

# COASTAL BLUFF VEGETATION CHANGE OVER 25 YEARS ON SANTA CRUZ ISLAND

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## ABSTRACT

Distribution of coastal bluff vegetation was monitored by continuous line transect over a 25 year period on Fraser Point, Santa Cruz Island. Introduced annual species (such as *Mesembryanthemum crystallinum* L.) were abundant after periods of disturbance and or drought. Native annual species (such as *Lasthenia californica* Lindley.) were abundant after periods of high late autumn and winter rainfall. *Dudleya nesiotica* (Moran) Moran, a rare island endemic, persisted in the same section of the transect over the entire course of the study. The introduced perennial *Atriplex semibaccata* R.Br. was selectively removed by pig rooting. The native perennial *Frankenia salina* (Molina) I. M. Johnston expanded its range after pig rooting. Once a species occupied a site, it usually continued to occupy that site due to high levels of seed deposition or vegetative reproduction until unusual meteorological events triggered its replacement. Rapid replacements of one annual species by another, occasionally in one season, were preceded by meteorological events which suppressed one species and favored the other. Summer rainfall accompanied by high temperatures followed by warm fall rains favored germination of *Mesembryanthemum* and simultaneously inhibited germination of *Lasthenia*. Rainless summers followed by cold fall rains favored *Lasthenia* germination and inhibited *Mesembryanthemum* germination. Establishment of vegetation patterns, or shifts in those patterns, are rare events triggered by unusual weather.

**Keywords:** Vegetation change, coastal bluff, *Mesembryanthemum crystallinum* L., *Lasthenia californica* Lindley, germination, dormancy, establishment, maintenance.

## RESEARCH NOTE

This study documents change in the distribution of annual and perennial plant species on a coastal bluff over a 25 year period. The distribution patterns were documented annually using a 250 m continuous line transect on Fraser Point, Santa Cruz Island, Santa Barbara County, California. The investigation was designed to identify the processes which lead to the establishment of a vegetation pattern and the maintenance of that pattern over time. During the course of the study, it became clear that establishment and

maintenance of a pattern are not controlled by the same environmental or biotic conditions. Establishment of a new vegetative pattern was observed several times during the course of this investigation. Establishment events are rare and typically occur in response to extreme or unusual weather conditions. Loss of dominance by one species and replacement by another is the basis of the establishment of a vegetation pattern. Such replacement occurs in annual plants when the germination requirements for one species are met while germination is simultaneously inhibited for the previously dominant species. Once it is established, maintenance of a vegetation pattern usually continues for several to many years. Gradual replacement of one species by another (succession) was not observed in this vegetation. Each species responded to the meteorological and biotic conditions in a unique way. Groups of species did not respond simultaneously to changes in environmental conditions.

Maintenance of a vegetation pattern is controlled by several factors. In the annual species, a large seed bank in the soil can promote continued dominance by the species that produced it. Soil samples in the upper centimeter underneath *Mesembryanthemum crystallinum* L. (Nomenclature according to Junak et al. (1995) can consist of 90% seed of this species by weight. This large bank of long-lived seeds (at least 25 years), allows the species to reestablish whenever conditions are favorable. Germination of the non-native *Mesembryanthemum* is favored by any form of disturbance which reduces standing biomass: grazing, trails, roads, drought. Fire not only removes biomass, it also breaks dormancy in seeds with hard or semi-hard seedcoats, such as the seed of *Mesembryanthemum*. Areas in Baja California, Mexico, which are dry farmed and then burned, may develop continuous cover of *Mesembryanthemum crystallinum*. Dominance by *Mesembryanthemum* is maintained in part by the release of salt from the dried dead plants into the soil beneath them (Vivrette and Muller 1977). Heavy rains will leach this accumulated salt and under the right conditions, allow other species to germinate and grow in areas previously occupied by *Mesembryanthemum*. *Mesembryanthemum* seed also must be leached by fresh water before it will germinate (Vivrette 1980). After leaching, it germinates best at warm temperatures (20 to 30°C). Since

leaching can occur throughout the rainy season, there can be several waves of germination throughout the fall and spring.

The native *Lasthenia californica* Lindley germinates best under cool conditions (5 to 15°C). *Lasthenia* can germinate over a broad range of soil salinities (Vivrette 1980). If the seed is exposed to warm, moist conditions (summer rain followed by high temperatures), a strong secondary dormancy is initiated. The seed is then less likely to germinate in subsequent rains, regardless of the temperature. This enforced dormancy may increase the longevity of the seed in the field. Under constant dry, cool conditions in the laboratory, the seed of *Lasthenia* is short lived (1 to 2 years). In the field, *Lasthenia* seed can remain viable up to 10 years. *Lasthenia* will replace *Mesembryanthemum* when there is no summer rain, and the first rains in the fall are cool. Once there is a standing biomass of *Lasthenia*, *Mesembryanthemum* is less likely to germinate and is unable to grow in the low light conditions. *Mesembryanthemum* will replace *Lasthenia* when a salt-leaching summer rain is followed by warm fall rains, standing biomass is low and there are bare areas of soil exposed, especially after a drought or disturbance.

The distribution of perennials changes more slowly. *Salicornia subterminalis* Parish was reduced after a series of freezing nights. The introduced perennial *Atriplex semibaccata* R.Br. was selectively removed by pig rooting. The upper parts of the plant were pushed aside, and the roots were eaten. The disturbance caused by the pigs unearthed

many *Frankenia salina* (Molina) I. M. Johnston stems. New plants grew from these stems, expanding the coverage by this species. The rare island endemic, *Dudleya nesiotica* (Moran) Moran, persisted in the same area for the entire course of the study. The individual plants were larger or smaller depending on the rainfall, but the position of the *Dudleya* patches along the transect remained the same. This suggests that there may be some site-specific condition which favors *Dudleya*.

Establishment of a new vegetation pattern is an unusual event controlled by weather conditions. Once established, a vegetation pattern usually is maintained for several to many years.

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