



Channel Islands National Park

Terrestrial Vegetation Monitoring Annual Report - 2015

Natural Resource Data Series NPS/MEDN/NRDS—2021/1325





ON THIS PAGE

Coastal sage scrub habitat, Santa Cruz Island

Photograph: CHIS

ON THE COVER

Ironwood habitat

Photograph: CHIS

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Terrestrial Vegetation Monitoring Annual Report - 2015

Natural Resource Data Series NPS/MEDN/NRDS—2021/1325

Dirk Rodriguez

Channel Islands National Park
1901 Spinnaker Drive
Ventura, CA 93001

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The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Executive Summary

This report presents the data collected in 2015 as part of the long-term terrestrial vegetation monitoring program at Channel Islands National Park (Figure E1).

The purposes of the monitoring program are to document the long-term trends in the major vegetation communities within the park. The data collected are from 30 m point-line intercept transects. In the past, each transect was sampled annually. However, beginning in 2012 the program began adding randomly located transects on 4 of the 5 islands—Santa Barbara Island, Anacapa Island, Santa Cruz Island, and San Miguel Island—within the park to improve the representativeness of the sampling, and transitioned to a rotating panel design. Now, for those 4 islands only a core subset of the transects are read annually. Non-core transects are assigned to one of four panels and those transects are read only once every four years. The implementation of the new monitoring design will not be implemented on Santa Rosa Island until 2017.

A summary analysis of the 2015 data shows that:

- 162 transects were read.
- The 162 transects were distributed across all five islands: Santa Rosa Island ($n = 85$), Santa Cruz Island ($n = 33$), Santa Barbara Island ($n = 17$), Anacapa Island ($n = 13$) and San Miguel Island ($n = 14$).
- Relative native plant cover averaged 61% across all islands and sampled communities while absolute native plant cover averaged 37% across all islands and sampled communities. For plant communities, relative percent native cover ranged from a low of 6% in barren types to a high of 99% in ironwood groves.
- In general, the number of vegetation data points recorded per transect appears to correlate with average rainfall. In other words, as rainfall increases, vegetation cover increases and this is reflected in the number of “hits” or transect points containing vegetation. When precipitation declined there was a corresponding drop in the number of hits. In 2015, as a result of 4 years of below average rainfall, the average number of hits was 88. To put this into perspective the highest average number of hits was 240 in 1993.
- Due to the random placement of the monitoring transects, by chance, not all communities on an island may be monitored. In addition, due to the rotating design used by the CHIS monitoring program, a community may not be monitored in all years if it is solely represented by transects within the rotating panels. Knowing the number of communities monitored versus the total number of known communities on an island, can help a reviewer gauge how accurate the monitoring program may be in detecting island-wide change in a particular year. In 2015, 12 of the 16 communities were sampled on Santa Rosa Island; 7 of 10 communities on Santa Cruz Island (NPS section) were sampled; 7 of the 9 known communities on San Miguel Island were sampled; 7 of the 8 known communities on Santa

Barbara Island were sampled; and 5 of the 7 known communities on Anacapa Island were monitored.

- 23 different vegetation types were sampled in 2015. Of these, 12 occurred on more than 1 island. The most commonly shared community was Valley/Foothill grassland which was found in one form or another on all 5 islands within the park. The next most common shared communities were coreopsis scrub, coastal sage scrub, coyote brush scrub, and island chaparral which were shared on 3 islands, although not necessarily on the same 3 islands. The other 5 shared communities—caliche scrub, coastal bluff scrub, coastal scrub, herbaceous scrub, mixed woodland, oak woodland, and riparian were shared on 2 islands each.



Figure E1. Map of the Channel Islands.

Acknowledgments

No one accomplishes their work without assistance from others. This report is a result of the hard work done by all the employees at Channel Islands National Park and is just one of the fruits of their labors. Their assistance and company were invaluable and made the long field days much more enjoyable.

Introduction

Channel Islands National Park (CHIS) is comprised of 5 islands off the coast of southern California: Anacapa Island (ANI), Santa Cruz Island (SCI), Santa Rosa Island (SRI), San Miguel Island (SMI), and Santa Barbara Island (SBI).

The National Park Service (NPS) created the Inventory and Monitoring (I&M) Program following the National Park Omnibus Management Act of 1998 to acquire data needed to support effective management and protection of native habitats located on park lands. The role of the I&M Program is to collect, organize, and make available natural resource data and contribute to the National Park Service's institutional knowledge by facilitating the transformation of data into information through analysis, synthesis and modeling (Fancy et al. 2009). The park, under the auspices of and financial support from the national I&M Program, began a formal long-term terrestrial vegetation monitoring program in 1984 when it was comprised of just three islands—Santa Barbara Island, Anacapa Island, and San Miguel Island. At that time, a total of 54 transects were installed or incorporated from prior monitoring efforts as the basis of the long-term terrestrial vegetation monitoring program (Halvorson et al. 1988). The goal, as established in 1984, was to monitor the dominant island vegetation communities by utilizing 30-meter point-line intercept transects. Under the SOPs established at the time, the objective was to read each transect annually (McEachern 2001). In subsequent years, shrub and tree-based monitoring SOPs were added to the point-line intercept transects adhering to protocols outlined in the U.S. Geological Survey Open-File Report 00-74 (McEachern 2000).

In 1990, the park acquired Santa Rosa Island (54,000 acres) and additional 86 transects were installed on that island as part of the long-term monitoring program. The largest of the Channel Islands—Santa Cruz Island—falls within the park boundary; however, the majority of the island is owned and administered by The Nature Conservancy (TNC). In 1999, the park acquired approximately 6,000 acres at the east end of the island which was not owned by TNC. This was followed by the acquisition of the adjacent 8,702 acres in 2001 which was owned by TNC at that time. Following these additions to the park, 43 additional transects were installed on those acquired lands and incorporated in to the vegetation monitoring program. No park monitoring occurs on that portion of Santa Cruz Island that is owned by TNC.

Beginning in 2012, changes were made to the original monitoring protocol to correct identified deficiencies in the monitoring program and strengthen the statistical validity of the data. Some of the improvements to the program include the installation of additional transects and transitioning from the goal of monitoring each transect annually to a rotating panel design where a core set of transects are read annually while the remaining transects are read over a 4-year period. While this will result in a loss of some statistical power to detect year to year variability, it allows for statistical inference to the entire islands (except in the case of SCI) and provides broader spatial coverage of park lands.

In conjunction with the modification to the Channel Islands terrestrial vegetation monitoring program, similar protocols were established for the 2 other parks within the Mediterranean Coast Network—Santa Monica National Recreation Area (SAMO) and Cabrillo National Monument (CABR). For a more in-depth review of the changes to the Channel Islands monitoring program and

the establishment of community vegetation monitoring programs at SAMO and CABR please see the Mediterranean Coast Network Terrestrial Vegetation Monitoring Protocol (Tizler et al. 2016)

In 2013, following the CHIS protocol revision, additional transects—consisting of those for the core panel and panel A—were installed on 4 of the 5 islands within the park on Santa Barbara Island, Anacapa Island, Santa Cruz Island, and San Miguel Island. It was decided to delay implementation of the new monitoring design on Santa Rosa Island until 2017 as the last of the non-native herbivores had only been removed 2 years prior in 2011. This removal marked a significant change to the effects on the island's plant communities and it was felt that revising the legacy protocol on that island so soon afterwards would complicate the ability to infer changes to those communities from the monitoring data.

This report summarizes data collected in 2015. Summary statistics that include previous years are provided in order to provide context.

Methods

Monitoring Dates

The timing of monitoring and variation in annual climate conditions can have a large effect on the character of the vegetation data collected. Because California, especially southern California, has a Mediterranean climate which is characterized by cool, wet winters and warm dry summers, important aspects of the data that are collected may change if the field season spans a wet, cool spring into a warm, dry summer. Many plant species within California experience changes with decreased water availability which can affect the data. For instance, many species are small and herbaceous annuals that typically initiate growth during the wet season and have completed their life course by the time the heat of summer has arrived. Monitoring done early in the growing season will more likely capture the presence of these species versus data collected in summer. If monitoring occurs after these small annual species have disappeared from the landscape, the data may suggest an artificial decrease in species richness or biodiversity. Seasonality can even affect perennial species, especially those that are drought deciduous; data collected late in the season may show an artificial decrease in cover after leaves have dropped. Based on historic weather patterns the optimum period for terrestrial vegetation monitoring on the Channel Islands seems to be between late February and mid-May (D. Rodriguez, unpublished data). After that, the decrease in water availability typically results in less cover for at least the annual species. This is especially exacerbated during drought years as the vegetation typically dries up sooner than normal and is usually reflected in a decrease in the average number of “hits” that are recorded for each transect.

Transects are monitored during separate tours to each island. Each tour is 8 days in length, 2 travel days for each visit and 6 full days on the island. For the smaller islands—Santa Barbara, Anacapa, and San Miguel—1 tour per island is sufficient to monitor all transects scheduled to be monitored for a particular year. For Santa Cruz Island, 2 tours are usually necessary to complete the monitoring while for Santa Rosa Island up to 4 tours may be needed. Table 1 below shows the dates that each island was visited in 2015. Anacapa Island was sampled outside of the ideal March–May sampling window due to nesting seabirds which prohibited access to the transects. The islands, particularly Santa Barbara Island and Anacapa Island serve as important rookeries for several species of seabirds including brown pelicans (*Pelecanus occidentalis*) and western gulls (*Larus occidentalis*) due to the lack of natural predators on those islands. As nesting seabirds will often abandon their nests either temporarily or permanently when humans are present, the park limits or prohibits entry into those areas when and where seabirds are nesting. The nesting season can vary from year to year, likely due to food availability but usually active nesting occurs during the optimum monitoring period. With regards to Anacapa Island, particularly the Middle and West islets, another factor in the restriction of access is due to transportation availability. There is no regular commercial transportation to those islets nor does the park provide a set transportation schedule. Therefore any park sponsored trip imposes additional operating costs to the park’s transportation budget. To minimize this cost, the park preference is to combine multiple purposes into a single trip. In 2015, the purposes of the trips were to count the number of nests used by seabirds for the year and to conduct vegetation monitoring. Since nest counts are only done after the nesting season is completed, the trips to Middle and West Anacapa were in the fall of 2015.

Table 1. 2015 field schedule.

Island	# of transects	Dates visited
Santa Barbara Island	17	03/05–03/12
Santa Rosa Island	18	03/24–04/01
	06	04/22–04/27
	09	07/15–07/17
Santa Rosa Island	27	05/05–05/11
	26	05/20–05/28
	18	06/03–06/08
	14	06/16–06/22
San Miguel Island	14	07/01–07/05
Anacapa Island (East)	04	09/30
	01	10/14
Anacapa Island (Middle)	03	11/12
Anacapa Island (West)	05	09/22–09/24

Transect Locations

The transects monitored in 2015 were a combination of legacy sites used for other research purposes and additional transects installed as part of the monitoring program. Depending on the original intent, or out of necessity, some of the legacy transects were placed subjectively. For instance, on SRI, very little intact native vegetation remained on the island due to grazing by nonnative animals at the time monitoring began. Consequently, the legacy transects were deliberately placed in areas with intact native vegetation. The locations of new transects were chosen using a Generalized Random Tessellation Stratified (GRTS) survey design (Stevens and Olsen 2003; Olsen et al. 2012) to achieve a spatially balanced random sample that allows inference to the entire island, in all cases except SCI (as explained above). Due to the issues associated with the placement of transects on the islands, any thorough analysis of the data would need to take these factors into account, but for the purposes of this annual report the data are treated as a simple random sample. Figures 1–5 show the locations of transects monitored in 2015.

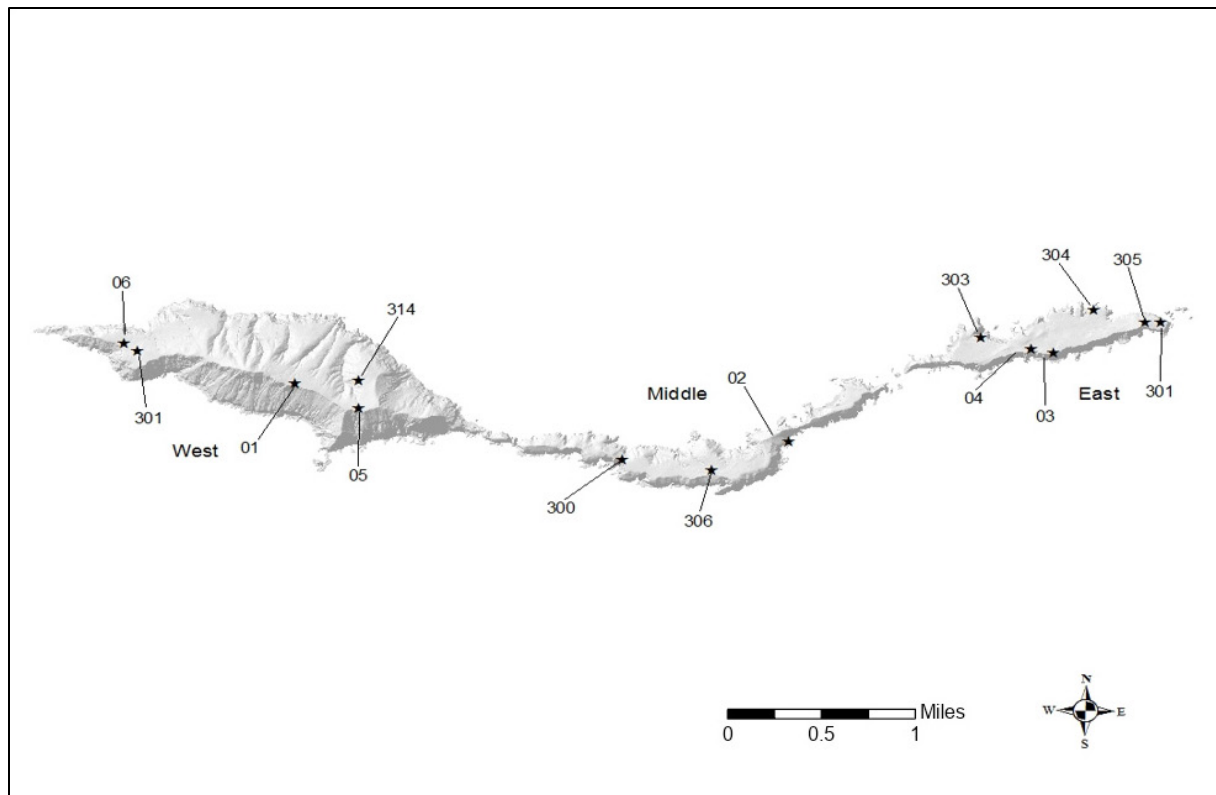


Figure 1. Vegetation monitoring transects on Anacapa Island that were sampled in 2015.

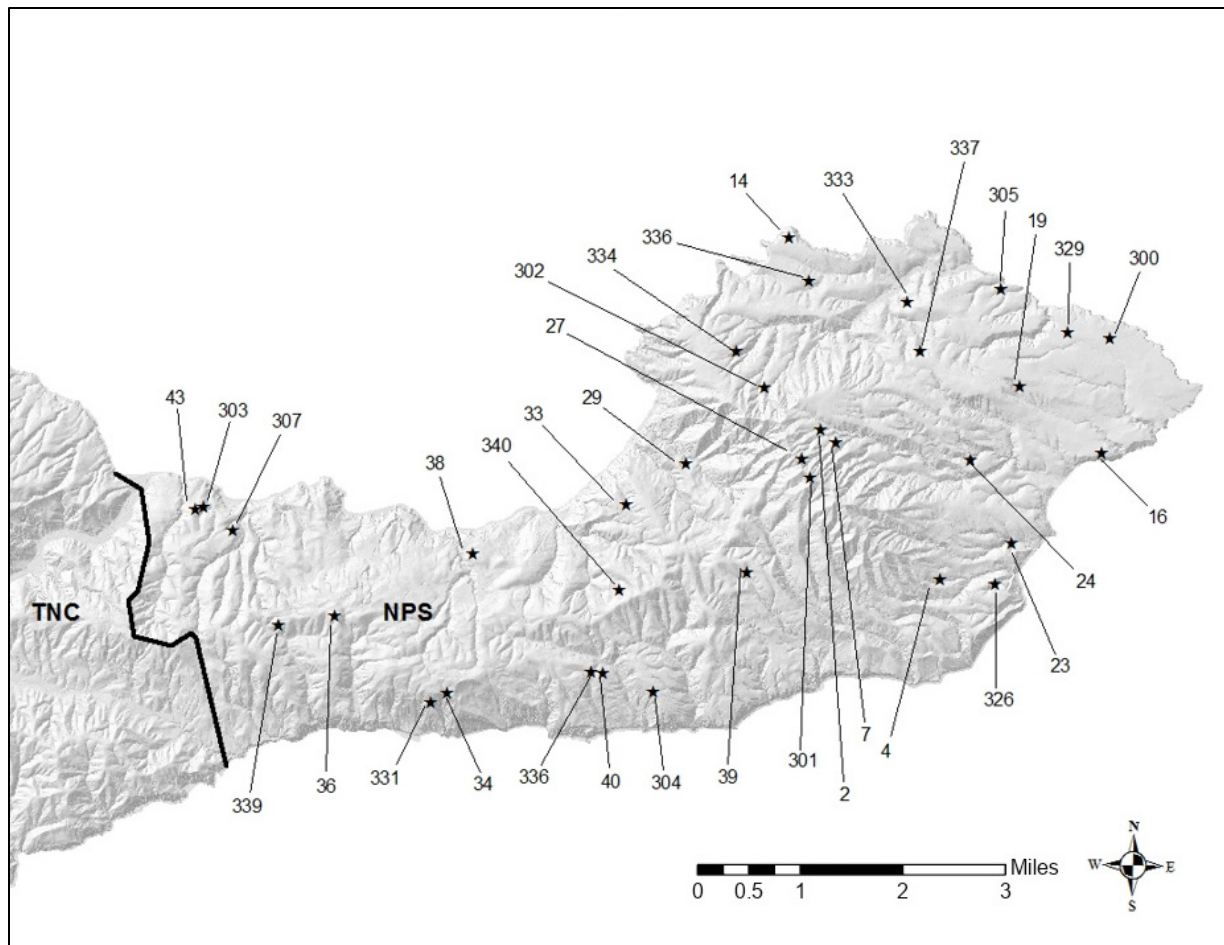


Figure 2. Vegetation monitoring transects on Santa Cruz Island that were sampled in 2015.

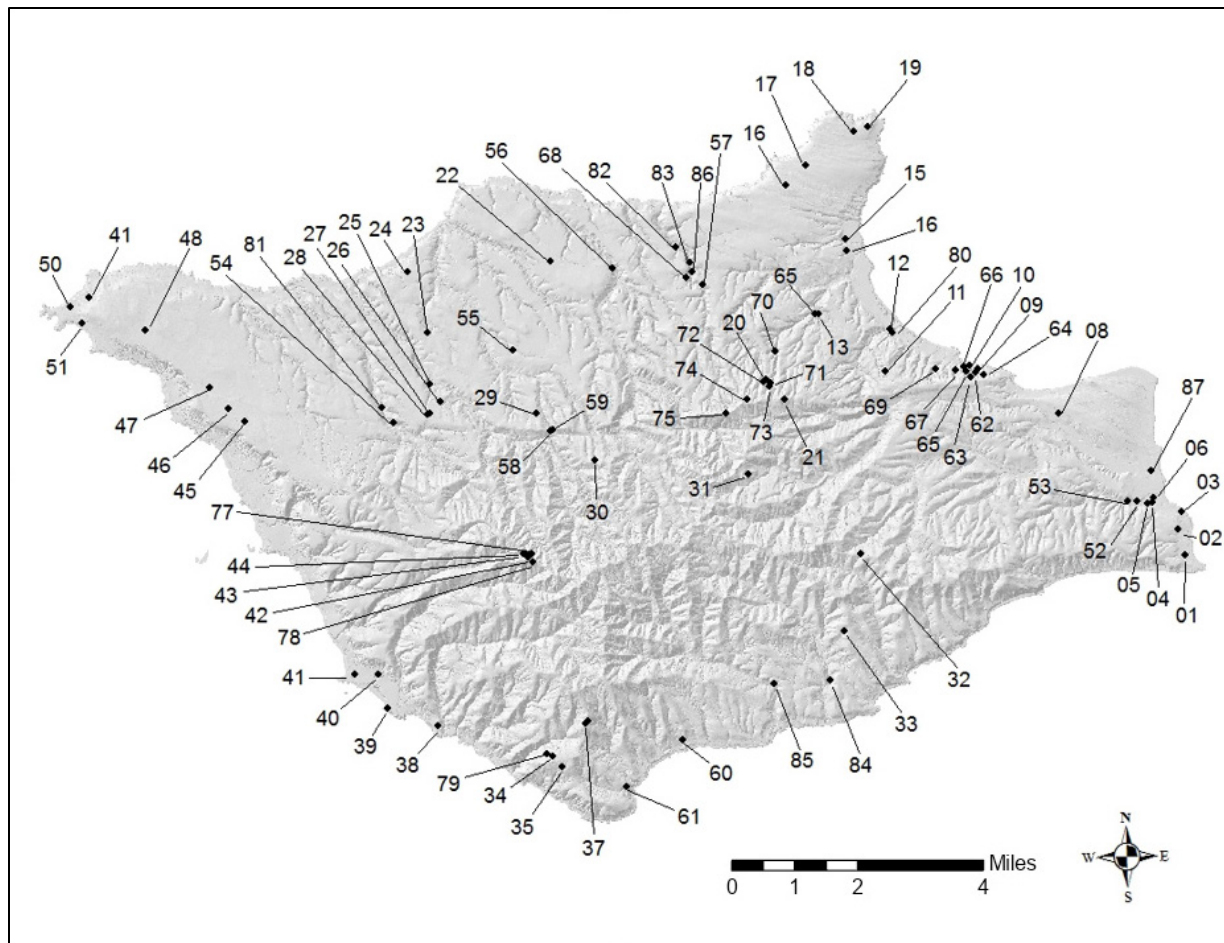


Figure 3. Vegetation monitoring transects on Santa Rosa Island that were sampled in 2015. These points are for the legacy transects. The first of the GRTS transects for SRI weren't installed until 2017.

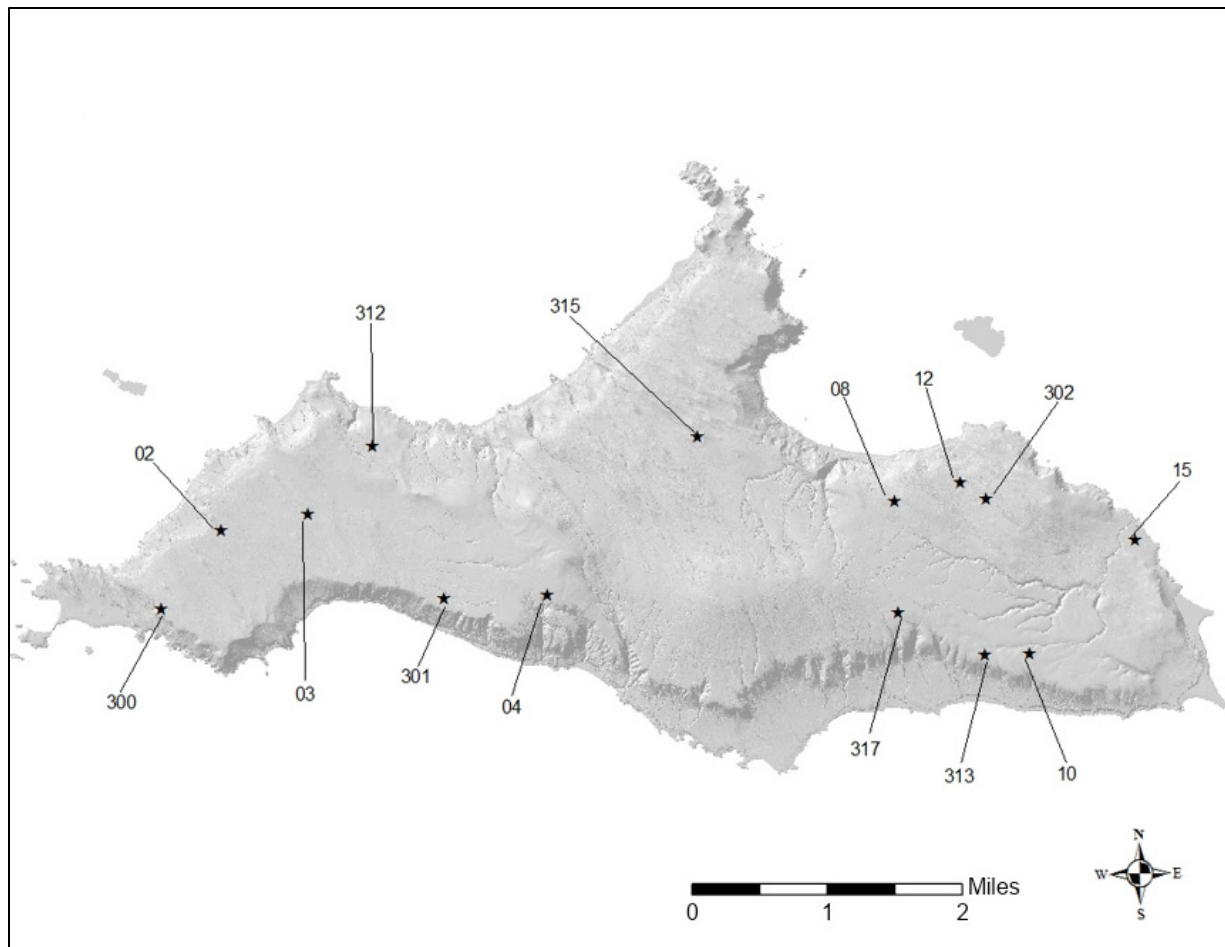


Figure 4. Vegetation monitoring transects on San Miguel Island that were sampled in 2015.

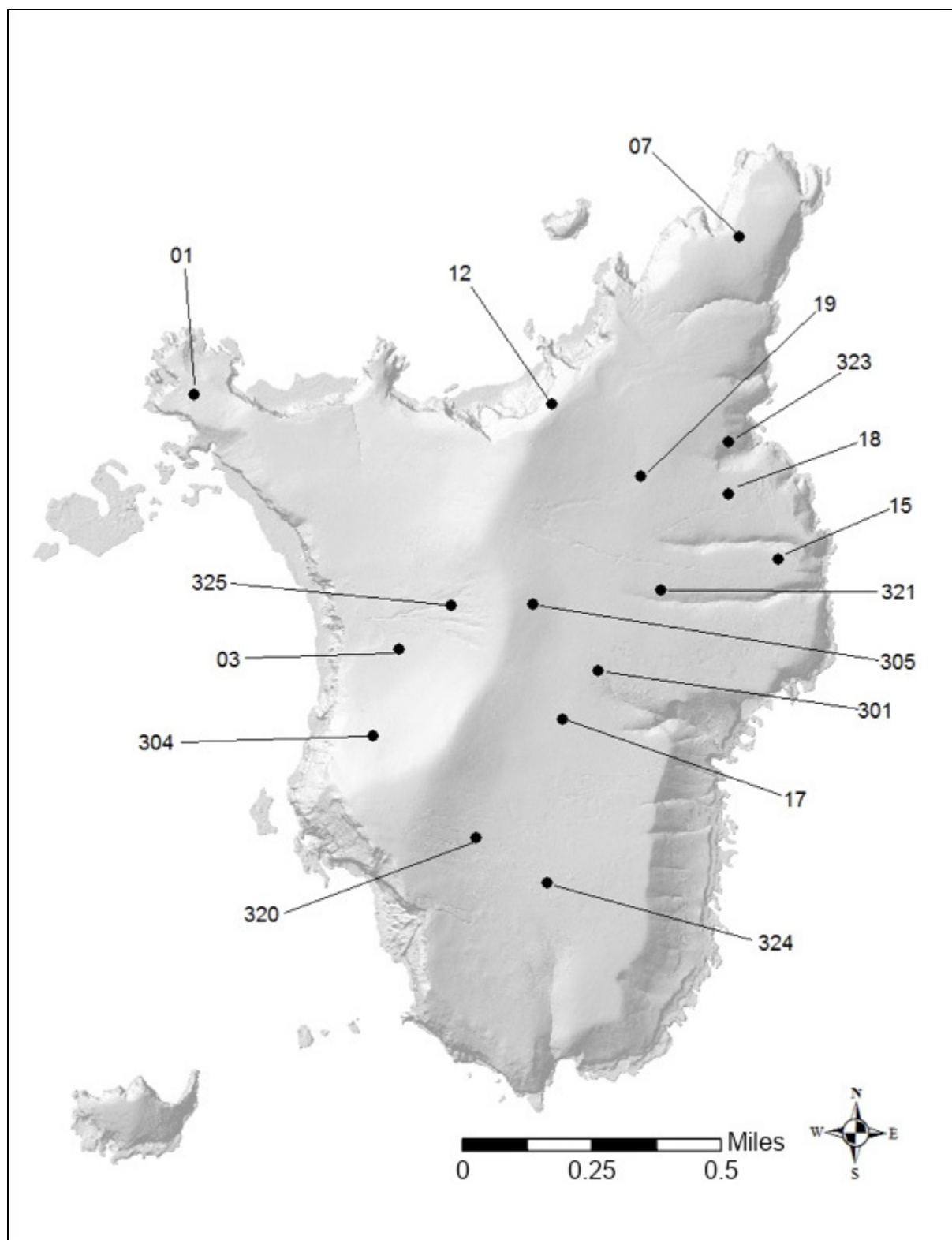


Figure 5. Vegetation monitoring transects on Santa Barbara Island that were sampled in 2015.

Field Data Collection

Three SOPs describe the methods that are used when recording terrestrial vegetation monitoring—a base SOP, a shrub SOP, and a tree SOP. (Note: these methods or SOPs were referred to as protocols in the CHIS legacy vegetation monitoring handbook and in USGS report on tree and shrub monitoring; Halverson et al. 1988; McEachern 2000). Under the base SOP, a meter tape is stretched out between the 2 aluminum stakes that mark the ends of a transect and data are recorded every 30 cm along the meter tape (i.e. the point-line-intercept method). The data recorded are the plant species that are present at those points (both live and dead tissue for perennial species). The height of the tallest vegetation is also recorded at each point. By recording data every 30 cm along the 30 meter length, each transect provides 100 points of data which is then easily converted to percent absolute cover.

It should be noted the majority of the transects are 30 meters in length, however there are five transects on Santa Barbara Island and one transect on Anacapa Island that were originally 39 meters in length. These longer transects were installed for other monitoring purposes and were later incorporated into the park's long-term monitoring program. For three of these longer transects, the data collected can simply be truncated to 30 meters. It is a bit more complicated for the other three transects though, as they were deliberately located across ecotones. To address the complications associated with the data generated from these transects it was decided to essentially split these ecotone crossing transects in half, resulting in 6 smaller length transects with each approximately 2/3 the length of the normal length transect. These shorter transects are all located on Santa Barbara Island (SBI) and can be identified by their alpha-numerical naming convention (e.g. 08N or 09S).

For transects located in shrub dominated plant communities, data are also collected according to the shrub SOP. This involves placing a 1 meter belt adjacent to the base transect, dividing the 1-meter wide belt into six 1 x 5 sub-belts, and then recording the number of shrub individuals present within each sub-belt (Figure 6). Shrub data are recorded by 4 stage classes: seedling, juvenile, live adult, and dead adult. For the live adult species, the numbers of live and dead stems on each individual shrub are also recorded.

The tree SOP is performed in tree dominated communities every 4 years. This SOP consists of a 10 x 30 m belt plot that is centered atop the 30 m point-line intercept transect with half of the plot on the uphill side of the base transect line and the other half on the downhill side of the transect line (Figure 6). Within the plot, tree species are recorded in 5 categories: seedlings, juveniles, live adults, dead adults, and basal resprouts. Shrub species are also recorded in 4 stage classes: seedlings, juveniles, live adults, and dead adults within the tree plot.

Data were recorded on paper datasheets and, at the end of each day, collected data were reviewed for possible errors. Prior to entering the data, the data sheets were reviewed once more. Data were then entered by the park's I&M botanist into a Microsoft Access database maintained by the MEDN I&M Data Manager. The entered data were then verified against the paper datasheets by the park's I&M botanist.

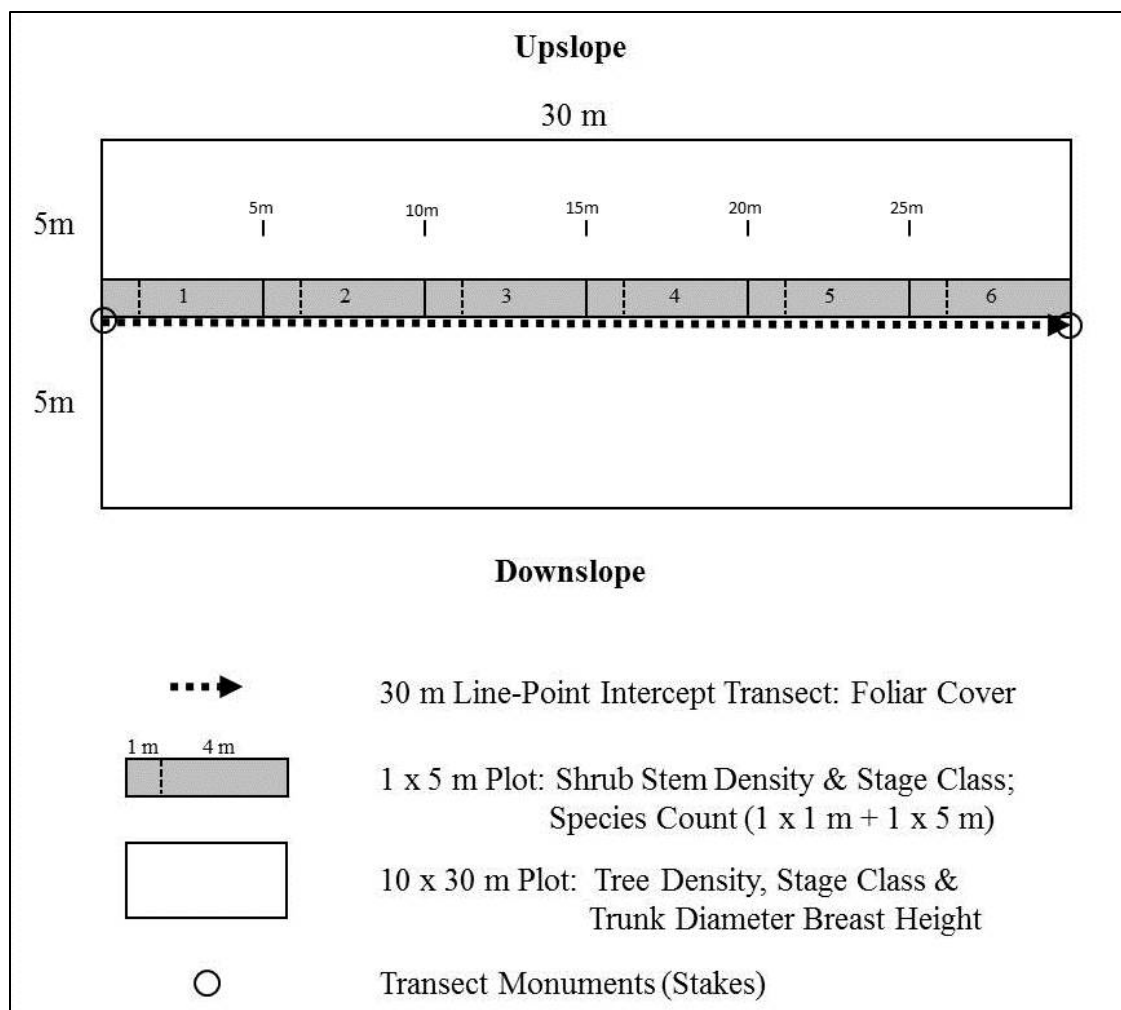


Figure 6. Diagram showing 30 m transect with overlying shrub and tree plots (NPS/John Tiszler.)

Data Analysis

The quality assured/quality-controlled data were then summarized using Access queries. The summarized data were exported to Microsoft Excel where calculations were run to determine simple quantitative community indicators such as species richness and species diversity. The charts and tables presented in this report were generated in Excel.

Results

Minimal data analyses are presented in this report as it presents only a single year of data. However, simple comparisons can be made between native plant communities within and between islands. Species richness, evenness and diversity are examined along with a summary of target species detected in 2015. Additionally, the nomenclature and basis for the classification of vegetation communities has evolved since the first attempts by ecologists to identify plant communities. Although there are more contemporary naming conventions available, this report uses the park's historic plant community nomenclature. This is to provide continuity with previous park reports. However future reports may use more contemporary naming conventions as the historical nomenclature becomes more anachronistic. While this will allow for easier comparisons with other parks in the Mediterranean network, it will make comparisons with earlier CHIS park reports more difficult.

Because of the large volume of data collected, and the difficulty of presenting them, a species list of plants recorded by transects is not included in this report, however they are available in electronic format from the Mediterranean I&M network upon request.

Precipitation

A fourth year of below average precipitation for southern California and Channel Islands National Park was recorded in 2015. Below average rainfall tends to result in lower vegetation cover as measured by the number of vegetation “hits” across all islands and all years (Figure 7).

Native Plant Cover

In evaluating the condition of park's vegetation communities after years of extensive grazing, one metric is the ratio of native to non-native plants. Some plant communities increased native plant cover following the removal of various introduced herbivores to the islands (Channel Islands National Park, unpublished data). However, the ongoing drought in California has likely had the most influence on the data this year, in particular the cover of annual species. Figures 8–17 show the average absolute and relative cover of native plant cover and non-native plants by island and plant community.

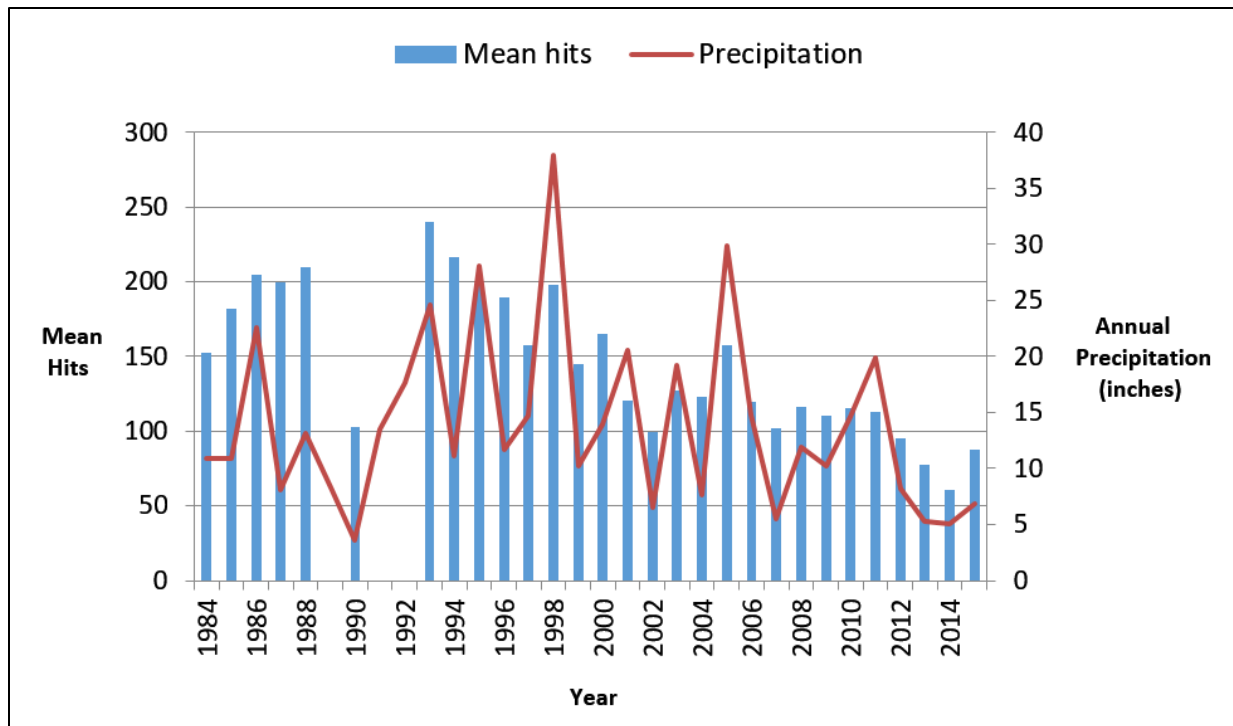


Figure 7. Mean number of plant hits across all transects and islands per year as compared to annual rainfall. Note: precipitation amounts are from Station 168 (Ventura County Watershed Protection District), near the Oxnard airport on the mainland and, while not the same as the actual precipitation that fell on the islands, is comparable, and reflects the high variability of rainfall from year to year in southern California. No transect data are presented for 1989, 1991, and 1992 as monitoring was not conducted in those years.

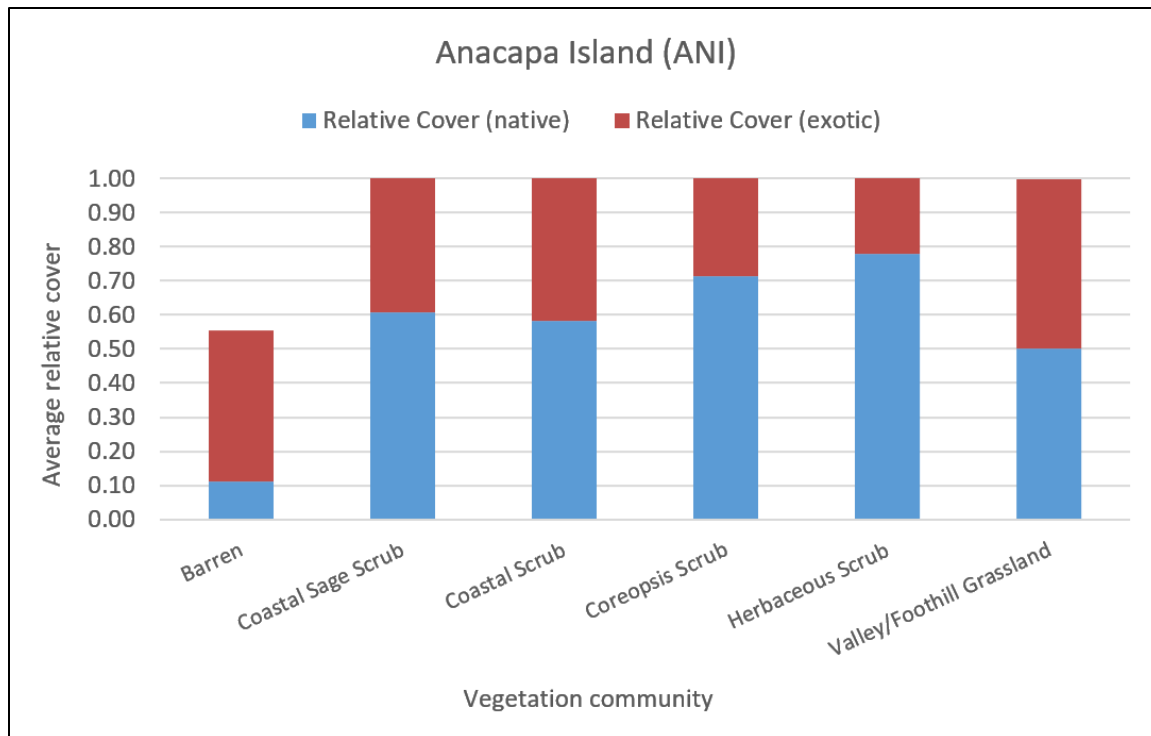


Figure 8. Average relative cover of native cover vs non-native plant cover on ANI (not including Middle or West Islets).

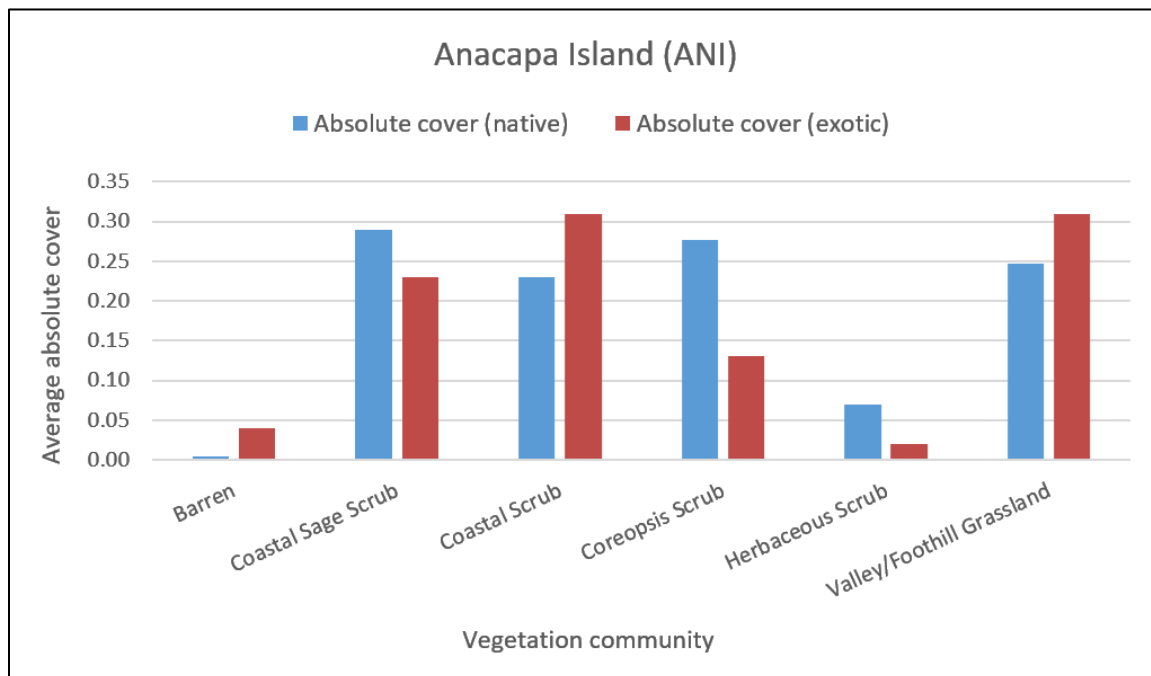


Figure 9. Average absolute cover of native versus non-native species on ANI (not including Middle or West Islets).

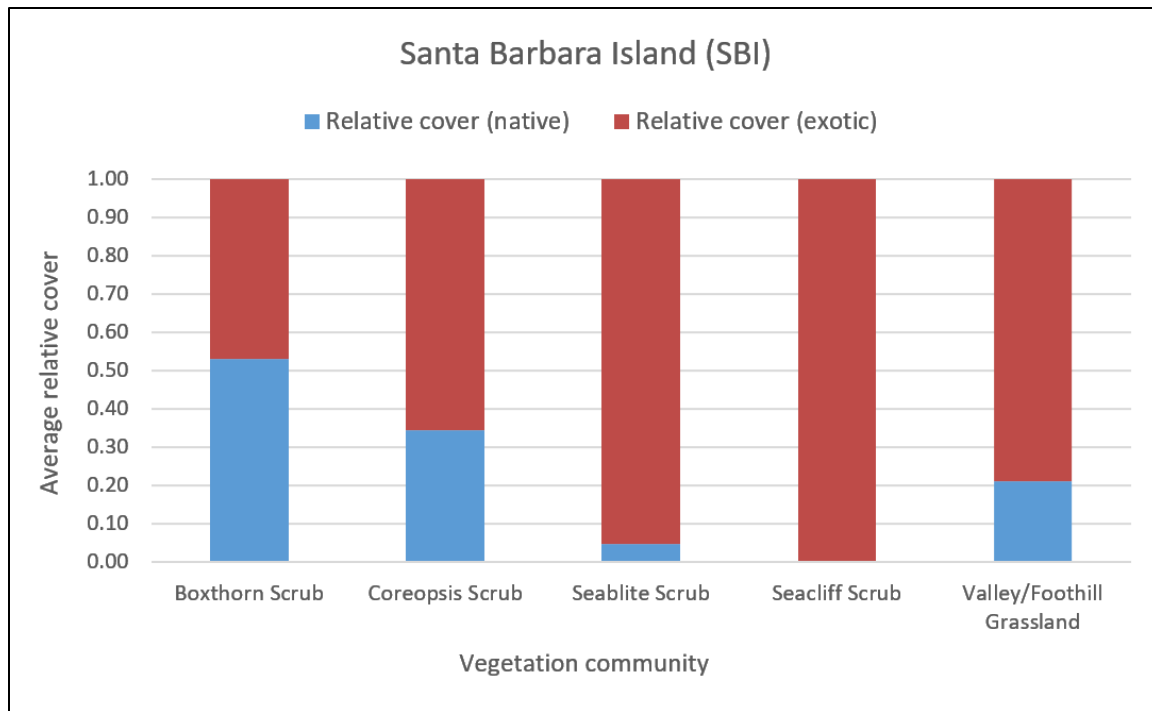


Figure 10. Average relative cover of native versus non-native species on SBI.

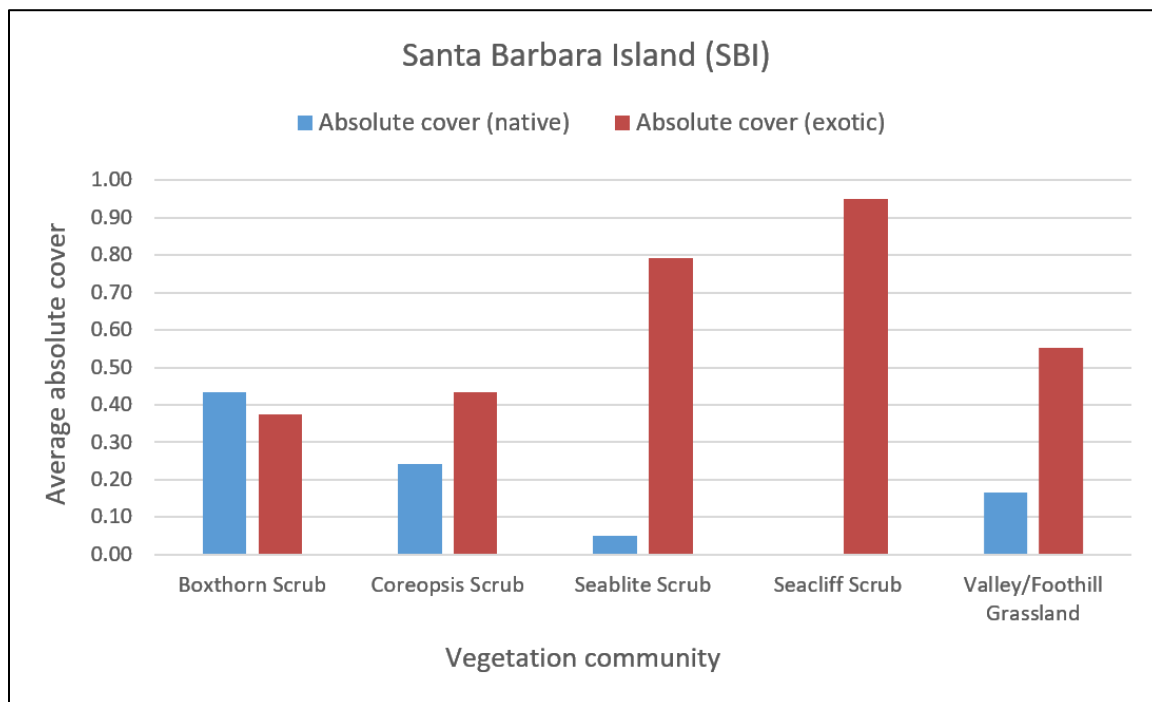


Figure 11. Average absolute cover of native versus non-native species on SBI.

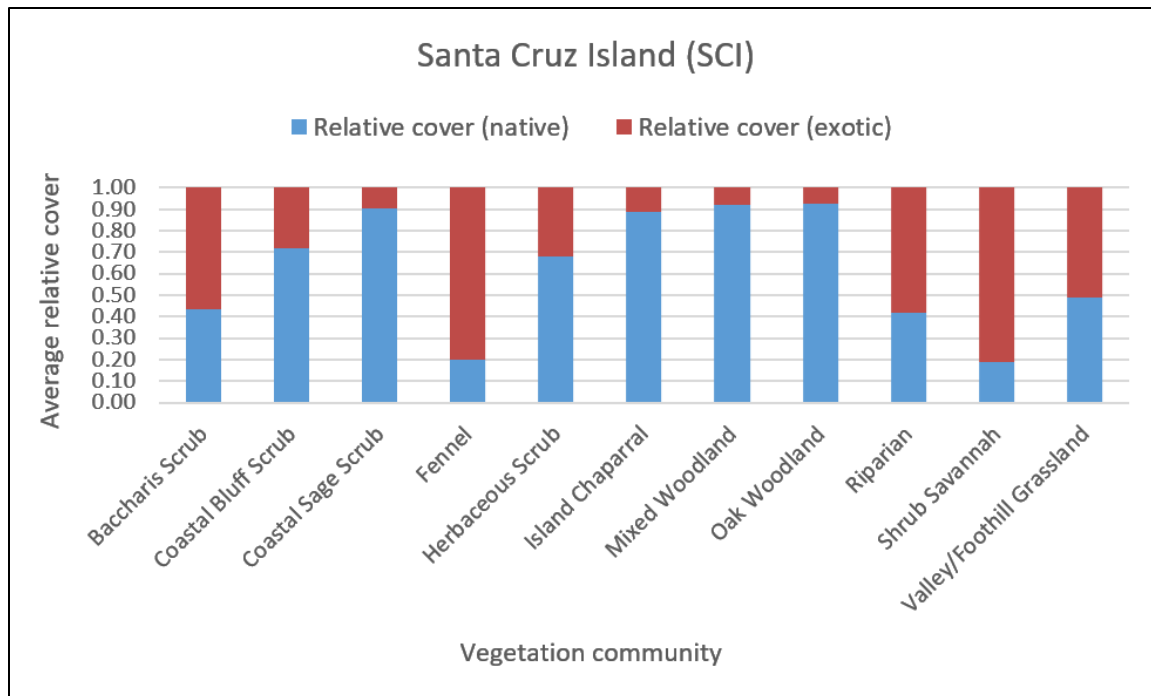


Figure 12. Average relative cover of native versus non-native species on SCI.

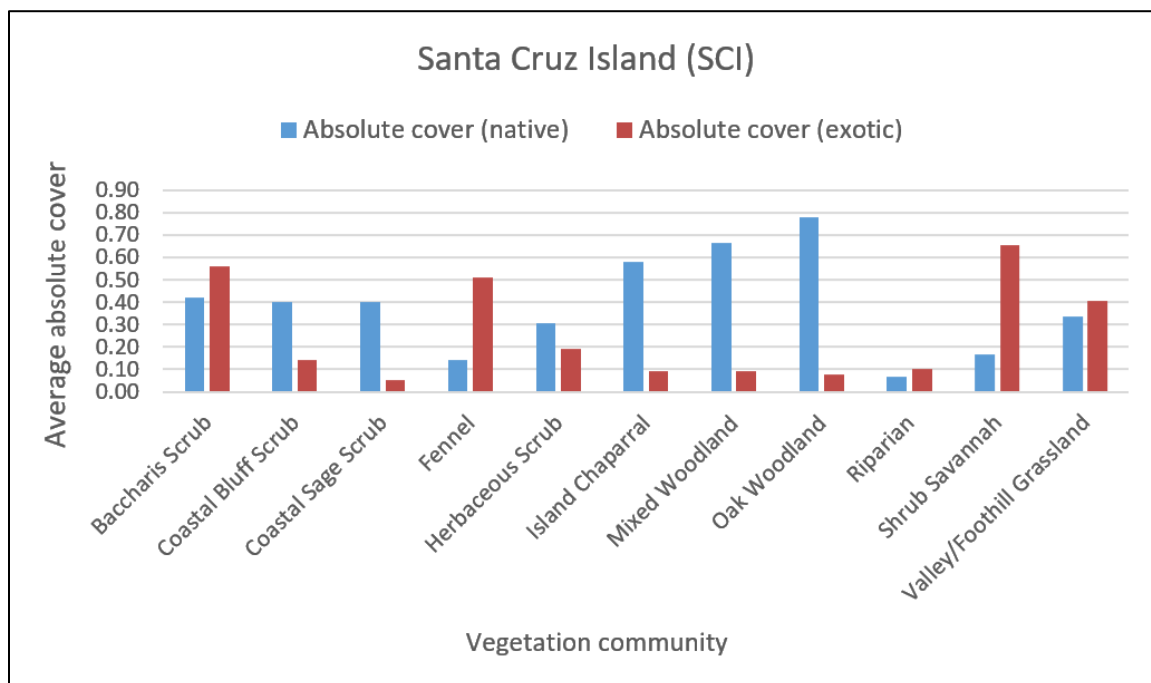


Figure 13. Average absolute cover of native versus non-native species on SCI by vegetation community.

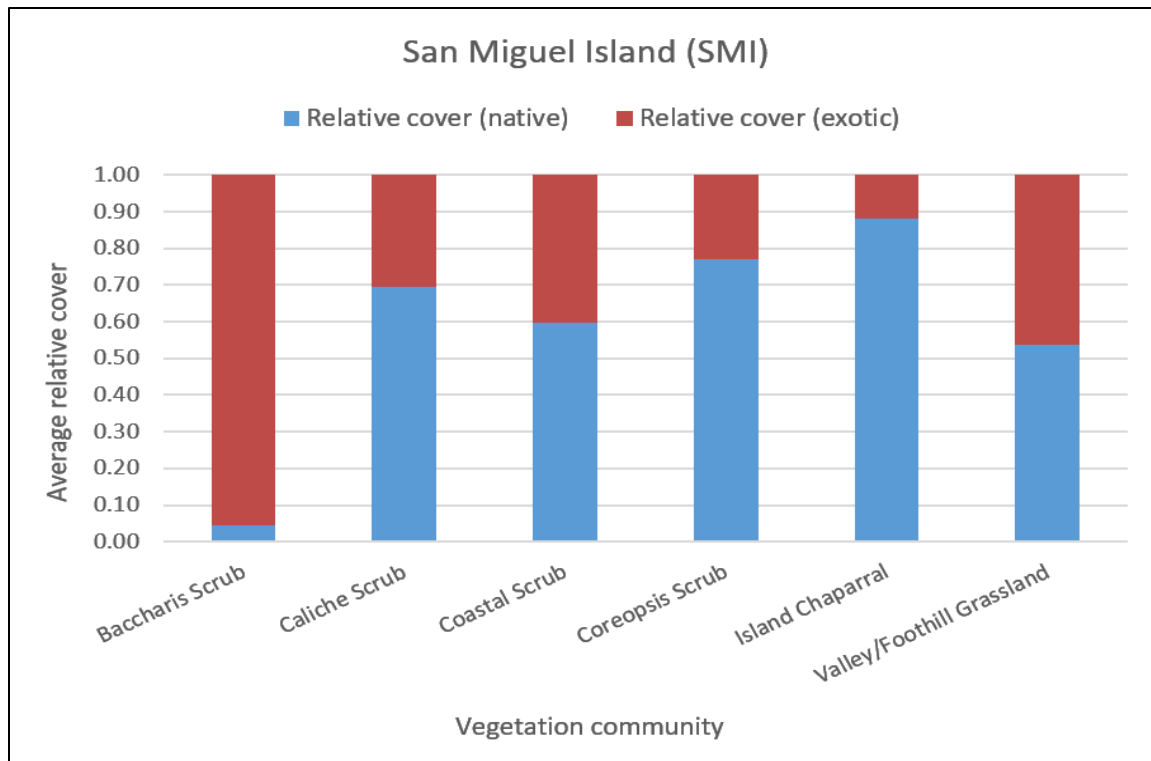


Figure 14. Average relative cover of native versus non-native species on SMI.

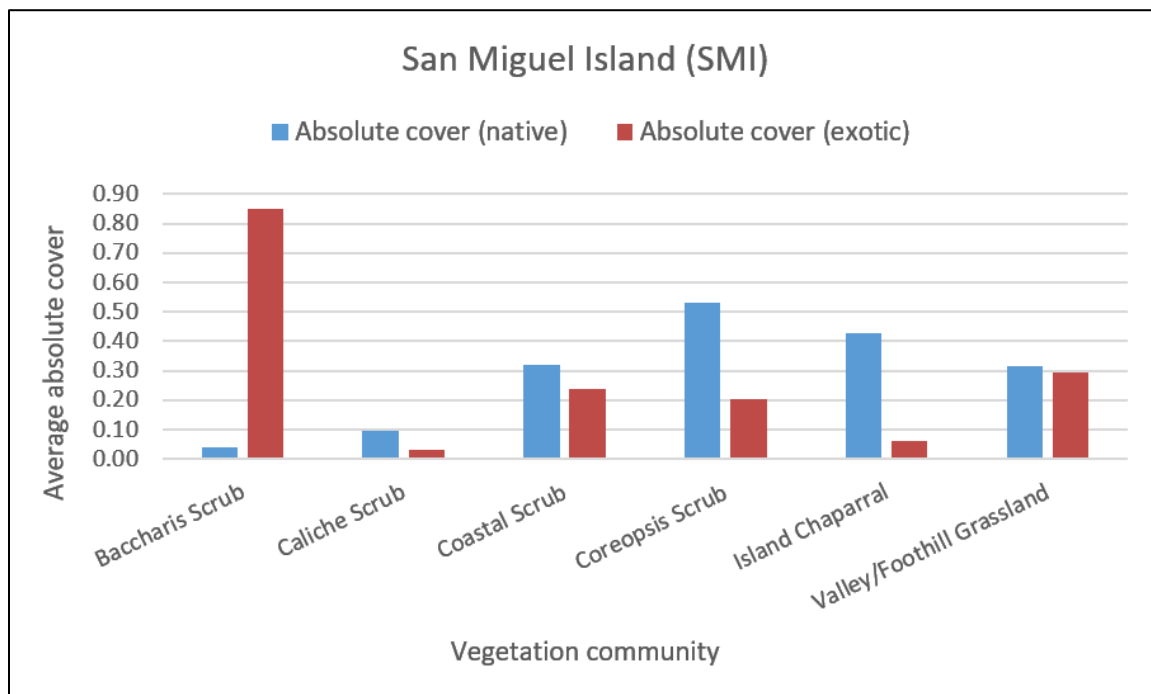


Figure 15. Average absolute cover of native versus non-native species on SMI.

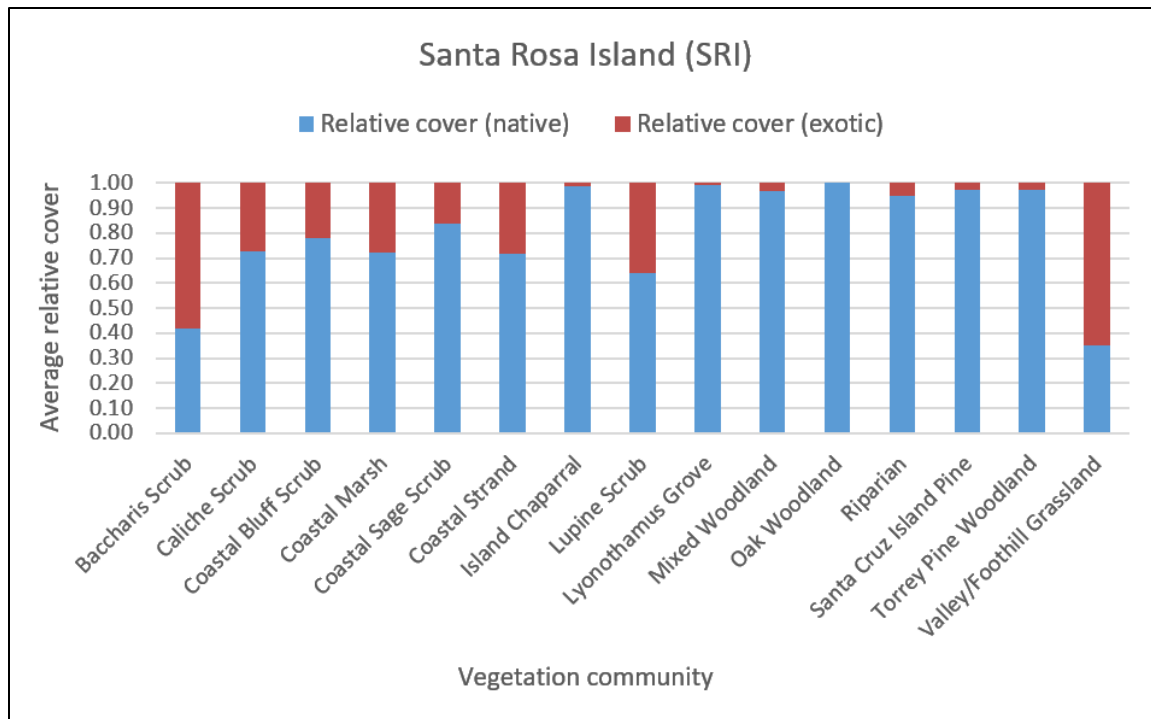


Figure 16. Average relative cover of native versus non-native species on SRI.

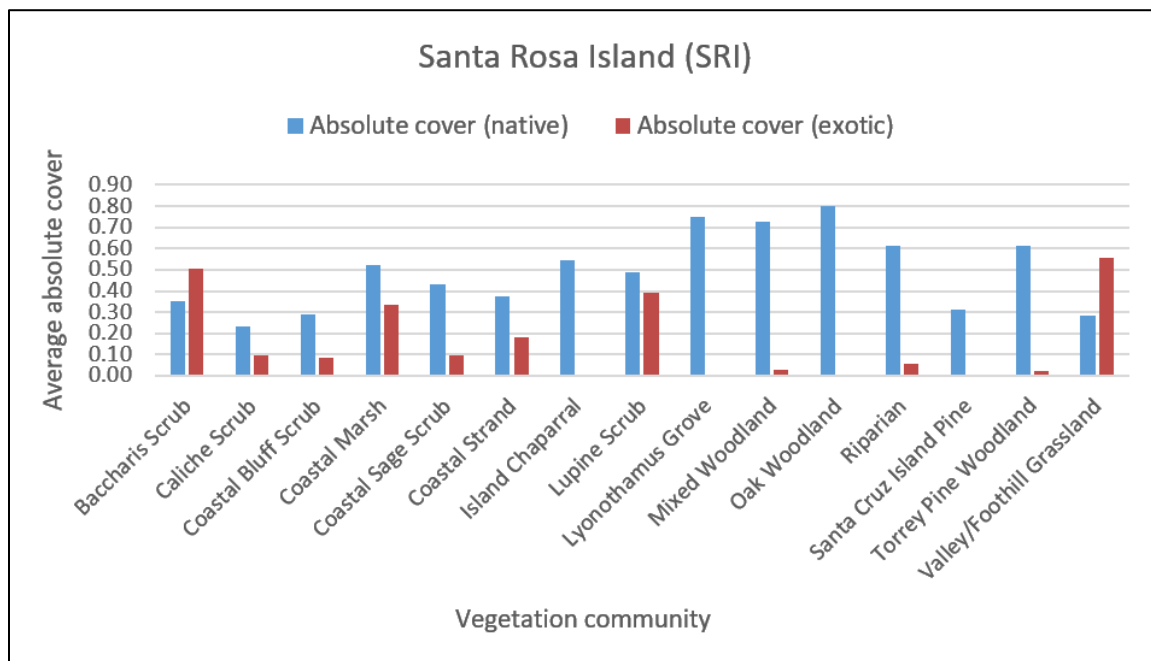


Figure 17. Average absolute cover of native versus non-native species on SRI.

Community Diversity

Other measures of plant community condition are indices such as species richness or species diversity. A long-held and frequently debated tenet of ecology is that diversity of plant communities

confers stability of ecosystem services (MacArthur 1955; Elton 1958; Frank and McNaughton 1991) The merits of this belief and the associated debate are beyond the scope of this report; regardless, these diversity indices have become a common way of evaluating and comparing plant communities. Three of the most commonly used indices are species richness, species evenness, and species diversity.

Species Richness

This parameter is simply a sum of the number of species found on a single transect or on all transects within a specific community, depending on the spatial scale considered. Data presented here reflect the number of species found along all the point-line intercept transects monitored within each particular community. Table 2 shows the relative species richness among the islands' dominant plant communities. It should be noted however that the use of point-line intercept transects typically underestimates the actual number of species present in an area or plant community. This is because point intercept monitoring often misses the infrequent or rare plants that may occur in an area, a significant flaw (Dethier et al. 1993). In addition, species richness can be misleading in that even though an area or community may have a high number of species present, if only 1 or 2 species dominate the area then the biodiversity of the area or community is low. Another critique of species richness is that up to a certain point the number of species recorded in an area increases with the number of samples taken, thus it can be sample dependent.

Table 2. Vegetation species richness for all 5 islands at Channel Islands National Park. ANI=Anacapa Island, SBI=Santa Barbara Island, SMI=San Miguel Island, SCI=Santa Cruz Island, SRI=Santa Rosa Island.

Vegetation Community	ANI	SBI	SMI	SCI	SRI
Baccharis scrub	–	–	3	8	43
Barren	3	–	–	–	–
Boxthorn scrub	–	18	–	–	–
Caliche scrub	–	–	6	–	20
Coastal bluff scrub	–	–	–	9	10
Coastal marsh	–	–	–	–	12
Coastal sage scrub	14	–	–	23	49
Coastal scrub	9	–	26	–	–
Coastal strand	–	–	–	–	8
Coreopsis scrub	18	15	20	–	–
Fennel	–	–	–	5	–
Herbaceous scrub	4	–	–	15	–
Island chaparral	–	–	8	20	22
Lupine scrub	–	–	–	–	15

Table 2 (continued). Vegetation species richness for all 5 islands at Channel Islands National Park. ANI=Anacapa Island, SBI=Santa Barbara Island, SMI=San Miguel Island, SCI=Santa Cruz Island, SRI=Santa Rosa Island.

Vegetation Community	ANI	SBI	SMI	SCI	SRI
Lynothamnus scrub	–	–	–	–	12
Mixed woodland	–	–	–	14	23
Oak woodland	–	–	–	8	2
Riparian	–	–	–	10	26
Santa Cruz Island Pine	–	–	–	–	8
Seablite scrub	–	9	–	–	–
Seacliff scrub	–	1	–	–	–
Shrub Savannah	–	–	–	6	–
Torrey Pine woodland	–	–	–	–	22
Valley/foothill grassland	21	21	19	54	62

Species Evenness

Species evenness is a measure of how different the abundances of the species in a community are from each other (Smith and Wilson 1996). It is a way to evaluate the relative dominance between the species present with the idea that evenness is highest when a community is not dominated by a few species of very high abundance, or equivalently that all species have an equal abundance (Magurran and McGill 2011). For instance, if there were 3 species within a plant community but there were 100 plants of species X and only 15 and 10 plants of species Y and J respectively then the community would not be very even. However, if the plant community had 50 plants of species X, and 45 of species Y and 52 of species J, it would be considered to be fairly even. While species evenness is highly important in helping to evaluate diversity, it does not reflect how many species may be present within the area or community that is being measured. The evenness of a community or area can be represented by the Shannon Evenness Index equation:

$$E_H = H / H_{max}$$

where H is the number derived from the Shannon diversity index and H_{max} is the maximum possible value of H (i.e. if every species were equally likely). E_H falls between 0 and 1 with lower values representing samples or populations with lower evenness. Species evenness values by vegetation community and island are provided in Table 3.

Table 3. Shannon evenness index values in 2015 by vegetation community and by island at Channel Islands National Park. ANI=Anacapa Island, SBI=Santa Barbara Island, SMI=San Miguel Island, SCI=Santa Cruz Island, SRI=Santa Rosa Island.

Vegetation Community	ANI	SBI	SMI	SCI	SRI
Baccharis scrub	–	–	0.46	0.58	0.58
Barren	0.85	–	–	–	–
Boxthorn scrub	–	0.69	–	–	–
Caliche scrub	–	–	0.76	–	0.74
Coastal bluff scrub	–	–	–	0.63	0.58
Coastal marsh	–	–	–	–	0.81
Coastal sage scrub	0.72	–	–	0.51	0.56
Coastal scrub	0.67	–	0.67	–	–
Coastal strand	–	–	–	–	0.74
Coreopsis scrub	0.81	0.78	0.70	–	–
Fennel	–	–	–	0.74	–
Herbaceous scrub	0.57	–	–	0.66	–
Island chaparral	–	–	0.55	0.53	0.60
Lupine scrub	–	–	–	–	0.70
Lynothamnus scrub	–	–	–	–	0.51
Mixed woodland	–	–	–	0.75	0.71
Oak woodland	–	–	–	0.50	0.41
Riparian	–	–	–	0.74	0.62
Santa Cruz Island Pine	–	–	–	–	0.50
Seablite scrub	–	0.60	–	–	–
Seacliff scrub	–	0.00	–	–	–
Shrub Savannah	–	–	–	0.72	–
Torrey Pine woodland	–	–	–	–	0.44
Valley/foothill grassland	0.70	0.81	0.69	0.64	0.60

Species Diversity

Species diversity is the function of the number of species (richness) in an area or community and their relative abundance (evenness) to one another within that area or community (Hulbert 1971). Often diversity is represented by the Shannon Index or Shannon-Wiener Index (Spellerberg and

Fedor 2003), or the Shannon diversity index (SDI). The Shannon index is represented by the equation:

$$H = - \sum_{i=1}^r P_i \ln P_i$$

(where P_i represents the portion of species i to all species within the population or sample). As the evenness of the sample declines (one species is largely dominant) the index approaches zero and a sample consisting of only one species would be zero. SDI numbers between 2 and 3 reflect communities or populations that are considered moderately diverse.

Shannon diversity values for 2015 are presented in Table 4.

Table 4. Shannon diversity index values for 2015 by vegetation community and island at Channel Islands National Park. ANI=Anacapa Island, SBI=Santa Barbara Island, SMI=San Miguel Island, SCI=Santa Cruz Island, SRI=Santa Rosa Island.

Vegetation Community	ANI	SBI	SMI	SCI	SRI
Baccharis scrub	–	–	0.50	1.20	2.18
Barren	0.94	–	–	–	–
Boxthorn scrub	–	2.06	–	–	–
Caliche scrub	–	–	1.49	–	2.19
Coastal bluff scrub	–	–	–	1.38	1.33
Coastal marsh	–	–	–	–	2.02
Coastal sage scrub	1.94	–	–	1.60	2.18
Coastal scrub	1.47	–	2.18	–	–
Coastal strand	–	–	–	–	1.55
Coreopsis scrub	2.38	2.12	2.07	–	–
Fennel	–	–	–	1.19	–
Herbaceous scrub	0.79	–	–	1.92	–
Island chaparral	–	–	1.15	1.68	1.95
Lupine scrub	–	–	–	–	1.89
Lynothamnus scrub	–	–	–	–	1.35
Mixed woodland	–	–	–	2.09	2.31
Oak woodland	–	–	–	1.10	0.67
Riparian	–	–	–	1.70	2.03
Santa Cruz Island Pine	–	–	–	–	1.20

Table 4 (continued). Shannon diversity index values for 2015 by vegetation community and island at Channel Islands National Park. ANI=Anacapa Island, SBI=Santa Barbara Island, SMI=San Miguel Island, SCI=Santa Cruz Island, SRI=Santa Rosa Island.

Vegetation Community	ANI	SBI	SMI	SCI	SRI
Seablite scrub	–	1.37	–	–	–
Seacliff scrub	–	0.00	–	–	–
Shrub Savannah	–	–	–	1.40	–
Torrey Pine woodland	–	–	–	–	1.39
Valley/foothill grassland	2.17	2.46	2.02	2.61	2.51

Percent Species Captured

The point-line intercept method minimizes bias between observers as the data merely reflect whether a species occurred on each point along a transect and is not dependent on an estimation of percent cover for a particular species. This method, however tends to capture only the more common species present in a particular community or sample. One technique employed to minimize this deficiency is to record those species that were not “hit” along the transect line, but occur in a 1- meter plot along the length of the 30-meter transect line. Although those data were collected, they have not been tabulated and are not presented here. Another measure to ascertain the percentage of species missed by the point-line intercept method is to examine the proportion of species recorded on transects against all species known to occur on that island (Table 5). It is important to note with this approach that the majority of Santa Cruz Island is not included in the vegetation monitoring program, with some of its communities not being sampled at all.

Table 5. Percent species captured on sampling transects in 2015 by island at Channel Islands National Park.

Parameter	ANI	SBI	SMI	SCI*	SRI
Number of species hit on transects	37	30	38	85	162
Number of species known to occur	266	130	285	661	528
Percent species hit	14%	23%	13%	13%	31%

*Majority of SCI is not monitored by the park

Indicator Plant Species

In the network protocol (Tiszler et al. 2016), individual plant species were identified as important status indicators for certain plant communities. They were chosen based on their importance in defining community structure or for what was believed to be their ability to provide inference to community function. These species were also seen to “represent varying ranges of environmental adaptation and their co-occurrence is a response to the unique conditions in each park”. The tracking

of these species should provide greater insight into the overall health of the native plant communities over time.

Some species were common to all three parks within the Mediterranean Coast Network (CHIS, CABR, and SAMO) while others were shared by only 2 parks (CHIS and CBR or CHIS and SAMO), or were unique to individual parks (CHIS) (Table 6). The selection of these species may change as our understanding of them increases and individual park interests change over time. For CHIS, 12 plant species were selected as indicator species (Table 6).

Table 6. Network indicator species.

Species	Community	Network Distribution
<i>Adenostoma fasciculatum</i> *	chaparral	CHIS, CABR, SAMO
<i>Arctostaphylos confertiflora</i>	chaparral	CHIS
<i>Quercus pacifica</i>	chaparral	CHIS
<i>Artemisia californica</i>	coastal sage scrub	CHIS, CABR, SAMO
<i>Baccharis pilularis</i>	coastal sage scrub	CHIS
<i>Lycium californicum</i>	coastal sage scrub	CHIS, CABR
<i>Stipa lepida</i>	coastal sage scrub	CHIS, CABR, SAMO
<i>Stipa pulchra</i>	coastal sage scrub	CHIS, CABR, SAMO
<i>Leptosyne gigantea</i>	coastal sage scrub	CHIS, SAMO
<i>Isocoma menziesii</i>	coastal sage scrub	CHIS
<i>Suaeda taxifolia</i>	coastal sage scrub	CHIS
<i>Rhus integrifolia</i>	transitional/ubiquitous	CHIS, CABR

*This also includes *A. fasciculatum* var. *prostratum* which is more commonly found on CHIS.

All CHIS indicator species occurred on one or more of the transects read in 2015. Except for *A. confertiflora*, all occur on at least 2 islands within the park (*A. confertiflora* only occurs on SRI) although their abundance can vary. *A. californica*, *L. gigantea*, and *B. pilularis* are the more common of the species (with regards to the number of islands on which they are present) and occur on all 5 park islands. Table 7 presents the mean number of hits per transect and, because these numbers can be sample dependent, the number of transects that the indicator species occurred on within the park. The table also shows the maximum and minimum mean hits for the indicator species that have occurred since data collection began in 1984. Although there will be inter-annual fluctuation in the amount of cover for these indicator species, ideally, we want them to remain stable or increase over time. In addition, the identification of the native grasses *Stipa lepida* and *Stipa pulchra* have been problematic to distinguish from each other over the course of the monitoring program. The data shown for those 2 species should be evaluated accordingly.

Table 7. Mean number of hits per transect/# of transects during point-intercept sampling for indicator species at Channel Islands National Park in 2015, with maximum and minimum counts obtained from 1984 to 2015.*

Indicator species	2015	1984–2015 Max	1984–2015 Min
<i>Adenostomma fasciculatum</i> (var. <i>fasciculatum/prostratum</i>)	23.0/5	46.5/46	22.8/5
<i>Arctostaphylos confertiflora</i>	13.6/5	15.2/5	2.0/4
<i>Quercus pacifica</i>	22.0/22	36.2/16	16.7/21
<i>Artemisa californica</i>	14.1/34	40.0/4	14.1/34
<i>Baccharis pilularis</i>	7.0/28	19.8/22	5.8/33
<i>Lycium californicum</i>	18.3/3	24.0/1	4.0/2
<i>Stipa lepida</i>	6.0/1	40.0/2	2.0/2
<i>Stipa pulchra</i>	14.5/32	44.4/14	10.0/40
<i>Leptosyne gigantea</i>	7.6/10	33.5/13	7.6/10
<i>Isocoma menziesii</i>	8.4/15	25.9/12	5.3/3
<i>Suaeda taxifolia</i>	6.4/5	44.9/7	2.7/3
<i>Rhus integrifolia</i>	11.2/5	28.0/2	2.0/1

*Note: Over time the number of transects read has increased. This could have some influence on the values presented in the table.

Discussion

No long-term trends can be discerned when presenting only a single year of data; however, some general comparisons can be made between the islands and vegetation communities. For instance, when looking at percent cover of native versus non-native species, the smaller islands (ANI and SBI) generally had greater cover of non-native plant species within their plant communities. For the larger islands, native cover exceeded non-native cover except for valley foothill grassland on SRI and SMI.

For the indicator species, all show declines in cover from recorded highs but this is not unexpected given the current dry spell. On a positive note, although one species (*Q. pacifica*) has fallen to a previous recorded low in terms of the number of hits, none have declined below their recorded lows.

Since the creation of the Channel Islands National Park, its staff has worked to eliminate the non-native animals that were introduced to the islands within the park. Many of these animals such as rabbits, goats, pigs, cattle, sheep, deer, and elk altered the composition of many island plant communities and caused impacts such as accelerated erosion, trail formation, and nutrient loading in riparian areas. With the elimination of these animals the island plants communities are now recovering and changing. The tracking of their response is just one of the goals of the National Park Service's Inventorying and Monitoring program.

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The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525