Seedling herbivory → no survival to reproduction → reduced seed production
3. Gopher rototilling → subterranean conversion of coastal scrub → change in exotic/native and annual/perennial ratios

Exotic grasses promote gopher activity, ↑ Competition from annual non-native grasses → Loss of native plant diversity.

At Channel Islands National Park mice populations rise and fall. This seems to be unrelated to annual grass abundances. It's a good working hypothesis but there maybe isn't a direct linkage to type conversion.

Once converted, native herbaceous communities just don't come back.

Terrestrial Invertebrates—aren't shown in the proposed model.

Exotic grasses → increased fuel for fires → vegetation drives fire. This link isn't shown here.

Greater availability of water

Increase in exotics. Moist areas have greater rate of invasion by exotic plants. Arundo is always associated with water. Many invasive species are transported directly in water ways. Where you formerly had brakes in the period of flow there is now continual flow. The link should run through landuse—during summer, 70% of the water in our creeks is imported, overland and through soil. Medeo Creek willow riparian is due to imported water. Lawns back right up to stream course.

Light pollution

No a direct link to vegetation.

Change in community structure

How would you characterize it? How do stressors change structure? It's a linkage and an attribute problem. Exotics play a part in it. How do exotics affect native communities? They alter community structure. It's the woodiness, there are changes in the number of vertical layers, canopy height, and open vs. closed ratio.

There are places that are not so much invaded but are converted. *Brome* and *Vulpia* creep into under-structure becoming part of the structure and changing. It's no longer the same native community—it impacts consumers and other organisms. Structure is an important linkage from vegetation to animals—how they'll use it and who can use it. From park visitors' point, there's a change in esthetics.

Fire: The larger parts of our herbaceous species are fire followers. In chaparral, you now have huge non-native fuel as fire followers. After the Santa Margarita fire there was no resurgence of fire sprouting shrubs. There was 95% reduction in native shrub cover and exotics took over. Establishment of exotics results in more frequent fires which burn cooler. Vegetation + fire → non-static community → high variability in fire return → with high variability the upper end of vegetation community variability is lost. In Keeley's model the number of human ignited fires is overwhelming. Virtually all fires here in the mountains are anthropogenic in origin.

Historically the greatest impact by Native Americans was probably in collecting firewood. Vegetation Type Maps (Weistlander Maps) from the mid 1930's characterize the mountains as predominantly *Adenostoma*—now it's *Ceanothus*.

Justification for control burn is the money they get to protect homes. Housing creates a need for fuel reduction the issue is much politicized. Is that a key component? It has to go in because it impacts vegetation so heavily. Should be in urbanization and should be treated the same as pesticides. Much of the habitat is fragmented. We need a link from hazard fuel reduction to vegetation.

Slope and Aspect are not included in drivers. What would you monitor? You need to consider them when you set up your plot design. In terms of monitoring ecological change it is not a measure. You could use them in stratifying data. They factor into sampling design but you don't monitor them. You could and perhaps should inventory them. It's useful information. Topography is linked to vegetation structure and composition. We're talking about process—slope and aspect is not a process that might change, but they're a key component in developing monitoring program.

Soil, compaction is an issue. Grading is likely to have occurred on any land we buy. Microbial changes are linked to exotics. Keeley has identified road cuts as loci for new invasives. Soil nutrients and nutrient dynamics can be an issue. Although the vegetation community composition is different, Cabrillo National Monument could be a useful control for what the soil profile should look like over time. It's not a direct model but it is an example of old growth coastal sage scrub.

Cryptobiotic crusts have been reported to either promote or retard exotics? There may be a feedback to exotics? At Colorado Plateau cryptobiotic crusts were associated with increase in exotics. In other area they work as a physical barrier that limits nutrient availability. *Pentachaeta* sites that have persisted have well established crusts. When the crust is broken exotic plants invade quite readily.

Litter accumulation. Litter is plant material waiting to die. There are well established links from litter to vegetation community, fire, and soil characteristics. Litter can influence soil nutrients.

Climate link to vegetation isn't shown; cooler, moister climate will lead to some change in the vegetation community. Climate is just one driver of vegetation dynamics. Is it a direct link?

Has anyone looked at the Manzanitas? Are they still happy? It's so dry you can't tell plants apart. Long drought or long wet will change competitive relationships. Keeley suggests that native plants are better adapted to wet climate. Model for California shows colder nights, shorter wetter winters, but doesn't show wetter summers. Night freeze is the 2nd largest factor after fires. A wet year and followed by a long drought will significantly build the fuel load.

Is erosion a significant driver on these mountains? Slopes are notably unstable. When this is combined with fire and rain there can be significant erosion events. Mass wasting in the mountains is linked to urbanization.

Walnut trees favor well drained areas that get a good deal moisture. They grow on heavy clays and shady slopes in mesic areas. Here they're their distribution is defined by where they were planted by Native Americans. There are very get localized concentrations of walnut trees in the mountains. They are also associated with roads.

Fog Drip can be significant. Where there is more plant structure there is more drip.

Bryophytes and Lichens are significant indicators of air quality, climate, and erosion.

> "Because lichens grow so slowly, a relatively small circular patch can actually be very old. In the arctic, crustose species such as the map lichens (*Rhizocarpon geographicum* and related species) add only a fraction of a millimeter of radial growth each year" Irwin Brodo in Lichens of North America
>
> Lichens and bryophytes can be a seedbed nursery for *Dudleya* spp.

Vernal Pools There is some uncertainty that any vernal pools exist in the mountains.

In Summary:

1. Vegetation issues include natives, exotics, and non-vascular plants
2. It is difficult to separate stressors and attributes
3. Slope and aspect are overriding influences although you wouldn't monitor them. They're drivers that are responsible for variation. Have to use them to stratify.
4. Must include faunal influences on vegetation
5. Must include air pollution impacts on vegetation
6. Fire, almost everything interacts with it and is modified by it.

Vegetation group's session on vital signs development

The group wrestled with the definition of a "vital sign." It was thought that any indicator of life could be called a vital sign. It was also suggested that no one has yet found a truly vital indicator of ecosystem health.

Ecosystem attributes such as diversity, species cover, and biomass are the traditional measures used by plant ecologists. What's new, or are the traditional measures the best to use for vital signs? Should alien plants be measured? What do you want to monitor? You should track community composition while alien species increase and decrease. You should track new introductions—these should be included as an element of species diversity. You need to differentiate between signal and noise, and consider issues like lag time. You want to monitor community structure i.e.

- landscape level vs. focal species,
- native vs. exotic % cover
- relative vs. absolute
- permanent plots with gradients replicated

1. You need to differentiate between structure, composition, and process.
2. You need to identify kinds of change and the resilience of communities.
3. You need to identify the drivers and stressors that are actionable.
4. Why document your system going to hell—monitor what's actionable. In measuring, you don't need to know why things change.
5. You should be worried about aliens or the naturalness of your ecosystem.
6. You should understand the ecosystem in a temporal way.
7. You should understand vegetation composition.

Alien species have an impact on ecosystems. It is not enough to track presence and absence; you need to track numbers, ratios, percent cover, and new introductions. Total diversity is the key. You need to be able to keep track of the seemingly unimportant. Monitor the major disturbances: fire, fragmentation, etc. You need to know what is natural and what is noise and you need to understand variability. You need to understand baseline items such as flow rate of water, indicator species, and the physical elements of the ecosystem.

Is riparian condition an indicator? Should you look at it as a process? What would you measure? You should measure biological factors like species cover and geomorphology. Flow and quality of water are easy to measure. You want to see change over long term. Determining the temporal scale of monitoring is very critical. Habitat connectivity, i.e. migration routes are a landscape level indicator. Fragmentation is the real issue. Migration of mega-fauna can be tracked with remote sensing technology. Community structure and gradients in structure from patch edge to the interior of the patch are important to quantify. Changes in core habitat structure within patches can dramatically impact patch viability as a habitat for some species. Urban and wildland spatial relationships can be monitored. When your core areas are $40 \times 50\ km^2$ patches or smaller, pretty much everything is edge. Comparing relatively undisturbed areas to those heavily impacted is very important. It is important to determine the natural disturbance regime. What is the long-term cycle of change? What is it with and without invasive species? Several disturbances have multiple temporal and spatial scales of impact.

Fire is one significant disturbance that is natural but exacerbated by human activity. Monitoring may not be the right answer to fire question. You would want to track the history of fire and monitor vegetation change after fire. We already monitor fire frequency. One possible question to ask is "What is nature of ecological change in relation to fire frequency."

It is important to differentiate between community wide issues and species specific issues. For instance *Arundo* is really a maintenance issue it should be tracked down and killed wherever it occurs. The presence of non-native grasses that have displaced native forbs is an issue of concern.

Some kind of early warning system of indicators would be useful, but that kind of knowledge comes from people working over long periods of time. An alternative approach might be to identify specific monitoring questions and then propose resources to monitor and methods as well.

Rate of invasion of alien species along trails might be a good process to monitor. Sections of the Backbone trail could be used for this. Information needed would include proximity to developed areas, temporal use patterns, trail use type, and use intensity.

The seasonal and temporal pattern of how communities change and their physical structure at the landscape level should be determined and a degree of predictability for these communities estimated. At the community level it is important to look at: structure, cover, abundance, rare species, litter fall, soil nutrient level, and seed bank. It is important to understand the seed bank but it's hard to determine the natural variability in species types and number of seeds in the seed bank. It would be possible to compare sites by what comes up after disturbance. Photopoints monitoring might be a possible method to do this.

It might be advantageous to focus on critical ecosystem habitats and measure species composition and shifts in composition. One could look at native plant demographics in relation to alien plant demographics. Replication this process over some temporal scale could give a good indication of the state of vegetation communities in the mountains.

We need to understand natural system before we can understand what shouldn't be there. The intent of the monitoring effort is to identify undesirable change. First we must measure change. We can decide later if it is desirable or not. It is necessary to understand the range of natural variability before we can make assumptions about what may be happening as we review the data from monitoring efforts. Some baseline studies may be necessary.

If there was money for one big project only you should monitor landscape change. High resolution land use looking at everything, (even more than weeds there's cement) would be important. Landscape composition plots aren't enough; is change happening over a broad scale. A remote sensing approach could detect herbaceous/shrub shifts over a large spatial scale.

If you were to monitor a single vegetation community type on the ground what would it be? Riparian? What's the most threatened?

Monitoring could be focused to find out the variability in natural systems to set trigger points for management action.

The scientific method moves from question to hypothesis to method, rather than wait for the question to reveal itself. We don't know what we've got. Let monitoring generate the questions. Let monitoring trigger research once you have data to support it. One virtue of monitoring is serendipity. There is a monitoring data collection to /research link

We know exotics will change the system in ways we don't want it to change. We're not trying to route out *Arundo* but to find out what it does to the system.

Monitoring should look at gradients of productivity; succession; plant/animal interaction from the edge to the interior of habitat fragments or patches.

There are numerous potentially confounding factors in planning monitoring activities. North facing versus South-facing differences on fire regime, land use, vegetation community type, etc. can become a nightmare in terms of actual sampling.

Concentration on vital signs seems to have been on processes, not on stressors…Here it's the stressors that seem important.

Two questions: Where is *Artemisia* chaparral and what is the structure of those communities (age, species composition, etc.) Detecting natural change from unnatural change need not be done with monitoring but how the sampling plots are set up.

At Channel Islands there are native stand plots that provide information on native community, and change in cover and abundance over time, but we don't know what is happening at edges in the ecotone. Is this sufficient? We need to know, on a landscape level, what relative changes are of real importance and which are part of the natural variation in landscape processes. Often we don't know what the natural communities look like, and therefore cannot really tell when they have changed significantly.

Monitor change in plant community with fire as one factor. Monitoring should not define mechanistic relationships.

Post-fire monitoring can tell you that the vegetation community has changed but not how or what changed it. You should not monitor just because something happened but because it indicates some other change in process or structure.

Socially important questions can drive monitoring. We're supposed to protect chaparral and within the mountains one third of it is gone. Weed management has become a charismatic issue world wide. South Africa enforces weed laws like weeds are hazardous waste.

How do you set the monitoring plot design?

First list what we think is important; define what you want to see changing. Regardless of question, you still deal with same kinds of design problems. Set up two parallel monitoring worlds.

Important aspects of vegetation structure to monitoring include what changes might be occurring in core habitat areas, and what changes are occurring at built (urban) environment and natural community ecotones? How would you structure a program to capture this kind of change?

You could use aerial photo records, and look for key areas of change to establish baseline conditions. You can use exotics and rare plants as markers.

Keeley points out that to detect change requires intensive sampling, with permanent plots. When sampling cover, natives, dominants, single species different sampling rigor is needed. Sometimes years periodic demographic surveys alone will tell you what you needed to do.

There's a difference between research and monitoring.

Selecting monitoring attributes isn't the problem. Establishing natural variability of the selected attributes is the problem.

When monitoring exotics there is a need to establish good permanent sites and to identify vulnerable sites or sites with high risk of invasion. So far this approach hasn't worked. The most obvious high risk sites are disturbed sites, but there are so many things that are related to the health of the ecosystem that come to play that just looking at exotics invasions in disturbed sites can miss important impacts developing elsewhere.

Look at inter-phase areas, or pay botanists just to wander around. There is almost no way of having an early warning system for the invasion of exotics.

Fire: Monitor site development at different intervals after a burn, and monitor vegetation recovery variability and weedy indicators as well.

Experience at Channel Islands with point-intercept and line transect methods have shown the importance of maintaining consistency over time in applying the methods and in data collection. Lack of expertise can significantly increase the error in data measurements. Sampler training is critical. Grasses often are overlooked in training. It is possible to monitor functional groups but there is a significant loss in resolution, especially with the occurrence of new exotics, and ruderal species.

Crusts: The relation of crust occurrence to the presence of non-native grasses might be important. Cryptobiotic crusts may facilitate the establishment of native grasses. There may also be a relationship between the presence of *Pentachaeta* and cryptobiotic crusts.
Monitoring of cryptobiotic crusts might track their increase and decrease. These are hard to monitor. There is a significant seasonal component in their demography. There are instrumental in nitrogen fixing but this action may be swamped out in the mountains by anthropogenic nitrogen sources. Cryptobiotic crusts don't show up much inland, but are a bigger influence in coastal areas. Measure presence and extent of their distribution.

Lichens: This discussion caused a bit of a stir. Phil Rundel suggested that lichens are not critical within the mountains. They are a good biological monitor but they are not a key element here. Carl W. suggested that they are a constituent of cryptobiotic crusts. Phil stood firm saying that they are not significant here. They're part cyanobacteria and really do not do well in the Santa Monica Mountains. They're an element of park health and the fact that they're here should be reported. There needs to be some justification to focus on lichens. Politically it's easier to make a case for a mountain lion with a lot of public charisma. You should want to monitor keystone species—Species that have influence beyond their physical presence, species with commercial application, threatened species—listed or not; required by statute. These often play a small role in the system but they have big public interest. Socially important species should also be considered even if like the mountain it's loss from the system will result in little change in the system.

Rare Plants: Some species by their nature are just uncommon, but our rare Dudleyas aren't so troubled because they grow on rock walls that will never be developed. One rare plant that is problematic is *Pentachaeta* which grows in grasslands that are declining. *Pentachaeta* can be very abundant one year and absent the next. No-one quite knows what's happening with *Pentachaet.* If you have small but widely distributed patches, they'll survive, but if it's the only population then preserve it.

Species richness should be an issue. You want to preserve native diversity. Native diversity has to be a function of ecosystems health.

More on Lichens: Lichens are not stable. There is a red list of lichens on a California Lichen Society we page by David Magney. There's a lichen that is normally flat here in the region but has a functional response to fog and has a three dimensional growth form. There is more surface area to absorb moisture. You could monitor presence and extent of this lichen. The mountains are sitting in the northern end of Baja lichen range—you'd want to document that.

"The species that center in the California mountains and isolated peaks in the desert are best grouped with other Western Montane lichens…There is, however, a unique Californian distribution type especially in the southwestern sector where there is a warm, temperate climate with cool winters and hot, rainless summers—very similar to the climate found in the Mediterranean region…Along the windy and misty coastal strip from San Francisco to Baja California, there is a unique lichen community whose distribution forms a special part of the California element. Shrubby sage, herbs, an grasses dominate the flowering plant vegetation. The lichen, able to absorb all the water they need directly from moisture-laden and benefiting from abundant sunshine and mild temperatures, thrive on the coastal cliffs and the branches of shrubs. Many lichen genera characteristic of the coastal strip are common to California and the Mediterranean region (e.g. *Roccella*, *Schizopelte*, and *Niebla*), but most of the lichens of coastal California (many ranging into Baja California) are endemic" Brodo, Sharnoff, Sharnoff in Lichens of North America—paraphrased by Phil Rundel

It was suggested that periodic surveys, once every five years, may be sufficient for any lichen monitoring.

Chaparral vegetation structure is driven by microclimate conditions. Some rare lichens are driven by microclimates; it might be worth looking at crust/lichen/habitat in relation to microclimate conditions. Lichens are an understudied group. New species show up in the least expected places. A previously undescribed species was found in Baja. The patch was so big it could be seen from an airplane.

When lichens die off and decline in density they first begin to disappear from periphery, from the not-so-good habitat. Lichen patch size could be monitored. You could track decline rate or recovery rate in patch size or you could do transplant experiments.

Pollinators: Paul Aigner's has worked on *Dithyrea maritime* on San Miquel Island. It is not known if this work has been published yet.

In Summary:

1. Perform generalized monitoring
2. Establish natural variability
3. Monitor core habitat and intact habitat
4. Monitor exotics
5. Monitor along geomorphological and climate gradients
6. Monitor along a general set of disturbances that are spatially explicit—trails, fire, fragmentation, pollution, exotics,
7. Monitor mesopredators (coyotes, skunks, possums, raccoons, foxes…)
8. Placement and stratification of plots in significant. They should be directed toward sensitive areas
9. Monitoring shaped to work with research questions
10. Specialized monitoring for sensitive species—demographics rather than structure and composition (?)
11. Can't see how to set up for early warning signs
12. Monitor trails—use type and intensity
13. Sampling design: presence/absence
14. Don't forget the lichens

A table of proposed relations among ecosystem drivers, ecosystem stressors, and ecological effects was presented for review and comment. This table with proposed changes highlighted in red is attached.

Vital Signs Worksheet

Santa Monica Mountains National Recreation Area Vital Signs Indicators Worksheet
Critical Ecosystem Process or Component:
Relationship of the above to Conceptual Model:
Ecosystem Process or Component Related Question to be Answered by Monitoring:
Vital Sign or Indicator:
Organizational Level of Vital Sign or Indicator (Check All That Apply): ☐ Regional/Landscape ☐ Community/Ecosystem ☐ Population/Species ☐ Genetic ☐ Other____
Specific Attribute of Vital Sign or Indicator to be Measured/Monitored:
Why was this Vital Sign Chosen?
Contacts: (Individuals or groups with expertise or experience in monitoring this ecosystem component or process.)
Other Information:

Elements of the conceptual model development process. Text in red indicates changes in the table suggested during the SAMO Vital Signs Workshop held in December of 2002.

Ecosystem Drivers	Ecosystem Stressors (Agents of Change)	Ecological Effects (Response, Things Affected)
Parent Materials (Geology)		
• Geology • Soils • Topography • Geological Change • Hydrology	♦ Erosion ♦ Land Form Changes ♦ Urban Development ♦ Seismic Events ♦ Extreme Storms	▪ Sediment & Nutrient Transport ▪ Toxic Materials Transport & Accumulation ▪ Water Budget ▪ Water Quality ▪ Mass Wasting ▪ Geologic Stability ▪ Altered Soils Structure
Climate (Weather)		
• Precipitation • El Niño • Climate (Temperature) Change • Fog • Ocean Currents	♦ Flood ♦ Drought ♦ Winds ♦ Urbanization Erosion ♦ Temperature Change	▪ Mass Wasting ▪ Altered Soils Structure ▪ Vegetation Habitat Type ▪ Exotic Propagule Transport ▪ Fire Susceptibility
Fire		
• Fire Interval • Fire Seasonality • Fire Intensity	♦ Decreased Intensity ♦ Increased Intensity ♦ Altered Fire Return Interval ♦ Altered Timing of Fire Starts ♦ Fire Suppression ♦ Prescribed Burning	▪ Native Community Structure ▪ Colonization & Dispersal of Exotics ▪ Native Community or Species Genetics ▪ Water Budget ▪ Water Quality ▪ Seed Bank Structure ▪ Vegetation Community Type
Anthropogenic Impacts		
• Land Use Conversion • Urbanization • Direct Human Contact	♦ Recreational Use ♦ Water Pollution ♦ Air Pollution ♦ Hazard Fuel Reduction ♦ Increase Fire Frequency ♦ Introduction of Horticultural & non-Horticultural Exotics ♦ Habitat Loss ♦ Habitat Fragmentation ♦ Pesticide & Fertilizer Use ♦ Urban Irrigation ♦ Habitat Disturbance ♦ Grazing by Introduced Species ♦ Roadway Mortality ♦ Domestic Animals ♦ Wild Animal Control	▪ Native Community Structure ▪ Colonization & Dispersal of Exotics ▪ Native Community & Species Genetics ▪ Water Budget ▪ Toxic Materials Accumulation ▪ Habitat Structure & Composition ▪ Vegetation Habitat Type ▪ Migration & Dispersal ▪ Water Quality ▪ Air Quality ▪ Wildlife Reproductive Success ▪ Species Loss ▪ Disease ▪ Wildlife Behavioral Changes ▪ Resource (Food) Availability ▪ Altered Hydrology

Biological		
• Succession • Evolution • Species Range Dynamics	♦ Dispersion ♦ Invasion ♦ Hybridization ♦ Natural Selection ♦ Extirpation ♦ Drift ♦ Disease ♦ Native Richness & Diversity ♦ Exotic Richness & Diversity ♦ Competition ♦ Predation ♦ Dispersal ♦ Herbivory	▪ Habitat Type Conversion ▪ Genetic Change ▪ Community Structure ▪ Predator/Prey Dynamics ▪ Populations Dynamics