

STRUCTURE OF A HAWAIIAN DRY MONTANE GRASSLAND

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ABSTRACT

The objective of this study was to quantitatively describe the structure of a Hawaiian dry montane grassland. The study site is on the U. S. Army Pohakuloa Training Area, Hawaii, Hawaii. Climate is cool tropical with an annual precipitation of 374 mm and an annual temperature of 13 C. Mean relative basal vegetative cover was 7% in the grassland. The dominant species was a rhizomatous, native lovegrass (*Eragrostis atropioides*) with a relative basal cover of 3%. Bare ground, rock, and litter accounted for basal cover of 17%, 24%, and 40%, respectively. Mean herbaceous aerial cover was 45%, and lovegrass was the dominant species. Aweoweo (*Chenopodium oahuense*) and aalii (*Dodonaea viscosa*) were the densest woody plants. Fountain grass (*Pennisetum setaceum*) and other alien “weedy” species are invading disturbed areas caused by military training in the grassland.

KEYWORDS

Ecosystem, structure, grassland, Hawaii, lovegrass (*Eragrostis atropioides*), fountain grass (*Pennisetum setaceum*)

INTRODUCTION

Tropical dry plant communities are some of the most endangered ecosystems in the world (Janzen 1988). Hawaiian tropical dry ecosystems are particularly unique and known to harbor a great number of endangered species (Castillo 1996). Major threats to Hawaiian ecosystems are competition from invading plant species, grazing by feral animals, and wildfire (Cuddihy & Stone 1990).

Grasslands are one of the rarest ecosystems in Hawaii and constitute only 12% of all plant communities in the islands (Gagne & Cuddihy 1990). The only arid upland grassland in the islands is found in the dry (400-500 mm annual precipitation) montane (500-2300 m) ecological belt on the island of Hawaii. This grassland has been classified as the Lovegrass/Mountain Pili (*Eragrostis/Panicum*) vegetation type (Gagne & Cuddihy 1990). Much of the grassland has been heavily grazed by domestic livestock or feral animals, and monocultures of introduced grasses have replaced most of the native community.

One of the more pristine remnants of this plant community occurs in the saddle region between Mauna Kea and Mauna Loa. About 1000 ha of this grassland have been protected within the boundaries of the U.S. Army's Pohakuloa Training Area (PTA), Hawaii. The objective of this study was to quantitatively describe the ecosystem structure of this unique grassland.

STUDY SITE AND METHODS

PTA is a 47,000 ha area located near the center of the island of Hawaii (Figure 1). Castillo et al. (1996) have delineated 24 major plant communities on the installation, one of which is a relict dry montane grassland dominated by lovegrass (*Eragrostis*). Elevation of the grassland varies from 1600 to 1900 m. Average annual precipitation is 374 mm. Average annual temperature is 12.8 C.

Over 350 permanent U.S. Army Land Condition-Trend Analysis Program (LCTA) field plots have been used to gather ecological baseline information on the installation. Plots were located in a stratified random fashion based on vegetation, site condition and

soil series (Diersing et al. 1992, Shaw et al. 1990). Eleven of these plots fell within the lovegrass grassland and were used to describe the vegetation. The LCTA plot consists of a 100-m line transect. The point-quadrat method (PQM) is used to estimate ground and canopy cover and botanical species composition. Ground cover categories are: basal cover by plant species, prostrate cover by species, litter, dead wood, rock, and bare ground. Canopy cover by species also is measured. Woody plant densities are determined using a belt transect placed 3 m on each site of the 100-m line transect (600 sq m).

RESULTS AND DISCUSSION

Bare ground (17%), rock (24%), and gravel (5%) accounted for 46% of the total ground cover within the lovegrass community (Figure 2a). Litter, prostrate plant cover, and basal cover by plant species occupied 24%, 6%, and 6%, respectively. Lovegrass was the dominant species with a basal cover of nearly 3%. Weedy species, such as ripgut brome (*Bromus rigidus*), needlegrass (*Stipa cernua*), hawk's beard (*Crepis capillaris*), daisy (*Galinsoga parviflora*), storksbill (*Erodium cicutarium*), peppergrass (*Lepidum hyssopifolium*), bur clover (*Medicago lupulina*) and sow thistle (*Sonchus oleraceus*), composed the majority of remaining plant basal cover.

The lovegrass grassland had an average canopy cover of 45%. Canopy height was typically less than 1 m. Obviously, lovegrass constituted the majority (52%) of the canopy cover (Figure 2b). Other species with substantial canopy cover were peppergrass (7%), fountain grass (4%), stinkweed (*Tagetes minuta*)(3%), telegraph weed (*Heterotheca grandiflora*)(3%), and bluebell (*Wahlenbergia marginata*)(5%). Additional species found in the canopy included cheese weed (*Malva parviflora*), crown-beard (*Verbesina encelioides*), heupueo (*Trisetum glomeratum*), vervain (*Verbena litoralis*), and natal grass (*Rhynchelytrum repens*). Canopy cover of shrubby species amounted to only 9% in the lovegrass community. Aweoweo (*Chenopodium oahuense*) was the dominant shrub in the canopy.

Shrub density in the lovegrass community amounted to 4800 stems/ha. Dominant species were aweoweo (4575 stems/ha), aalii (156 stems/ha), akoko (*Chamaesyce olowaluana*)(35 stems/ha), mamane (*Sophora chrysophylla*)(20 stems/ha) and naio (*Myoporum sandwicensis*)(18 stems/ha). Shrub density in the fountain grass area was only 175 stems/ha. This low density was probably due to the repeated burning and hotter fires in the fountain grass community.

The grassland community is dominated by a native, perennial, rhizomatous lovegrass species. Interstitial species are typically introduced “weedy” plants. The large amount of “weeds” probably is the result of military activities in the area. The northern part of the installation, which is near the cantonment and airfield, receives the most training impacts. Infantry maneuvers, bivouac sites and artillery firing positions are all located in and around the grassland. Military disturbance increases the amount of bare ground, decreases competition with the native perennial plants, and allows for the invasion of alien “weedy” species. Much of the grassland, however, is still intact and pristine. The lack of mountain pili (*Panicum tenuifloium*) in the grassland on the installation is problematic. While

it occasionally is seen in the area, mountain pili is never abundant. The lack of this co-dominant is contradictory to a qualitative description (Gagne & Cuddihy 1990) of the community. Fountain grass is invading the native grassland, and it is known to form a monoculture if not controlled. Wildfire, which typically occurs much more frequently on military installations, is thought to be a major factor in the spread and maintenance of fountain grass.

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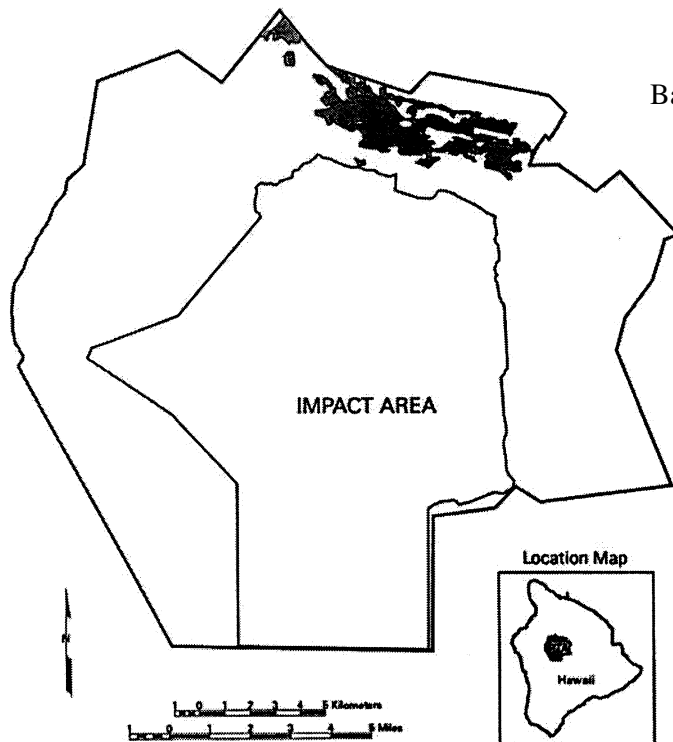
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Figure 1

Distribution of the relict lovegrass (*Eragrostis*) grassland (shaded area) on the U.S. Army Pohakuloa Training Area (PTA), Hawaii, Hawaii (Castillo et al. 1996). Insert map shows the location of the installation on the island of Hawaii.



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Figure 2

Quantitative vegetative parameters from the lovegrass (*Eragrostis*) grassland on U.S. Army Pohakuloa Training Area, Hawaii. a. Mean relative ground cover categories. B. Mean relative canopy cover categories.

