Progress in Mapping Vegetation on Santa Cruz Island and a Preliminary Analysis of Relationships with Environmental Factors

Julia Allen Jones[1], Steven A. Junak[2], and R.J. Paul[3]
[1]Department of Geography, University of California, Santa Barbara, CA 93106
[2]Santa Barbara Botanic Garden, Santa Barbara, CA 93105
[3]Environmental Studies Program, University of California, Santa Barbara, CA 93106

Abstract - This note describes and evaluates a recent contribution to vegetation mapping of Santa Cruz Island based on interpretation of 1985 color infrared aerial photographs (scale 1:24 000). The map was digitized to create a GIS data layer, in order to cross-tabulate the occurrence of vegetation classes with other geographical variables, namely digitized slope, aspect, and substrate data from maps. Cross-tabulations of the digitized data reveal marked co-occurrences of vegetation cover types with particular locations, slopes, aspects and geologic substrates. These strong patterns appear to reflect unquantified microclimatic variation due to maritime influences, elevation, and exposure. They also apparently reflect four attributes of substrates: disturbance (both natural and anthropogenic), soil nutrient status and degree of development, and to a lesser extent, relief and drainage. The distinct vegetation patterns on Santa Cruz Island, although modified by 140 yr of feral animal grazing and concomitant losses of woody vegetation cover, are apparently similar to those of vegetation in the near coast ranges of the California mainland. Further analysis of the spatial relationships among vegetation, topography, and substrate such as those demonstrated here could be utilized for mapping and management of island resources.

Introduction

Santa Cruz Island is the most ecologically diverse of the four northern Channel Islands, because of its large size, rugged topography, complex geology, the availability of groundwater and the presence of a central valley (Junak 1987). These features and their effects on precipitation, soil moisture, and cold air drainage patterns affect the distribution of the island's vegetation and flora. This note describes and evaluates a recent contribution to vegetation mapping of the island, where recent changes in management are likely to change the distribution and composition of plant cover (Hochberg *et al.* 1980). The island's flora includes about 500 native taxa and more than 40 taxa endemic to the California Islands (Channel Islands National Park & Santa Barbara Botanic Garden 1987). The occurrence and distribution of these endemics are being monitored and expanded through the efforts of the California Natural Diversity Data Base, the Nature Conservancy, the Santa Barbara Botanic Garden, the University of California and other organizations.

The preliminary map described here estimates the cover by vegetation classes on the island in 1985. The previous map of the island's vegetation (Minnich 1980) was photo-interpreted from 1970 1:22,000 color infrared (CIR) aerial photographs. The 1980 map distinguished eight major vegetation classes: grassland, chaparral, coastal sage scrub, woodlands, riparian, conifer forest, barren areas, and woody exotics, which were further broken down by dominant species. Minnich (1980) attributed vegetation patterns on the island to fire, grazing and other environmental factors. In the present study we quantified the relationships between vegetation and environmental factors by digitizing the 1985 vegetation map as one data layer of a geographical information system (GIS) which is being prepared as an aid for island

[1]**Current Address:** Department of Geosciences, Oregon State University, Corvallis, OR 97331

Table 1. Tone, texture and context rules used to map Santa Cruz Island vegetation from July 1985 1:24,000 color infrared aerial photographs.

Vegetation Class[1]	Tone	Texture	Context
coastal bluff	—	—	marine cliffs
barren	buff, brown-grey	smooth	strips, patches on ridges
coastal sage scrub	grey-brown	rough	—
pines	dark red-brown	rough	conical canopy
island oaks[2]	dark red	rough	round canopy
oaks	red	rough	round canopy
chaparral	bright red	rough	—
island ironwoods	bright red	smooth	—
riparian	bright red-orange	smooth	stream drainages
woody exotics	pink	smooth	Central Valley, near ranch
grasses	yellow, pale pink	smooth	—

[1]No areas of coastal dune or coastal marsh classes from Philbrick & Haller (1977) could be detected on the 1985 color infrared aerial photographs.

[2]Island oaks were distinguishable from other oak species on the aerial photographs.

management. Cross-tabulations of data using the GIS permitted us to explore and corroborate these vegetation-environment relationships, particularly with slope angle, aspect and underlying geologic formation.

Methods

We made two attempts to map Santa Cruz Island vegetation. The first was based on unsupervised classification of a Landsat Thematic Mapper image obtained on 14 December 1984. However, this spectral classification was unable to discriminate some contrasting vegetation types occurring on a similar background soil (*e.g.*, chaparral from oaks on volcanics or schist), and incorrectly divided a single vegetation type into several classes when it occurred on contrasting background soils (*e.g.*, grasses on Santa Cruz Island schist, versus grasses on coastal terraces). Moreover, the spatial heterogeneity of vegetation classes and limited resolution of coastline features on the satellite image created large registration and rectification errors when the image was overlaid on digitized 1:24,000 topographic and geologic maps.

The second approach to vegetation mapping combined manual interpretation of 1:24,000 CIR aerial photographs (taken in July 1985 by Pacific Western Aerial Surveys) and a classification system devised by Philbrick & Haller (1977). Eleven classes were distinguished according to tone, texture and context (Table 1). Except for island oaks (*Quercus tomentella*) and island ironwoods (*Lyonothamnus floribundus asplenifolius*), individual species were not distinguished. Vegetation classes were mapped onto U.S. Geological Survey topographic quads using a Bausch and Lomb zoom transferscope in the UCSB Map and Imagery Lab. In cases in which classifications were ambiguous, individual stands first were examined and identified under the high power binocular microscope. Repeated visits were made to the island during this process to cross check mapping rules with vegetation distribution. The completed map is shown in Figure 1. Considerable detail was achieved in the mapping; canopies of isolated individual trees could be distinguished (*e.g.*, Figs. 2 & 3).

The map was digitized to create a GIS data layer, in order to cross-tabulate the occurrence of vegetation classes with other environmental variables. A grid composed of 0.64 cm (2.25 ha) cells (used for digitizing all other layers in the Santa Cruz Island GIS) was overlaid on the vegetation map and each cell was classified according to the vegetation class that occupied more than 2/3 of the cell area. If any vegetation

class occupied more than 1/3 of the cell area it was noted as a secondary class in that cell. Riparian vegetation rarely occupied more than 1/3 of a cell, so it was noted as the secondary vegetation class in all cells in which it occurred. This procedure resulted in a lower spatial resolution of vegetation information for the cross-tabulations (Tables 2-4) than that of the map (Figs. 1-3). The cross-tabulated data were obtained from overlays of digitized vegetation, slope, aspect and substrate data in the GIS (see Junak 1987; Jones & Grice 1992).

Results and Discussion

Estimated percent cover of digitized vegetation classes on the island is shown in Table 2. Grasses are the dominant class, covering 52.5% of the island. Chaparral covers nearly one-fifth of the island and almost one-tenth of the island is mapped as barren, meaning that it had no detectable vegetation cover. Oaks, coastal sage scrub and riparian vegetation cover smaller areas (4-10% each). Pines, island oaks, island ironwoods, woody exotics and coastal bluff vegetation each cover less than 2% of the island. However, the small areas covered by these vegetation types are thought to reflect past disturbance rather than natural climax vegetation (Hochberg *et al.* 1980).

Shrub and tree vegetation commonly occurs in small stands (less than 1.5 ha) surrounded by grasses. Many barren patches also are smaller than 0.75 ha. The area covered by these classes was therefore systematically underestimated in the digitizing process, in which all stands occupying <1/3 of a cell (0.75 ha) were eliminated. This effect was mitigated by including dominantly grass cells with >1/3 cover of shrubs, trees or barren land in the respective shrub, tree or barren category (Table 2). The data in Table 2 overestimate the area covered by riparian vegetation, while slightly underestimating actual grass cover.

Because of their similar appearance in aerial photographs, distinctions between certain classes were somewhat ambiguous. Scrub oak (*Quercus dumosa*) was a dominant shrub in much of the chaparral, making it difficult to distinguish from the oaks class. Much of the area mapped as grasses, especially recently recovered areas on Willows diorite and Santa Cruz Island schist, have only sparse grass cover and could be classified as barren. The extent of

Table 2. Vegetation cover classes by quad on Santa Cruz Island. Cells noted as coastal bluff had that vegetation type in more than 1/3 of the cell. Cells noted as grass had grass cover in more than 2/3 of the cell. Cells noted as riparian vegetation either had that vegetation type in more than 1/3 of the cell, or had some area of riparian vegetation along with grass cover. Cells noted as barren, chaparral, island ironwoods, oaks, pines, coastal sage scrub or island oak either had that vegetation type in more than 2/3 of the cell or had that vegetation type in more than 1/3 of the cell and grasses were the primary vegetation class.

	Quad A		Quad B		Quad C		Quad D		TOTAL	
Class	km^2	%	km^2	%	km^2	%	km^2	%	km^2	%
coastal bluff	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.8	0.2	0.1
barren	3.2	5.7	17.3	15.0	2.2	4.0	1.6	6.4	7.9	9.7
coastal sage scrub	3.3	6.0	0.5	0.4	7.9	14.8	1.1	4.3	12.4	5.1
pines	0.3	0.5	3.1	2.7	0.4	0.8	0.0	0.0	1.3	1.5
island oak	1.0	1.7	0.8	0.7	0.0	0.0	0.0	0.0	1.8	0.7
oaks	0.9	1.7	7.8	6.8	1.0	1.9	0.3	1.1	7.1	4.1
chaparral	3.9	7.0	23.1	20.1	16.2	30.2	2.7	11.0	36.0	18.4
island ironwoods	0.2	0.2	0.6	0.5	0.0	0.1	0.1	0.3	0.7	0.4
riparian	3.9	7.0	10.5	9.1	2.3	4.5	1.2	4.9	13.2	7.2
woody exotics	0.0	0.1	0.3	0.3	0.3	0.4	0.2	0.7	0.8	0.3
grasses	39.0	70.1	51.1	44.4	23.2	43.3	17.5	70.5	130.8	52.5
TOTAL	55.5	100.0	115.1	100.0	53.5	100.0	24.9	100.0	249.0	100.0

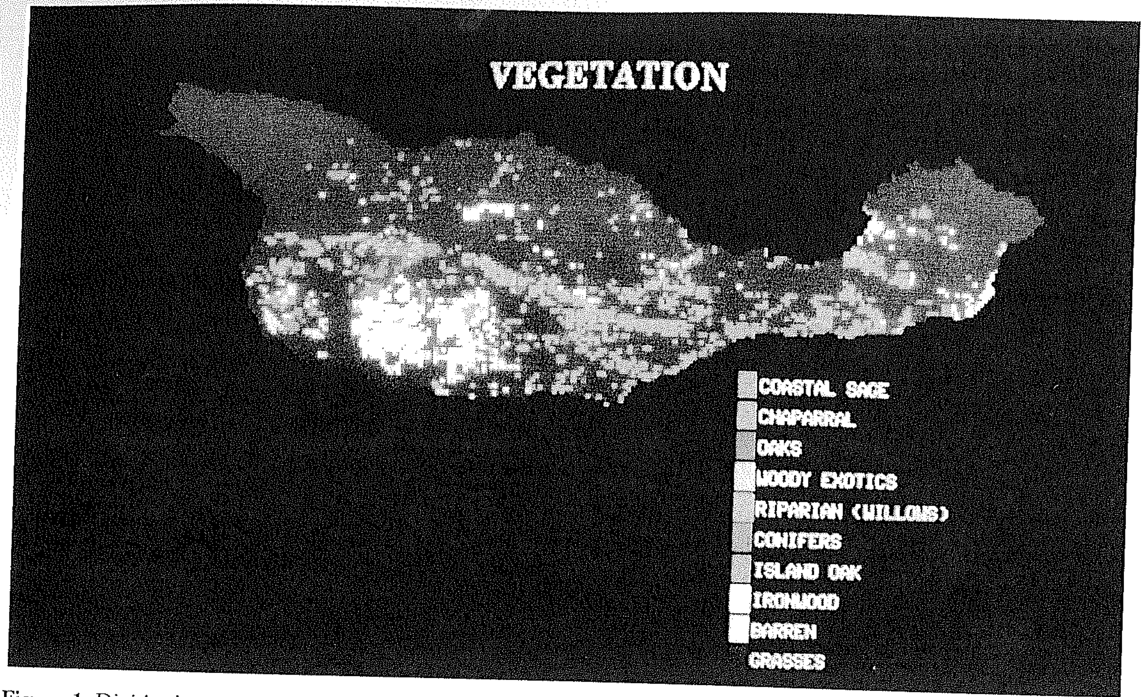

Figure 1. Digitized vegetation map of Santa Cruz Island. Only vegetation classes which cover more than 1.5 ha are shown. See text for further explanation.

coastal bluff vegetation was underestimated because of the steepness of the cliffs and shadows on the aerial photographs, especially on north-facing cliffs on Santa Cruz Island volcanics.

Cross-tabulations of the digitized vegetation map with digitized topographic and geologic maps reveal marked co-occurrences of vegetation cover types, with particular locations, slopes, aspects and geologic substrates. Grasses cover nearly 75% of the east and west ends of the island, while chaparral, barren land and coastal sage scrub cover relatively larger areas of the central quads (Table 2). Vegetation distribution clearly varies with ecological zone, defined by aspect and exposure to marine influence (Table 3). North-facing slopes in the central valley cover only 11% of the island but contain over 70% of the pines. The south-facing coastal slopes cover about 40% of the island, but they contain over 70% of the barren land. Nearly 75% of the area occupied by coastal sage scrub is on south-facing slopes. Nearly 80% of island oaks occur on north-facing coastal slopes, which cover only one-third of the island. In contrast, the distribution of grasses and other oaks is not clearly related to slope and aspect, although there is a concentration of oaks on north-facing slopes. These strong patterns appear to reflect unquantified microclimatic variation due to maritime influences and exposure. For example, the pines of Christy Canyon and much of the north-facing coastal zone are frequently inundated with summer maritime fogs, while south-facing coastal slopes usually have less fog.

Vegetation distribution also varies with respect to substrate (Table 4). Several workers have reported correlations between geologic substrate and the vegetation of the California Islands and the adjacent mainland (see Dibblee 1976; Cole 1980; Wells 1962). Wells (1968) noted that the distribution of *Arctostaphylos* taxa on Santa Cruz Island is strongly influenced by geologic substrate, as is

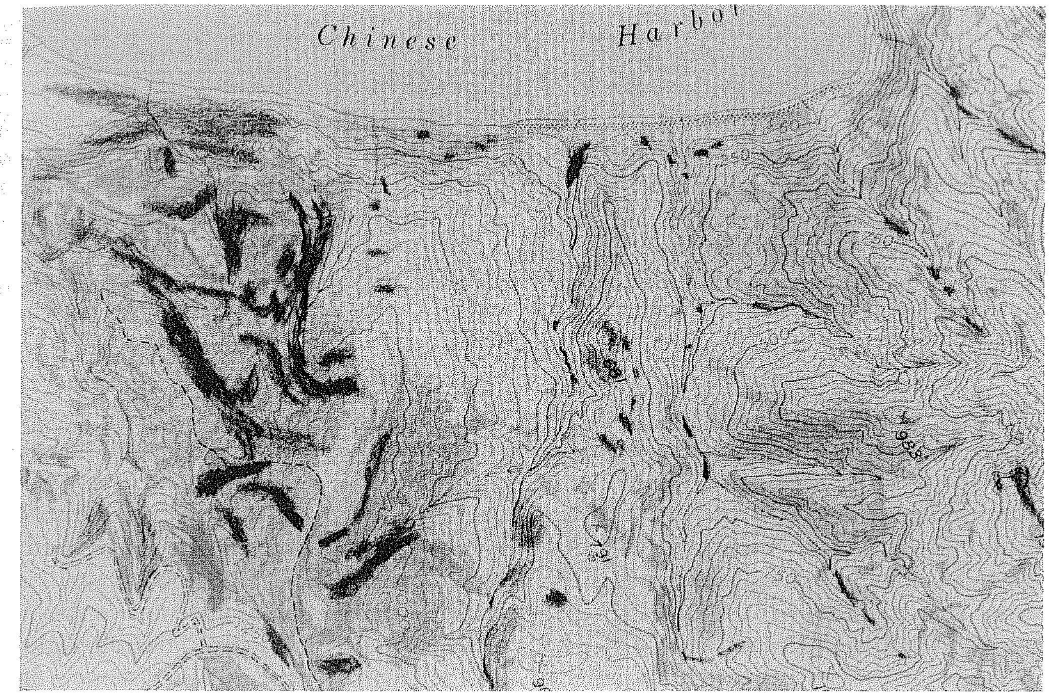

Figure 2. Detail of original polygon vegetation map near China Harbor (called Chinese Harbor on the USGS topographic sheet), northeast Santa Cruz Island. Orange = chaparral; pale blue = barren; dark green = pines; bright green = coastal sage scrub; red = oaks.

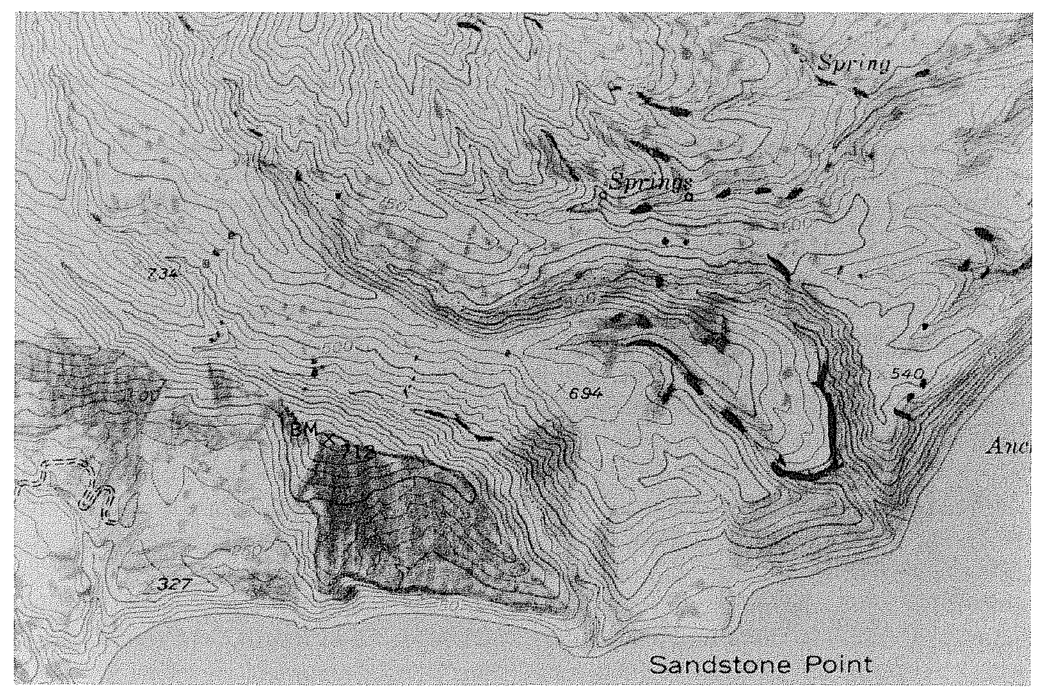

Figure 3. Detail of original polygon vegetation map near Sandstone Point, southeast Santa Cruz Island. Orange = chaparral; pale blue = barren; bright green = coastal sage scrub.

Table 3. Vegetation cover classes by ecological zone on Santa Cruz Island. See notes to Table 2.

Class	North-facing Coastal		South-facing Interior		North-facing Interior		South-facing Coastal		TOTAL	
	km²	%	km²	%	km²	%	km²	%	km²	%
coastal bluff	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.2	0.1
barren	2.0	2.6	3.9	10.2	1.2	4.4	17.1	16.2	24.2	9.7
coastal sage scrub	2.4	3.0	4.2	11.0	0.9	3.3	5.4	5.1	12.9	5.1
pines	0.6	0.8	0.3	0.7	2.7	10.1	0.2	0.2	3.8	1.5
island oak	1.4	1.7	0.1	0.3	0.0	0.0	0.3	0.2	1.8	0.7
oaks	4.5	5.8	0.8	2.2	2.	7.3	2.7	2.6	10.0	4.1
chaparral	9.7	12.3	6.5	17.1	9.2	33.8	20.6	19.6	46.0	18.5
island ironwoods	0.6	0.7	0.0	0.0	0.0	0.0	0.2	0.2	0.8	0.3
riparian	3.6	4.6	2.9	7.7	1.6	5.9	9.9	9.4	18.0	7.2
woody exotics	0.1	0.1	0.1	0.3	0.4	1.5	0.1	0.1	0.7	0.3
grasses	53.7	68.4	19.1	50.5	9.1	33.7	48.7	46.2	130.6	52.5
TOTAL	78.6	100.0	37.9	100.0	27.1	100.0	105.4	100.0	249.0	100.0

the distribution of the Santa Cruz Island ironwood (Junak 1987). We hypothesize that four attributes of substrate influence these patterns: disturbance (both natural and anthropogenic), soil nutrient status and degree of development, and to a lesser extent, relief and drainage. The clearest relationships between vegetation types and substrates occur for barren, coastal sage scrub, riparian vegetation, pines and oaks.

Barren areas cover less than 10% of the island as a whole, but they occupy nearly one-third of the Willows diorite and Blanca formations. These are among the most highly weathered and most heavily grazed substrates on the island, and they are also predominantly in the south-facing marine zone. Barren areas also cover about one-fifth of several densely faulted sedimentary substrates in the southwest of the island. In contrast, the less-faulted Quaternary landslides, terrace gravels, Santa Cruz Island volcanics and the San Onofre breccia have less than 4% barren area (Table 4).

The much-faulted and gullied sedimentary formations in the southwest and the recently deposited Quaternary landslides are disturbed habitats apparently favored by coastal sage scrub, which occupies one-third or more of these substrates. Coastal sage scrub covers 5% of the island as a whole but is virtually absent from Tertiary volcanics or Jurassic substrates.

Excluding the central valley, much of the island's riparian vegetation occurs in the southern coastal portion of the island, in wide canyons which have developed on the older, more highly weathered San Onofre breccia and the Blanca volcaniclastics, or the softer, less consolidated Vaqueros formation. The proliferation of riparian vegetation in relatively wide canyons may also be an artifact of structural geology, if, as geologic interpretations suggest (see Weaver *et al.* 1969), there is less rapid uplift in the southern part of the island.

Pines and oaks occur only on the less faulted highly weathered substrates, especially the Santa Cruz Island schist and Willows diorite, and they are absent from all disturbed substrates, including landslides, terrace gravels and faulted sedimentary rocks.

The relationship to substrate is less clear for the two most widespread vegetation types, grasses and chaparral. Grasses are much more prevalent on terrace gravels than on any other substrate, occupying nearly 90% of terrace gravels. Grasses also occupy over 65% of the area of Santa Cruz Island volcanics and the undifferentiated Santa Cruz Island schist/Willows diorite in Christy Canyon north of the central fault, compared to 53% on the island as a whole. In contrast, grasses cover less than one-seventh of the Willows diorite and less than one-fourth of the Santa Cruz Island schist, both of which are highly weathered, heavily grazed substrates with truncated soil profiles due to erosion (Butterworth *et al.* 1992). The Santa Cruz Island schist has retained chaparral on relict soil pediments (J.A. Jones, unpl. data) over nearly one-half of its area. Together with oaks and pines, shrubs and trees occupy over 60% of the Santa Cruz Island schist, and less than 5% of it is barren. In contrast, chaparral covers barely one-fourth of the apparently similar Willows diorite, and deep-rooted chaparral, oaks and pines cover just over one-third of the substrate, while one-third of it is barren.

In summary, the Santa Cruz Island volcanics which cover nearly one-half of the island have >65% grass cover, and less than 15% of their area is occupied by any other single vegetation class. Proportionately greater areas of coastal sage scrub, chaparral and barren land occur on Tertiary sedimentary formations, which either are densely faulted or have many mapped landslides. Much less grass and relatively larger areas of pines, oaks, chaparral, or barren land also occur on highly weathered, eroded Jurassic substrates on the southern portion of the island.

The cross-tabulated vegetation data suggest that the distinct vegetation patterns on Santa Cruz Island are the result of definable geographical factors, stemming from slope, aspect and substrate. We hypothesize that these factors influence microclimatic variation, geomorphic processes and soil characteristics, and thereby produce vegetation patterns. These patterns, although modified by 140 years of feral animal grazing and concomitant losses of woody vegetation cover, are apparently similar to those of vegetation in the near coast ranges of the California mainland (Dibblee 1976; Minnich 1987). Such relationships among topography, substrate, soils and vegetation may form the basis for dasymetric mapping of soils (see Jones & Grice 1992). These complex interactions merit a more detailed quantitative study, which is presently underway using the GIS and a large dataset of field and laboratory observations of vegetation and soils.

Table 4. Vegetation percent cover by geologic substrate on Santa Cruz Island. Includes only geologic formations which cover more than 1 km² (0.5%) of the island, following Weaver & co-authors (1969). **Jurassic formations:** pj = Santa Cruz Island schist; swd = undifferentiated schist/diorite; wd = Willows diorite. **Tertiary volcanic formations:** tb = Blanca volcaniclastics; tsc = Santa Cruz Island volcanics; tso = San Onofre breccia. **Tertiary sedimentary formations:** tms = Monterey shale; tc = Cañada formation; tcd = Cozy Dell; tjv = Jolla Vieja formation; tr = Rincon; tv = Vaqueros formation. **Quaternary formations:** qal = alluvium; qls = landslides; qtg = terrace gravels. The San Onofre breccia is a sedimentary rock by formations but it contains clasts of glaucophane schist, dacite, and diorite conglomerate, as well as sandstones and siltstones (Stuart 1976; McLean *et al.* 1976; Weaver *et al.* 1969).

Class	Jurassic			Tertiary Volcanics			Tertiary Sedimentary						Quaternary			
	pj	swd	wd	tb	tsc	tso	tms	tc	tcd	tjv	tr	tv	qal	qls	qtg	All
coastal bluff	0	0	0	0	0	0	0.6	0	0	0	0	0	0	0	0	0.1
barren	4.6	5.8	36.9	31.4	3.0	3.2	10.2	19.1	28.8	13.2	9.1	19.3	7.4	1.8	3.2	9.7
coastal sage scrub	1.4	0	1.0	0.5	1.9	3.2	7.8	27.2	30.0	35.9	4.5	2.6	3.8	33.4	1.2	5.1
pines	6.2	1.1	7.0	3.1	0.7	0	0.5	0.9	0	0	0	0	0.3	0.6	0	1.5
island oak	0	0	0	0	1.1	0	0	0	0	0	0	0	0	0	0	0.7
oaks	10.7	1.1	4.8	2.2	5.5	1.0	0.7	0	0	0	0	0	3.1	0	0	4.1
chaparral	46.1	5.8	26.0	22.4	14.6	19.4	27.5	11.9	3.7	28.3	16.7	2.6	13.8	12.2	0.7	18.5
island ironwoods	0.2	0	0	0.2	0.7	0.5	0	0	0	0	0	0	0	0	0	0.3
riparian	8.5	18.4	11.0	11.4	6.7	15.6	3.1	1.3	0	0	9.1	11.6	22.3	0.6	6.6	7.2
woody exotics	0	0	0	0	0.2	0	0.3	0	0	0	0	0	6.2	0	0	0.3
grasses	23.3	67.8	13.3	28.2	65.6	57.1	49.3	39.6	37.5	22.6	60.6	63.9	43.0	52.0	88.3	52.5
TOTAL	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
% of island	8.6	0.8	3.9	12.7	42.4	2.0	11.0	2.2	0.7	0.5	0.6	1.4	2.9	5.2	4.1	100

Acknowledgments

This research was partially supported by a grant from the Island Research Fund. The late Carey Stanton granted access to the island, encouraged and supported this research. We also thank Lyndal Laughrin, Peter Schuyler, Scott Jones, Du Tong and Lisa Mann for their assistance in this project.

Literature Cited

Butterworth, J., J.A. Jones and P.S. Jones. 1993. Soil forming factors, morphology and classification - Santa Cruz Island, California. *In:* F.G. Hochberg (ed.), Third California Islands symposium: recent advances in California Islands research. Santa Barbara Museum of Natural History: Santa Barbara, CA.

Channel Islands National Park, and the Santa Barbara Botanic Garden. 1987. A checklist of vascular plants of Channel Islands National Park. Southwest Parks and Monument Association: Tucson, AZ. 16 pp.

Cole, K. 1980. Geologic control of vegetation in the Purisima Hills, California. Madroño 27:79-89.

Dibblee, T.W. 1976. Geology of Santa Barbara County and its influence on vegetation. Pp. 7-13. *In:* C.F. Smith (ed.), A flora of the Santa Barbara region, California. Santa Barbara Museum of Natural History: Santa Barbara, CA. 331 pp.

Hochberg, M., S.A. Junak and R. Philbrick. 1980. Botanical study of Santa Cruz Island for the Nature Conservancy. Vol. I. Santa Barbara Botanic Garden: Santa Barbara, CA. 90 pp.

Jones, J.A. and D. Grice. 1993. A computer-generated soils map of Santa Cruz Island, California. *In:* F.G. Hochberg (ed.), Third California Islands symposium: recent advances in California Islands research. Santa Barbara Museum of Natural History: Santa Barbara, CA.

Junak, S.A. 1987. Environmental factors correlated with the distribution of Santa Cruz Island ironwood (*Lyonothamnus floribundus* subsp. *asplenifolius*) on Santa Cruz Island, California. M.A. thesis, Department of Biological Sciences, University of California, Santa Barbara, CA. 162 pp.

McLean, H., D.G. Howell and J. Vedder. 1976. Miocene strata on Santa Cruz and Santa Rosa Islands – a reflection of tectonic events in the Southern California Borderland. Pp. 241-253. *In:* D.G. Howell (ed.), Aspects of the geologic history of the California Continental Borderland. American Association of Petroleum Geologists, Pacific Section, Miscellaneous Publication 24. 561 pp.

Minnich, R.A. 1987. The distribution of forest trees in northern Baja California, Mexico. Madroño 34: 98-127.

———. 1980. Vegetation of Santa Cruz and Santa Catalina Islands. Pp. 123-137. *In:* D.M. Power (ed.), The California Islands: proceedings of a multidisciplinary symposium. Santa Barbara Museum of Natural History: Santa Barbara, CA. 787 pp.

Philbrick, R. and R. Haller. 1977. The southern California Islands. Pp. 893-906. *In:* M.G. Barbour and J. Major (eds.), Terrestrial vegetation of California. Wiley Intersciences: New York, CA. 1002 pp.

Stuart, C.J. 1976. Source terrane of the San Onofre breccia – preliminary notes. Pp. 309-325. *In:* D.G. Howell (ed.), Aspects of the geologic history of the California Continental Borderland American Association of Petroleum Geologists, Pacific Section, Miscellaneous Publication 24. 561 pp.

Weaver, D.W., D.P. Doerner and B. Nolf. 1969. Geology of the northern Channel Islands (California). American Association of Petroleum Geologists and Society of Economic Paleontology and Mineralogy, Pacific Section, Special Publication. 200 pp. + maps.

Wells, P.V. 1962. Vegetation in relation to geologic substratum and fire in the San Luis Obispo quadrangle, California. Ecol. Monogr. 32:79-103.

———. New taxa, combinations, and chromosome numbers in *Arctostaphylos* (Ericaceae). Madroño 19:193-224.

Editor's Note: The photographs submitted to illustrate this paper could not be reproduced in color. Black and white reproduction resulted in considerable loss of detail. Color Xeroxes can be requested from the authors.

A Study on the Natural History of *Cytisus* on Santa Catalina Island with an Emphasis on Biological Control

Lisa Wolfbrandt Mastro

Department of Biology,

California State University, Long Beach, CA 90840

Abstract – Exotic introduced species can disrupt native ecosystems and be particularly devastating on islands. Two brooms, Dyers' greenwold (*Cytisus linifolius*) and French broom (*C. monspessulanus*) (Fabaceae) may potentially outcompete native and endemic species on Santa Catalina Island. Re-establishment of these introduced invasive weeds is rapid following fire and disturbance. Seeds of these species may lay dormant in the soil for several years, although experiments show that abrasion of the seed coat enhances germination response.

Phytophagous larvae of the Genista moth (*Uresiphita reversalis*) (Lepidoptera: Pyralidae) are showing considerable promise in controlling the weeds and could be considered in the future for biological control.

Introduction

The spread of escaped exotic weeds can ruin the integrity of native California plant communities. *Cytisus linifolius* (L.) Lam. and *C. monspessulanus* L. (Fabaceae) may prove to be such weeds on Santa Catalina Island.

These two species, commonly referred to as Dyers' greenwold (see Thorne 1967) and French broom respectively, have become invasive introduced pests on Santa Catalina Island and in places, far outnumber native and endemic plants. Chemical or mechanical methods of control are not feasible due to watershed and habitat problems (streambeds or steep slopes). Biological control is a viable option, but a baseline study on the natural history of *Cytisus* must first be undertaken before considering or implementing a biological control.

Biological control of weeds may involve the introduction of natural enemies, the manipulation of the environment to increase the impact of natural enemies, and the release of natural enemies against naturalized weedy pests. The Klamath weed (*Hypericum perforatum* L.) was controlled by natural enemies in the western United States by the leaf-feeding chrysomelid beetle (*Chrysolina quadrigemina* (Suffrian)) and 60 million acres of prickly pear cacti (*Opuntia* sp.) were destroyed in Australia by the imported Argentine moth (*Cactoblastis cactorum* (Berg.))(see Andres 1976).

Before beginning a search for a biological control agent, the following basic information on a weed should be established, if possible: 1) taxonomic position, biology, ecology and economic importance; 2) native geographic distribution; 3) total present distribution; 4) probable center of origin and that of its close relatives (section, genus, tribe); 5) coextensive occurrence of related species; 6) occurrence of related and ecologically similar species in regions where the weed does not occur, but where exploration for an enemy agent seems desirable and 7) the literature record of the weed's natural enemies (National Academy of Sciences 1968).

In northern California, efforts have been made to control French broom through public education workshops, broom-pulling parties and agreements with Caltrans to discontinue the use of aggressive, non-native plants for highway planting (Mountjoy 1979). Bravo (1985) reported the return of native plants including species of *Lupinus*, *Calochortus*, *Baccharis*, *Dodecatheon* and *Lonicera* (genera all found on Santa Catalina Island) within a 4 yr period in a broom-removal area near Muir Woods.