was somewhat less promising at the Kern County location.

Progress of the stem weevil colonies has been less striking. There is less potential for reproduction per plant and as a result, this species appears to be more subdued in reproductive expression due to competition with its own kind when densities are even moderate on a given plant. However, this species too has shown encouraging indications of tolerance to our California conditions and, with more time, it may develop with increasing success.

The greatest hazard facing these tiny weed control experts at present is the passing of the winter period, much of it in the absence of its host plant. During this time the weevils hide out in sheltered spots, but they may move about considerably, dispersing widely from the areas where liberations were made. If the females succeed next spring in locating the new stands of puncture vine, they should be off to a much more promising season of multiplication. They will have a full season of reproduction ahead of them, rather than only the last half, as was the case this first summer in California.

C. B. Huffaker is Entomologist in Biological Control, University of California, Albany; D. W. Ricker is Laboratory Technician in Biological Control, University of California, Riverside; and C. E. Kennett is Laboratory Technician in Biological Control, University of California, Albany.

The foreign exploration, specificity testing, and importation were made in cooperation with the Entomology Research Division, Agriculture Research Service, USDA.

F. E. Skinner assisted with tests conducted in the quarantine facilities.

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William W. Paul.....*Manager*
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141

Aerial Photographs Show Ran

When taken to proper specifications, photos aid in estimating anim

R. N. COLWELL

The volume and species composition of herbage on a range are major factors governing its animal-carrying capacity—the number of animals of any given type that can be grazed on the range for a given period of time. Important differences in range herbage can be detected on small-scale aerial photographs, mainly on the basis of differences in photographic tone or color.

The accuracy of such photo classification of rangeland conditions depends on the scale of the aerial photography, the film-filter combination employed, and the seasonal stage of development of the forage. Viewing the aerial photographs as stereo-pairs (as illustrated here) makes differences even more obvious.

Rangeland conditions in several areas of Contra Costa County were analyzed after they had been classified by aerial photo interpretation. When checked on the ground, areas classified as "A" on the photos included here were found to have a per-acre carrying capacity nearly three times greater than "B" areas and eight times greater than "C" areas. These differences were consistently significant at the 95 per cent level of probability. Total acreage within each of the three photo classifications was also readily determined photogrammetrically. The three classifications were adequate for delineating significant differences, as well as being consistently recognizable on the photos. Outcroppings of rock ("R") were obvious on the photos because herbage was totally absent or unavailable on such areas.

Photo specifications

In developing the photo specifications, photographs of representative areas were taken at four seasonal stages in the development of the vegetation—spring, summer, fall, and winter. On each date, photographs were taken at four scales, ranging from 1:2,000 to 1:20,000. Each of the following film-filter combinations was used: panchromatic film with a light-red (25A) filter; infrared film with a dark-red (89A) filter; aerial ektachrome (color) film with a haze-cutting (HF-2) filter; and camouflage detection (color) film with an orange (15) filter. Ground-level photographs were also taken, using the same film-filter combinations to record range condition details for comparison with aerial photos of the same date.

Timing

The optimum time for aerial photography of rangelands in most of the foothill country of California is in the late spring, according to these tests. At that time, areas of sparse vegetation (including shallow soil) exhibit brown foliage and areas of denser vegetation (including deeper soil) exhibit green foliage. About one month after the first soaking rains in the fall, the new annual vegetation is very apparent on shallow-soil areas but is still obscured by ungrazed vegetation on the deep-soil areas. Photos taken at this time are next best in terms of tone or color contrast and general interpretability. At other seasons, photo classification of range conditions is difficult, because the entire area appears uniform—green in winter, brown in summer.

Scale

The optimum scale for aerial photography, when cost must be balanced against useful information, is about 1:5,000, although spot coverage of a few representative areas at a scale of 1:2,000 also is desirable.

Film-filter combinations

Of the four film-filter combinations tested, aerial ektachrome film with a haze filter gave the best results and panchromatic film with a light-red filter next best. The photographs should not be taken on hazy days because of the likelihood that tone or color contrasts between the range

ge Conditions

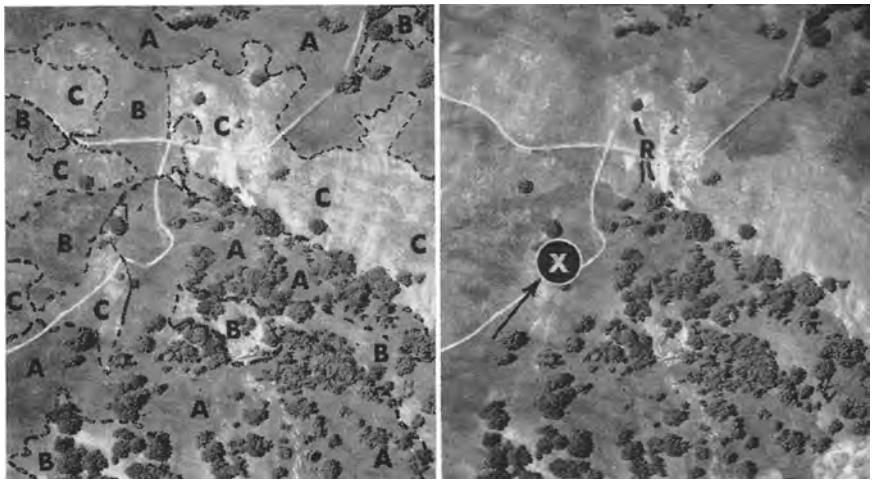
al-carrying capacity

types will be reduced below the threshold of recognizability.

Aerial photos were also found useful in this study for determining the prevalence and location of other features affecting range management, including springs, stock-watering places, salt grounds, fences, corrals, stock-poisoning plants, rodent concentrations, highly erodible sites, and areas in need of reseeding.

Robert N. Colwell is Professor of Forestry, University of California, Berkeley.

The above progress report is based on Research Project No. 1329.



Two overlapping vertical aerial photos, above, taken with panchromatic film and a 25A (light-red) filter at a scale of 1:5,000, show portions of a rangeland area in Contra Costa County. Left photo has areas classified into three significantly different types in terms of animal-carrying capacity. Photo to right indicates areas of rock outcrop, R, and the spot, X, from which terrestrial photos (below) were taken. Arrow adjacent to the X indicates direction in which the terrestrial photos were taken. Three-dimensional effects from these stereoscopic pairs of photos can be obtained by simultaneously viewing the left photo with the left eye and the right photo with the right eye. Terrestrial photos (below) of a portion of the same area, taken on the same date, show further details through use of filters. Upper pair of photos was taken with panchromatic film and a 25A (light-red) filter; bottom pair with infrared film and an 89A (dark-red) filter.

GROUND WATER RESOURCE PLANNING

A study is under way to develop project planning techniques for irrigated areas where ground water conditions of falling water levels, dwindling ground water supplies, or sea water intrusion may be a problem.

Emphasis is first being placed on development of planning procedures for areas which depend completely upon ground water. Consideration is being given to the planning and programming of water development facilities that will supply supplemental water after a firm demand or need for such amounts has been established in an area. In developing a program of this type it may be necessary to "mine" water for a given period of time and then recharge this depleted volume—plus any additional increments of ground water storage that may exist above the normal level of the ground water. Subsequent development of additional water use would require progressive construction of facilities which may involve additional dams, surface storage sites, recharge areas or distribution facilities.

Such planning allows for gradual expansion of facilities as they are needed and justified. This facilitates better design by being able to use hydrologic, geologic, agricultural and economic information which accumulates during the initial stages of development. Also, financing is placed on a more realistic basis. It is believed that this type of dynamic planning can be applied to certain areas in California anticipating increased utilization of ground water reservoirs.—*Verne H. Scott, Dept. of Irrigation, Davis.*

INDEX AVAILABLE

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