NATIVE SHRUB RECOVERY IN NONNATIVE ANNUAL GRASSLANDS, CALIFORNIA CHANNEL ISLANDS

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RESEARCH NOTE

Grazing by introduced herbivores on the California Channel Islands converted much of the native Mediterranean scrub to grasslands dominated by a few Eurasian annual genera (Dunkle 1950; Philbrick 1979; Cole and Liu 1994). Remaining native woody communities are fragmented, and many are reduced to isolated patches on steep slopes and ravines. Introduced herbivores are being removed from the islands, and restoration of native flora and fauna is a common management goal. Management agencies would benefit from an ability to predict where native plant community recovery is most likely to require active intervention and what type of intervention is most effective.

Studies of disturbed Mediterranean systems invaded by nonnative annual grasses show variable recovery of native species following release from grazing (Kirkpatrick and Hutchinson 1980; Hobbs 1983; Eliason and Allen 1997). Why native shrub species successfully invade some annual grasslands while other shrub-grass boundaries remain static is not well understood. Philbrick (1979), Hobbs (1983), and others suggest that soil texture and water-holding capacity are factors, noting the apparent affinity of annual grasslands for deep, clayey soils and of native shrubs for coarse-grained substrates. Halvorson et al. (1997, unpublished data) found native shrub cover on San Nicolas Island correlated with sandy, low nutrient, and low cation exchange capacity (CEC) soils while annual grasslands are on high clay, nutrient, and CEC soils. However, correlations were less significant at sites on other islands where soil texture is less variable.

We investigated biological and physical factors to characterize change across the shrubland-grassland boundary, and determine if biological or physical gradients exist which may affect the success of native shrub invasion into grassland. We were also interested in the extent to which native shrub cover influences native plant biodiversity. Five study sites where shrublands grade into grasslands were selected on four Channel Islands. Shrub communities at the sites are dominated by *Isocoma menziesii* on San Nicolas and San Miguel Islands and by *Lycium californicum* on Santa Barbara Island. The two sites on Santa Rosa Island include *Adenostoma fasciculatum* chaparral and *Artemisia californica* scrub. Grasslands at the sites are dominated by annual species of *Avena*, *Bromus* and *Vulpia*.

Three replicate sets of five equally-spaced, 30-m transects were established parallel to the shrubland-grassland boundary at each site, spanning the transition from shrubland to grassland. Slope, aspect, substrate characteristics and line-intercept relative cover were recorded for each transect. Shrub density and demography data, mean litter depth, and soil unconfined compressive strength (estimated by pocket penetrometer) were collected from five randomly located 2 m^2 plots on each transect. Soil samples were collected from the shrubland, grassland, and center transects of each 5-transect replicate set. Samples were analyzed for grain size distribution, moisture retention, pH, electrical conductivity, nutrients, organic matter, major ions, exchangeable cations, CEC, and sodium adsorption ratio. Relative cover, species richness, and Shannon-Wiener diversity indices were calculated for each transect. Cover and physical data were ordinated using nonmetric multidimensional scaling, and Pearson's correlations were calculated between dominant species cover and physical data. Data were analyzed to show whether patterns of change in biological and physical factors were correlated across the gradient, and whether correlations were consistent from site to site.

Results show that species richness and diversity generally decrease from shrubland to grassland at all sites. The decline in richness is greatest among native species but also occurs in nonnative species. Native shrub recruitment varies dramatically among the study sites. Physical data explain few of the differences in species cover and shrub density among sites. Litter cover, litter depth, and soil compressive strength increase across the gradient from shrubland to grassland, showing the most consistent correlations with changes in species cover of any physical factors. Soil chemistry shows some within-site trends across the gradient. However, trends are inconsistent and sometimes contradictory among sites. Attempts to promote native plant restoration through soil amendments would require site-specific evaluation.

Species reproductive strategies and community structure could explain the differences in shrub recovery among

the sites. Recruitment of shrubs into grassland is occurring at the two *I. menziesii*-dominated sites, where the dominant and subdominant shrubs form an open canopy and are composites with abundant, wind-dispersed seeds. Little or no recruitment is evident at the *L. californicum* and *A. fasciculatum* sites, where the dominant species form prostrate, nearly closed canopies and have fruits with limited dispersal ability. Results suggest that community structure and reproductive strategies and growth habits of the dominant shrubs should be primary considerations in prioritizing and planning native shrub community restoration.

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