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IMPACT OF GRASSHOPPERS ON THE RUSH SKELETONWEED GALL MIDGE IN SOUTHWESTERN IDAHO

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INTRODUCTION

Rush skeletonweed, *Chondrilla juncea* L. was first discovered in southwestern Idaho in 1960. Rapidly spreading from the initially observed infestation of two hectares this plant now occupies more than 1.4 million hectares of rough and mountainous rangeland in this area of the State. Because of the impracticality of chemical, cultural or mechanical weed controls a biological control program was started in 1976. This was prompted by the biological control successes realized first by the Australians and then by Californian workers. The first control agent introduced into Idaho was the gall midge, *Cystiphora schmidti* Rüb. (Diptera:Cecidomyiidae). It was released in several skeletonweed infested areas of southwestern Idaho and later, in northern Idaho where a localized infestation was present. Subsequent to these initial introductions, numerous other releases of the midge were made in 1977, 1978 and 1979.

The introductions have been monitored and biological studies conducted on *C. schmidti* since 1976. In spite of climatic conditions not conducive to optimum midge development, this insect has flourished at several locations and since 1978 'population explosions' have occurred in the late summer and early fall. These dramatic population increases have resulted in reduced flowering of the plant and decreases in stand densities have been observed. However, our studies on midge biology have shown that since 1977 population development of the midge has been affected by grasshoppers (Orthoptera:Acrididae). In several instances the impact has been substantial. It is the purpose of this report to document the nature of the relationships between grasshoppers and the gall midge, based on work conducted in southwestern Idaho.

The observations and studies relating to the midge and grasshoppers were principally made at three sites in the Payette River and the South Fork of the Payette River drainages, Boise County, Idaho. Elevations of the sites range from 853 to 1146 m. Two of the sites are associated with open stands of ponderosa pine, *Pinus ponderosa* Lawson, and the other with a bitter brush, *Purshia tridentata* (Pursh) DC,–grassland habitat. All sites have a gradient of 10 to 20°, a south exposure and well drained sandy granitic soils. Annual precipitation averages approximately 60 mm. It occurs mainly as rainfall in the fall, winter and spring and snow in the winter. A snow cover of 200 mm is not uncommon. Temperatures show a considerable range over the year. Highs of 35 to 40°C occur in the summer months and lows of -15 to -20°C in the winter months.

GRASSHOPPER SPECIES AND THEIR ABUNDANCE

Twelve species of grasshoppers were found at the study sites over a two-year period, but only five of these were implicated with rush skeletonweed and the gall midge. These are: *Melanoplus bivittatus* (Say), *M. femurrubum* (DeGeer), *M. foedus* Scudder, *M. sanguinipes* (Fab.) and *Oedaleonotus enigma* (Scudder).

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The most important species was *M. sanguinipes*. Not only did it make up in numbers approximately 86 per cent of the grasshoppers present, but it is known to have habitat adaptability and opportunistic feeding habits. Second in importance, but making up approximately 6 per cent of the populations was *M. bivittatus*. Each of the other three species made up approximately 2 per cent of the total populations.

As would be expected, densities of the grasshopper populations varied from site to site and, at a given site, from year to year and seasonally. Overall, densities ranged from three to four individuals/m^2 to more than 50 individuals/ m^2 in the two-year period at the three study sites.

GRASSHOPPER FEEDING

Grasshoppers were found to have an indirect or a direct effect on the galls of *C. schmidti* and constitute a major mortality factor in the life cycle of the midge under Idaho conditions.

1. Indirect mortality results when immature midges in galls and midge eggs in plant tissues become desiccated beyond the point of grasshopper feeding on stems and branches of the weed. *M. sanguinipes* was mostly responsible for this indirect mortality.

   Occasionally, girdling of lower stems occurs which results in the death of the upper portions of the plant and, indirectly, of any immature midges present. This type of mortality was associated with *M. bivittatus*.
2. Direct mortality is of two types. In one, the entire plant is generally fed upon by groups of grasshoppers and the epidermis and cortex is consumed. In the process all midge galls and contents and midge eggs are destroyed. This usually occurs at locations where skeletonweed plants are large and have a patchy distribution. *M. bivittatus* was commonly found to cause this mortality at most localities.

   The other type of direct mortality was the most important and was associated with *M. sanguinipes*. The grasshoppers selectively feed on midge galls on stems and branches and in the process consume the midge larvae or pupae present. This selective feeding was found to be widespread where midge populations were well established and galls were abundant. A significant relationship was found to exist between total galls present and the number of galls eaten by grasshoppers. Thus, over time, the more galls present the greater the number eaten. This occurred even at low densities of grasshoppers.

Grasshopper feeding appears to be the result of the availability of skeletonweed after preferred native plant species had been displaced by *C. juncea* or decline due to dry summer conditions. However, after *C. schmidti* was introduced and its galls became available as a food source they apparently were preferred, at least by *M. sanguinipes*, over skeletonweed plant tissues.

Several effects of grasshopper feeding on *C. schmidti* were found. First, the feeding of grasshoppers on skeletonweed tissue has the greatest influence on the establishment of new introductions of the midge. At low population levels sufficient numbers of the midge may not be able to survive such feeding by grasshoppers and thus the release is unsuccessful. This has occurred on several occasions, especially on the periphery of weed infestations. Second, midge populations have been severely reduced, especially in the late summer and fall due to selective feeding on midge galls. Such feeding begins in early summer and it may have a depressing effect over the entire summer and early fall on the development of midge populations. Furthermore the total effect is of a cumulative nature. By the first of November grasshopper feeding of midge galls at the three study sites was 66 to 70 per cent in 1978 and 22 to 68 per cent in 1979.