Tree and Shrub Community Monitoring Protocol for Channel Islands National Park, California

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U.S. GEOLOGICAL SURVEY

Open-File Report 00-74

Sacramento, California
2000

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Shrubs and trees should respond to the cessation of grazing in several ways: with increased canopy growth, additional stem production, and for certain species, with seedling recruitment. Therefore, the method for monitoring these changes will record canopy coverage, stem density, plant size and recruitment. Additionally, conservation strategies written for the islands (Coonan et al 1996) identify litter accumulation as an important process for seed bank development and eventual community recovery. Therefore, litter sampling is included as a component of the monitoring protocol, to be conducted at 5-year intervals. Finally, ungulate numbers will be reduced on Santa Rosa Island under the new management plan. The geographic distributions of deer and elk on the island are largely unknown by the National Park Service, and it is unknown how ungulate populations will respond to the reduction in numbers. Therefore, an index of shrub and tree community use will be developed for Santa Rosa Island by scoring each transect for signs of deer, elk and livestock.

Shrub monitoring protocol

This is a protocol for measuring shrub cover and density, and indexing size-class structure, using methods typically employed in studies of California chaparral and coastal sage scrub (e.g. Hanes 1971, Debano and Conrad 1978, Gray 1982, Zedler et al 1983, and Keeley 1992 a,b.) Shrubs and sub-shrubs will be monitored along the permanent vegetation monitoring transects located in shrub- or tree-dominated communities on Santa Rosa, Santa Cruz and San Miguel Islands (Table 1.) Monitoring will be done every two years for the first decade. The sampling interval may be extended after that if data show that change is occurring very slowly. Danielson and others measured shrub cover and density along Santa Rosa Island vegetation monitoring transects in 1990, 1993 and 1995 (unpublished data, Channel Islands National Park.) This protocol uses their methodology as much as possible, so that their data may be incorporated into a baseline data set for the island.

Introduction

Channel Islands National Park is one of the first parks funded for long-term monitoring studies through the Inventory and Monitoring Program of the National Park Service. Program objectives are to track ecosystem change, identify natural limits of variability, and provide information on status and trends for use in park management and public education. Channel Islands currently monitors vegetation, terrestrial wildlife, intertidal marine and kelp forest systems. Each discipline has a set of protocols for data collection, analysis and reporting designed and peer reviewed by subject matter experts, and implemented by a team of scientists employed by the park. It is anticipated that each discipline will be evaluated for precision, accuracy and applicability to park management concerns after several years of data collection have occurred. Adjustments to the program will be made on the basis of peer review from these evaluations.

Vegetation monitoring has occurred on Santa Barbara, Anacapa and San Miguel Islands since the early 1980's, it was implemented on Santa Rosa in 1992, and will be started on the east end of Santa Cruz Island in 1999. The program is designed to monitor change in plant communities, using the point-line intercept sampling method. This method is sufficient to track coarse-grained change in species composition and abundance, but it does not provide high-resolution data for understanding changes in shrub or tree communities. Channel Islands recently developed a new management plan for Santa Rosa Island that includes reduction in numbers of livestock (cattle, horses, deer and elk) over the next decade, and the park is currently removing sheep from the east end of Santa Cruz. Feral pigs will remain on Santa Cruz Island until funding for their eradication can be secured. The objective of these changes in management strategy is to encourage natural regeneration of native communities, particularly scrub vegetation. The current plant community monitoring protocol needs to be augmented with a method that will provide better resolution on change in woody vegetation, to evaluate the effects of these management actions.

Table 1. Tree and shrub dominated community sample sizes on San Miguel, Santa Rosa and East Santa Cruz Islands.

Santa Rosa Island (46 transects)	**San Miguel Island** (8 transects)
Chaparral - 6 transects	Chaparral - 4 transects
Coastal sage scrub - 11	Coastal sage scrub - 2
Baccharis scrub - 9	Coreopsis scrub - 2
Lupine scrub - 3	
Mixed woodland - 6	**East Santa Cruz Island** (18 transects est.)
Pinus muricata woodland - 2	Chaparral - 8 transects
Pinus torreyana woodland - 5	Lyonothamnus woodland - 5
Quercus tomentella woodland - 4	Creek bottom - 5

Field methods

1. Stretch a fiberglass meter tape the length of the transect, tight and on the ground.

2. Record line-intercept cover of shrubs and sub-shrubs by species (Table 2), litter, rock and bare ground for the entire length of the 30-meter monitoring transect.

3. Record the maximum height of each taxon along the line transect.

4. Record the number of stems of all shrubs and sub-shrubs rooted in a 1-meter wide belt on the most nearly uphill side of the vegetation transect, in 5-meter increments (ie - in consecutive 1x5-meter plots along the transect.) Use a meter stick to carefully identify the uphill limit of the 1-meter belt. For most taxa, it will be possible to record stem number by individual. Several taxa, however, are multi-stemmed (especially on Santa Rosa and Santa Cruz, where they have been grazed), and it will be difficult to identify individuals. Table 2 shows which taxa can be counted by individual, and which taxa should have counts recorded as simply the number of stems per 1x5-meter plot.

   For each taxon, record data in classes of:

   a) seedling: small plants that germinated from seed, not root suckers,

   b) sapling: small, single-stemmed or multi-stemmed individual in which most of the stems have a diameter of 7mm (the size of a wooden pencil) or less at ground level (include root sprouts here),

   c) live shrub: a shrub with any live vegetation on it,

   d) dead shrub: no live vegetation.

Table 2. Trees, shrubs and sub-shrubs likely to be encountered on sample transects, Channel Islands National Park, California.

	Count # stems per individual [1]	Count # stems only
Trees (measure dbh)		
Arctostaphylos confertiflora	•	
Comarostaphylis diversifolia s. planifolia	•	
Heteromeles arbutifolia	•	
Lyonothamnus floribundus s. aspleniifolius		•
Pinus muricata	•	
Pinus torreyana s. insularis	•	
Prunus ilicifolia s. lyonii	•	
Quercus agrifolia v. agrifolia	•	
Quercus pacifica		•
Quercus tomentella		•
Salix lasiolepis	•	
Salvia brandegeei	•	
Shrubs and sub-shrubs		
Adenostoma fasciculatum v. fasciculatum	•	
Artemisia californica	•	
Arctostaphylos confertiflora	•	
Arctostaphylos insularis	•	
Astragalus miguelensis	•	
Atriplex californica	•	
Atriplex semibaccata	•	
Baccharis pulilaris	•	
Baccharis salicifolia	•	
Ceanothus megacarpus s. insularis	•	
Coreopsis gigantea	•	
Eriophyllum confertiflorum v. confertiflorum	•	
Eriophyllum staechadifolium	•	
Isocoma menziesii v.vernonioides		•
Isomeris arborea	•	
Lotus dendroideus v. dendroideus	•	
Lupinus albifrons	•	
Lupinus arboreus	•	
Mimulus flemingii		•
Nicotiana glauca		•
Opuntia litoralis		•
Quercus pacifica		•
Rhus integrifolia		•
Senecio flaccidus s. douglasii	•	
Vaccinium ovatum		•

[1]Count only stems >3mm in diameter at ground level.

Note: It can be difficult to distinguish seedlings from root suckers (or root sprouts). If the seedling germinated this year, it may still have cotyledons on it. Seedlings will have true roots that narrow and sometimes branch with depth. Suckers have "roots" (these are really stems) that maintain a fairly constant thickness down to the connection with the rhizome. In some cases (particularly *Quercus* and *Ceanothus*) minor, gentle excavation of the top few centimeters of duff or soil may be needed to see the root area well enough to determine plant status. Excavate only when you are sure you won't harm the plant.

Data analysis

For the cover, height and density data, the sample unit is the transect. Transect values are averaged to give overall mean, standard error, median and mode statistics for the plant community. See Table 1 for sample sizes for each scrub community on each island.

1. Total the intercepts for each taxon by transect, and convert that value to a proportion of total transect length, for total taxon cover for the transect.
2. Report the maximum height of each taxon by transect.
3. Total the stem counts for each of the six 1x5-meter plots along each transect. For taxa that can be identified by individual, report the number of individuals per square meter for each transect, and the average number of stems per individual. For clonal taxa, simply report the number of stems per square meter. Report these values for each species by size class.

Tree monitoring protocol

Tree density and basal area will be monitored in 10x30 meter plots, centered on the vegetation monitoring transect. Tree data should be taken every 4 years, unless field observations indicate that change is occurring so rapidly that important trends would be missed by taking data at 4-year intervals.

1. Count and measure the diameter at breast height of all trunks rooted within 5 meters of each side of the transect. Record by individual for taxa that can be identified to individual, and by trunk for others (Table 2.)

   Record data in classes of:

   a) seedling: (use the rules-of-thumb given above for shrubs regarding distinguishing seedlings from saplings),

   b) sapling: dbh (diameter at breast height) 4cm or less,

   c) live tree: dbh >4cm, with any live tissue,

   d) dead tree: dbh >4cm, no live tissue.

2. Total the trunk counts for the plot, and express as numbers of individuals (or trunks for some taxa, see Table 2) per plot.
3. Calculate the basal area of each trunk measurement by assuming that the stem area approximates a circle [Area = $pi\ r^2$], where r = radius = (diameter/2).
4. Total the basal areas by species for the plant community, and calculate relative dominance of each species by dividing the total basal area of each species by the total basal area of all trees in the community.

Litter monitoring protocol

Clark et al (1990) indicated that litter cover is low in scrub and woodland communities on Santa Rosa Island, and Coonan et al (1996) noted that litter cover values reported for island chaparral and coastal sage scrub are lower than comparable, but less heavily grazed, sites elsewhere. Litter accumulation is an important ecosystem property in scrub communities, as it conserves nutrients, provides a reservoir for a seed bank, and establishes conditions conducive to seed germination (Christensen and Muller 1975, Gray 1982.) Litter accumulation rates should increase as animal browsing, trampling and rooting decrease. Although sheep will be completely removed from East Santa Cruz in 1999, feral pigs will remain at least into the next decade. Disturbance will probably remain high in the Santa Cruz Island woody plant communities until the pigs are eradicated. On Santa Rosa,

ungulates will be eradicated over a longer period of time, and litter accumulation will be affected by continued, but declining, use as well as vegetation recovery. Litter mass will be sampled every four years to provide an index of ecosystem recovery. Methods are similar to Debano and Conrad (1978), and Keeley (1992 a,b) in studies of nutrient cycling and fire recovery in California scrub communities.

1. Randomly choose 3 locations along the vegetation transect. At each location, vacuum all the litter present in a 1x0.5-meter plot placed 1- meter downhill from the transect. Bag each sample separately.
2. Separate the litter (organic matter) from soil and rock by sieving through a 2mm sieve, and then removing the remaining rock and soil peds from the litter sample.
3. Search each sample for seeds of woody plants, tally by species, and return them to the litter sample for weighing.
4. Oven dry the litter samples, and weigh.
5. Average the litter mass samples for each community, and express as kg of litter per m^2.
6. Report the numbers of seeds per m^2 by species.

Ungulate use monitoring

Cattle were removed from Santa Rosa Island in 1998. Deer, elk, and horses will be removed from the island incrementally until they are gone in the year 2011. Between now and then, shrub recovery will continue to be influenced by the levels and kinds of use the communities receive. The current patterns of ungulate habitat use are largely undocumented, and it is unknown how ungulate distribution may shift as densities decrease. It will be important to get some indication of rates and patterns of ungulate use in order to interpret factors associated with woody plant community recovery. The ungulate use rating form, next page, has been designed to develop an ungulate use index for the vegetation monitoring transects in Santa Rosa Island woody plant communities.

Ungulate use rating for vegetation transects

Island: _____

Date: _____
Transect #:_____

Researchers: _____

Objective: Measure a suite of categorical variables that can be used to index utilization, and identify users of the vegetation in the vicinity of transects.

Fill out the following scorecard for each transect. In making these evaluations, look at a square 30 by 30 meters in area, centered on the transect:

1. Amount of trailing: 0 (none) 1 (not much) 3 (common) 5 (alot)
2. Depth of trailing: ____cm average depth into (circle one): soil sand litter bedrock
3. Amount of scat: _____ piles seen within 5 meters each side of transect
4. Species of scat: (circle appropriate ones) elk deer horses
5. Root exposure: ranges from ___ to ___ cm, average is ____ cm
6. Slope corregation: (circle one) present absent
7. Signs of antler rubbing: (circle one) present absent
8. Signs of hoof scraping: (circle one) present absent
9. Unambiguous evidence of browsing on vegetation: (circle one) present absent
10. Signs of bedding down: (circle one) present absent

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