In spite of early rains this year, soil seed reserves of annual range plants are still adequate to establish a stand of forage grasses, but the amounts of the various species will be changed.

Early rains alter range forage

James W. Bartolome

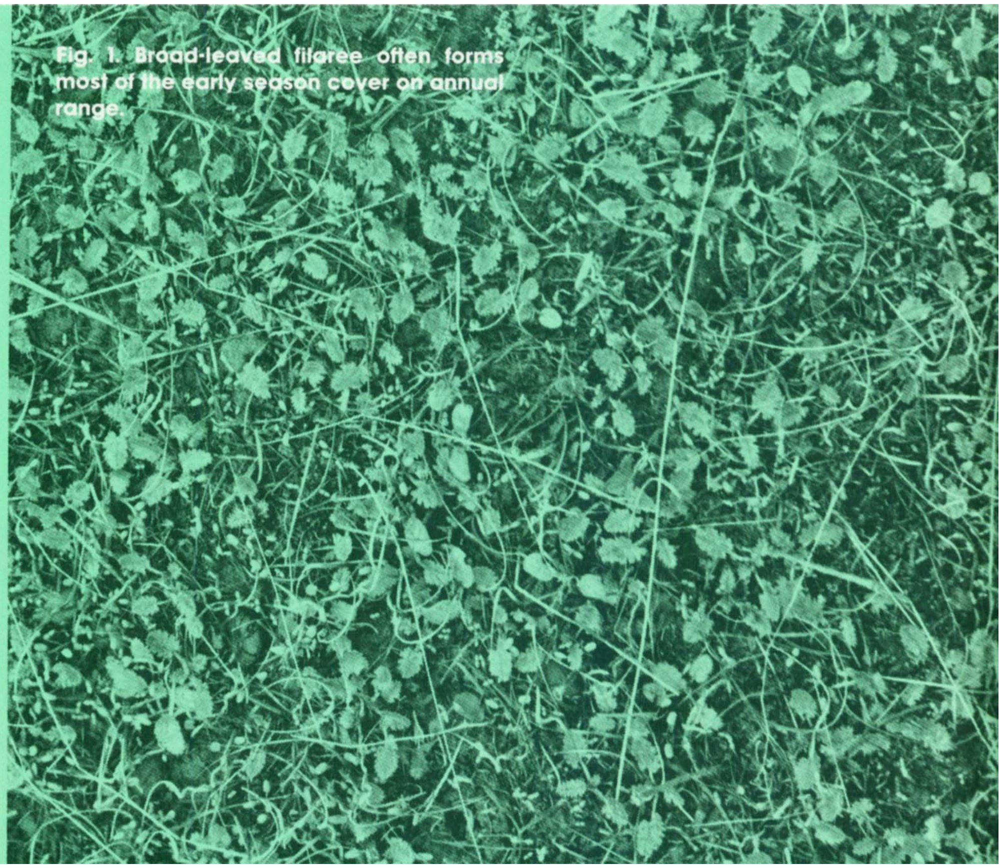

Fig. 1. Broad-leaved filaree often forms most of the early season cover on annual range.

Recent heavy summer rainfall throughout California has resulted in an exceptionally early start to germination of annual range plants. Since annual plants must start anew from seed each year, very early germination raises questions concerning the potential depletion of the soil seed supply, survival of seedlings, and forage productivity.

Data were collected in 1973-74 and 1974-75 at the Hopland Field Station, Mendocino County. Although yearly variability dominates other types of vegetational changes in annual grassland, information already collected helps in understanding even such a potentially unusual year as 1976-77.

An indirect method—germination of seed in soil samples in the greenhouse—gave data on stored seed. Information on seedling establishment and survival was collected from weekly counts of plant density in the field. Results presented here concern five major plant components of the annual range: broad-leaved filaree (*Erodium botrys*), soft chess (*Bromus mollis*), annual fescues (*Festuca* spp.), clovers (*Trifolium* spp.), and silver hairgrass (*Aira caryophyllea*).

Variable establishment patterns of annual range species start from different characteristic quantities of stored soil seed, patterns of soil seed depletion, and seedling establishment. The study-area soil contained total seed densities of 39.37 per square inch (610 per square decimeter) before germination compared with the maximum fall plant density of 16.87 per square inch (262 per square decimeter). The table gives maximum observed seedling densities and available seed for the four species. All species have more seed available than appeared at any one time as seedlings. This difference is most pronounced for annual fescues and silver hairgrass.

The major species in annual grassland show differing patterns of establishment after germination begins. Of the many species of annuals present in the study area, only broad-leaved filaree germinated synchronously with the first rains, reaching near peak density in the first week of the season (figs. 1 and 2). Other species germinated over a longer period; additional seedlings were added to the stand over several weeks, probably in response to additional precipitation. Annual fescues and soft chess, in particular, exhibit this pattern (fig. 3), as do clovers (fig. 2). Delayed germination is most pronounced in silver hairgrass; no seedlings appeared until the fifth week of the season (fig. 2). Silver hairgrass is also the only species with significant additional germination after the first six weeks of the fall season.

Patterns of establishment following germination over the first few weeks of the season determine the botanical composition of the grassland for the rest of the year. Most mortality of individual plants occurs in those first critical weeks, and further reduction in density during the winter and spring is much less important. When the establishment period is extended by very early rains, as in 1976, or by drought after rains initiate germination, botanical composition is altered. Total productivity of established plants, although influenced by the date of growing season onset, depends more on consistent rainfall later in the fall than on the pattern of very early rains.

Although the effect of unseasonable rainfall this year cannot yet be fully assessed, several points are apparent. Soil seed of most species will not be completely depleted by early germination, and soil seed reserves will still be adequate for establishing a stand of forage grasses later in the fall. However, the botanical composition will be changed. In particular, broad-leaved filaree seed has fully germinated in many areas, and thus the presence of significant amounts of

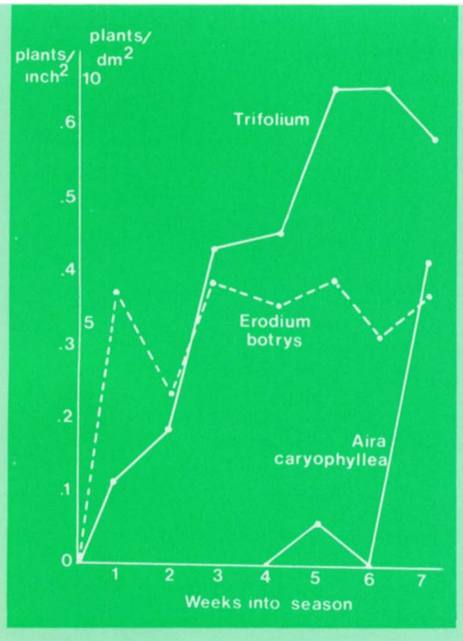

Fig. 2. Changes in density of clovers (Trifolium spp.), broad-leaved filaree (Erodium botrys), and silver hairgrass (Aira caryophyllea) during first seven weeks after rainfall sufficient to start germination. Samples taken in fall, 1973. L.S.D. (p .05) = 0.08 for Trifolium, 0.20 for Erodium, and 0.33 for Aira.

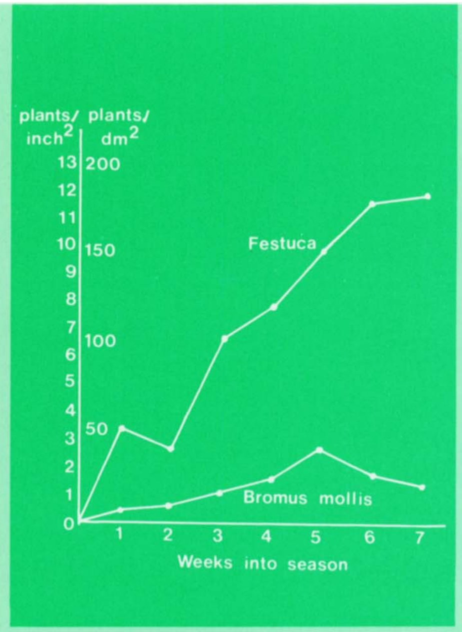

Fig. 3. Changes in density of annual fescues (Festuca spp.) and soft chess (Bromus mollis) during first seven weeks after rainfall sufficient to start germination. Samples taken in fall, 1973. L.S.D. (p .05) = 1.27 for Festuca, 0.52 for Bromus.

this plant in the grassland for the rest of the season depends on rainfall sufficient for survival of existing seedlings. Although many clover, soft chess, and annual fescue seedlings may now be evident and later die, enough seed will remain ungerminated in the soil to fully establish these species with later rains. Silver hairgrass will be unaffected by the early rains. Rainfall is only one of many factors influencing annual rangelands, yet an unusual year like 1976 emphasizes its importance in determining species composition through germination and establishment.

James W. Bartolome is Lecturer and Associate Specialist, Department of Forestry and Conservation, University of California, Berkeley. Research in this report was conducted under California Agricultural Experiment Station Project AES - 2500.

ESTIMATED SEED DENSITY BEFORE FALL RAINS, AND ESTABLISHMENT OF SEEDLINGS SURVIVING AT THE END OF THE FIRST SEVEN WEEKS OF THE GROWING SEASON

	Density*			
	Seeds		Seedlings	
Plant group	Per in²	Per dm²	Per in²	Per dm²
Festuca	17.99 ± 2.04	279.2 ± 32	11.97 ± 0.64	185.8 ± 10
Bromus	3.16 ± 0.55	49.0 ± 8	2.74 ± 0.26	42.5 ± 4
Aira	6.37 ± 1.76	98.9 ± 27	0.42 ± 0.16	6.5 ± 2.5
Erodium	0.67 ± 0.12	10.4 ± 1.9	0.38 ± 0.10	5.9 ± 1.6
Trifolium	0.66 ± 0.12	10.2 ± 1.9	0.64 ± 0.04	9.9 ± 0.62
Total	39.37 ± 3.02	610.0 ± 47	16.87 ± 0.80	261.8 ± 12

*Values are means and 95 percent confidence intervals.

Research in progress

Energy and water in California

A study by University of California water scientists analyzed various potentially feasible alternatives (ground water, surface water, desalinization, wastewater reclamation) in terms of electrical energy required to deliver water to water-short areas, particularly southern California.

The researchers calculate that despite all the electricity it generates, water flowing to southern California through the State Water Project (SWP) is a net user of energy, losing 2,500 to 3,500 kilowatt-hours of electricity for each acre-foot of water delivered. The federally operated Central Valley Project (CVP) produces somewhat more energy than it uses.

Taking the salt out of brackish water or reclaiming municipal wastewater (now severely restricted by health regulations) would cost from 3,000 to 4,000 kilowatt-hours per acre-foot of water. Desalting seawater would cost as much as 20,000 kilowatt-hours per acre-foot.

The report concludes that if water demand in the state during the next century outgrows the ultimate capacity of existing systems, the energy cost for desalting seawater or reclaiming wastewater may turn out to be less than the cost of importing new water supplies from far-distant sources.

New project:

Environmental quality in lakes and streams

Physical and chemical measurements of California lake and stream water have limited value in that they only reflect conditions at the time of sampling. The objective of this new project is to develop the concept of biological indicators as long-term monitors of environmental quality. Selected streams and lakes throughout California will be examined in detail, and a sampling system will be established for biotic collections and measurements of key water chemistry and physical properties. Data will be used to prepare predictive models of the dynamic interactions occurring in lakes and streams. Project leader is V. H. Resh, U.C., Berkeley.