Ornamental brooms have become weeds

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The weedy brooms *Cytisus* spp. are ornamental shrubs introduced to the West Coast a hundred years ago. Their aggressive attributes have unfortunately contributed to their displacing other vegetation of forests, meadows, and rangelands in California, and they now have status as nationally important weeds. Our study investigated the significance of the pyralid caterpillar *Uresiphita reversalis* in the ecology of *Cytisus monspessulanus*.

We performed field surveys to determine the relative importance of *Uresiphita* as a defoliator of *Cytisus* in relation to climate, comparing the mild climate of the San Francisco Bay Area with regions east of the coastal range and with regions south to Los Angeles. The 1984 populations of *Uresiphita* were notably high in the Bay Area, with a number of reports of total defoliation in and around Berkeley. In 1985, however, appearance of insects was late, and populations did not build up to levels approaching those of 1984. Further east, only isolated plants of broom were found, usually in gardens. We surveyed areas in southern California in the fall for abundance of plant stands of *Cytisus* spp. and *Uresiphita* caterpillars. A further object was to make relative censuses of *Uresiphita* on different species of *Lupinus*, since the original host of this moth was probably lupine.

Using old distribution maps of *Cytisus* from the U.S. Department of Agriculture, the survey covered sections of the coastal region and coastal range from Los Angeles to the Bay Area. Distribution of *Cytisus* has apparently somewhat expanded over the past 10 years and is very patchy south of Big Sur. The northern edge of Big Sur and the Monterey region have dense expanding populations, as do parts of the Santa Cruz mountains and coastal ranges south from San Francisco. While the Bay Area also has patchy dense expanding populations, their extension east is limited to areas with less harsh environments.

In brief, population density of plants appears to be negatively correlated and with population density of insects on a per-bush basis. The best theory for this pattern at present is that plants are limited by extremes of heat and drought, while the insects are somewhat limited by cool, damp weather. The regions where climate falls between these two extremes are regions where there is probably greatest pressure on the insects to change.

On lupines, *Uresiphita* was largely restricted to *L. arboreus* (there is some doubt concerning the taxonomy within this species). In some areas, the lupines and brooms occurred side by side, with apparently no caterpillars on lupines while moderate to high populations were on the brooms. The reasons for this difference are not known, but possible hypotheses for investigation are: (1) Overall herbivore densities on the native lupines, including aphids, tend to be high, with concomitant high levels of arthropod natural enemies. The coccinellids, spiders, and the like may consistently reduce numbers of eggs and young stages of *Uresiphita*. (2) *Uresiphita* caterpillars have the properties of an aposematic species (protective coloring). They are yellow and black, somewhat gregarious, and conspicuous on the periphery of the plants. It may be that sequestered alkaloids from lupines and brooms are different, with the latter conferring greater protection from vertebrate predators.

Field data in the Bay Area indicate that on broom some predation by spiders may accrue, but greatest mortality is due to disease outbreaks during cool, damp weather. It is also clear that, while three to four generations may be possible in the Bay Area, five are more likely in southern California, allowing a greater seasonal population buildup.

Aggregation of this insect may be an important aspect of its behavior. Feeding occurs on peripheral parts of the plant, and insects are usually found in conspicuous groups. It may be that this is a fortuitous result of laying large egg masses, but a field experiment on a planted area of broom, carried out at the Gill Tract in Berkeley, showed active aggregation and suggests a chemically protected life style. Casual observations indicate that this species is not eaten by birds, probably being distasteful to them. Studies of the variation in plant alkaloids already show that the insects may be using the alkaloids in self-defense. Further studies are needed to see if the alkaloid differences in plants lead to differential survival of the insects on these plants.

Following field studies, we undertook a study of host plant selection by larvae. Earlier studies have suggested that this insect may be found on *Lupinus*, *Genista*, *Laburnum* and *Lonicera*. Insects in collections at Los Angeles and Riverside, in particular, had been found on *Lupinus* spp.

Newly hatched larvae were given choices of leaves: *Cytisus monspessulanus* was paired with one of nine other related species, and the choices made by larvae monitored after 24 hours. Further, larvae were placed on leaves of one plant, and their movements off the plant were monitored. In these ways a clear-cut pattern of preference was established; among the host plants and potential host plants *Cytisus* is preferred by larvae.

Development of larvae was then compared on two definite nonhost legumes (*Medicago* and *Trifoliuum*) as well as Santolina sp., *Sambucus* sp., *Lonicera hispidula*, *Ulex europaea*, *Lupinus arboreus*, and *Cytisus monspessulanus*. Insects survived only on the last three of these, and overall, *Cytisus* was superior for larval performance. On the other hand, oviposition trials indicated that female moths prefer to lay their eggs on *Lupinus*.

More work is needed, but the following conclusions may be drawn: (1) The caterpillar *Uresiphita reversalis* is indeed rather host-specific, with French broom being apparently the best host, supporting the highest populations. (2) Heat and drought probably limit the plant, while cool, wet summers probably limit the moth. (3) Moths lay eggs on lupine in preference to broom, yet field evidence indicates very small populations of moths on lupine. At present it seems that natural enemies associated with lupine may play some role in moth decline, but the hypothesis needs further testing. (4) Cultural practices that encourage the moth, and possibly artificial spreading of the moth to broom areas, probably pose no threat to the native lupines.

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