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ABSTRACT: In 1 decade, more than 10^7 seeds/ha were dispersed by two species of *Arctostaphylos* in a stand of chaparral. At the end of this decade no significant change in the size of the soil seed bank was detected for either species. Previous studies suggest that predation by ground-dwelling rodents limits the accumulation of seeds in the soil.

INTRODUCTION

Many plant species have seedling recruitment restricted to disturbed sites. In some cases diaspores are short-lived and colonization is dependent upon dispersal onto sites following disturbance, e.g., fireweed *Epilobium angustifolium*. In other species diaspores lie dormant in the soil until germination is cued by disturbance, e.g., pin cherry *Prunus pennsylvanica*.

This latter pattern is quite prominent in the fire-prone chaparral of semiarid parts of California. The majority of species in the two largest shrub genera, *Arctostaphylos* and *Ceanothus*, are reproductively specialized to disturbance—in particular, fire. Throughout their relatively long life span, these species produce long-lived seeds on a more or less biennial basis. Diaspore characteristics suggest that the bulk of their seed crops are not widely dispersed. Since germination is dependent upon heat shock from fire, or a chemical stimulus from charred wood, seeds accumulate in the soil beneath the parent plants. These shrubs are typically killed by wildfires but the populations are replaced with a pulse of seedling recruitment. Seedlings establish from seed stored in the soil and few seedlings establish after the 1st postfire year. Soil seed banks are clearly a critical factor in the reproduction of these species as well as for species in other vegetation types.

Demographic studies have shown much variation in the size of soil seed banks and in the extent of annual variation (Harper, 1977; Cook, 1980). Much less is known about the dynamics of seed bank accretion over time, in particular for long-lived species. With respect to the example described above, a previous study of chaparral shrubs found that there were many more seeds produced and dispersed in a single good year of fruit production than were present in the soil seed bank (Keeley, 1977). Postdispersal seed predation was implicated as a major factor affecting the size of seed banks in the soil (Keeley and Hayes, 1976). One conclusion from these studies is that the soil seed bank is quite dynamic on a short-term annual basis. The question addressed here is what are the long-term demographic patterns in seed accumulation in soils. Soil seed banks of two chaparral shrubs were quantified in 1972 (data from Keeley, 1977) and then 10 years later in 1982. During this period the size of seed crops dispersed annually were measured.

STUDY SITE AND METHODS

The study site was a 1-ha, mature, chaparral stand in eastern San Diego Co., California, that was codominated by *Arctostaphylos glauca* and *A. glandulosa*; it is the same site as studied in Keeley (1977). Each year from 1972 to 1982 at the time of dispersal, fruits/m² of areal cover were counted on 50 individuals of each species. Based on the areal cover and seeds per fruit, the total seed production dispersed in the stand each year was calculated. Soil and duff were collected from within a square frame with an inside dimension of 28.5 cm (= 0.0812 m²) and to a depth of 15 cm. Seeds were separated by flotation. Germination is not a reliable means of determining viability since germination is dependent upon receiving the appropriate fire-related stimulus. Viability was established with the tetrazolium test.

RESULTS AND DISCUSSION

Annual fruit production by *Arctostaphylos glauca* and *A. glandulosa* was variable between 1972 and 1982 (Fig. 1) The number of seeds per fruit was estimated to be 5.6 for *A. glauca* and 6.4 for *A. glandulosa* (Keeley, 1977). Thus, the number of seeds estimated to be dispersed in this stand during the decade was 22.5×10^6 /ha for *A. glauca* and 89.9×10^6 /ha for *A. glandulosa*. Between 1972 and 1982 no seedlings of these two species were observed.

Despite the massive input of seeds into the soil, there was no significant change in the size of the soil seed bank (Table 1). Deterioration of seeds in the soil is not a likely explanation for the fate of the seed crops. Although viability may be lost, the seeds remain in the soil for decades due to the resistance of the resinous endocarp of the diaspore. Postdispersal seed predation however has been shown to account for a substantial proportion of the loss of seeds from the seed bank (Keeley and Hayes, 1976).

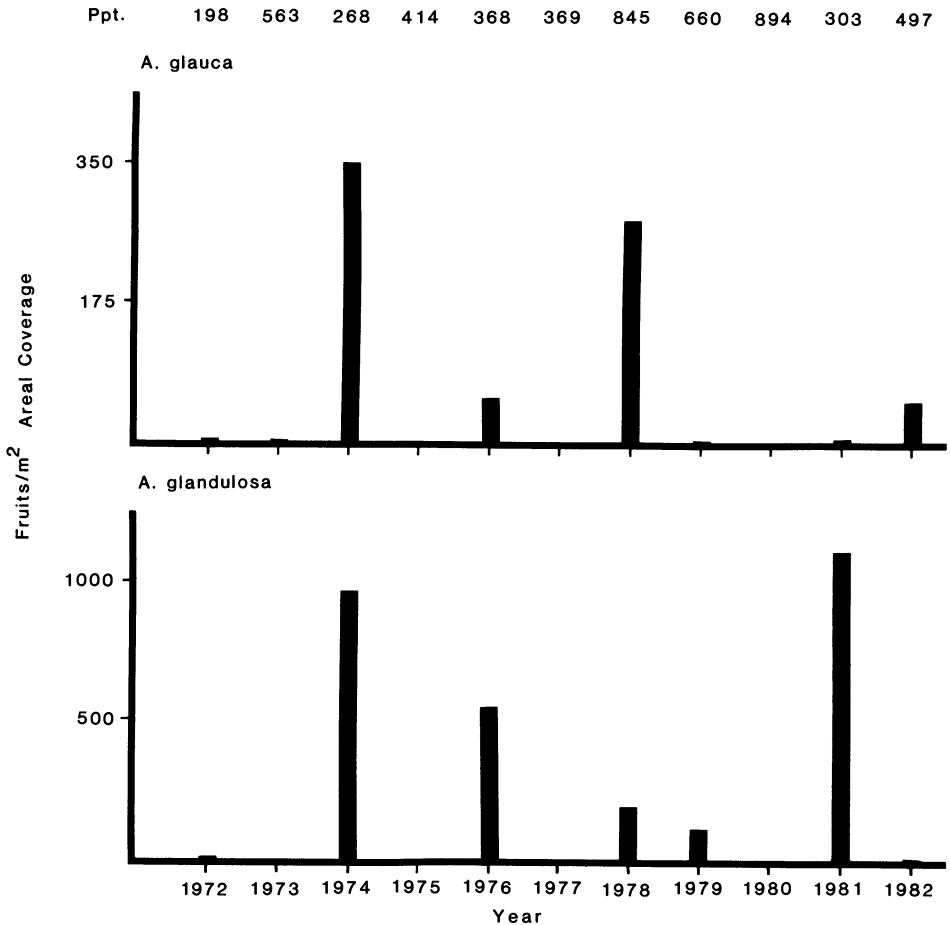


Fig. 1.—Annual fruit production measured prior to dispersal for *Arctostaphylos glauca* and *A. glandulosa* in California chaparral

TABLE 1.—Soil seed banks of *Arctostaphylos glauca* and *A. glandulosa* in 1972 and 1982 in southern California chaparral (comparisons between years were with a two-tailed t-test, $n = 20$). Note, these numbers do not represent the number of diaspores, since the seeds of these species are “packaged” differently; *A. glauca* fruits average 5.6 seeds/fruit coalesced into a single stone whereas *A. glandulosa* fruits average 6.4 seeds/fruit which break apart irregularly into segments with 1 or more seeds (average = 3.8 seeds/segment, Keeley, 1977)

	Seeds/ha						P
	1972			1982			
	\bar{x}	\pm	(SD)	\bar{x}	\pm	(SD)	
<i>A. glauca</i>	346×10^4		(617×10^4)	298×10^4		(380×10^4)	>0.05
<i>A. glandulosa</i>	4116×10^4		(4391×10^4)	3038×10^4		(3271×10^4)	>0.05

Comparison of these species reveals differences in the demography of their seed banks. *Arctostaphylos glauca* produced and dispersed one fourth as many seeds but had only one tenth as many seeds in the seed bank as did *A. glandulosa*. Part of the explanation for this is that the diaspores of the former species are much larger and much more likely to be taken by predators (Keeley and Hayes, 1976). Seed viability, however, is much lower in *A. glandulosa*, with the result that the number of viable seeds per hectare were similar between species: 187×10^4 (1972) to 161×10^4 (1982) for *A. glauca* and 288×10^4 to 212×10^4 for *A. glandulosa*.

During this period, soil seed banks appear to reflect a dynamic system of annual influxes and effluxes.

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ERRATUM

In the article by A. W. Ghent, Tau as an Index of Similarity in Community Comparisons: The Opposite Null Orientations of Contingency and Correlation Tests Vol. 117(1): 221-222 January 1987, the Greek symbol for pi (π) was incorrectly substituted for tau (τ).