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PREDATION BY CARPENTER ANTS: A DETERRENT TO THE SPREAD OF CINNABAR MOTH

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ABSTRACT

Cinnabar moth, an introduced biological control agent for tansy ragwort, suffers heavy predation by carpenter ants in recently logged areas of Oregon. We suggest that this mortality factor will reduce the spread of Cinnabar moth, thus preventing it from attacking a major seed source of tansy ragwort and reducing its potential as a biological control agent. Single larvae escape predation by ants more often than those in groups which suggests that carpenter ant predation may select for larval dispersal.

The Cinnabar moth, *Tyria jacobaeae* L. (Arctiidae), has been widely spread from its native Europe because of its potential as a biological control agent against the weed Tansy ragwort, *Senecio jacobaea* L. The success of these introductions has ranged from "never seen again" to "abundant and thriving" after 15 years. At Abbotsford, B.C. the failure of the first releases was attributed to heavy predation by ground beetles (Wilkinson, 1965). In the Gippsland vicinity of Victoria, Australia a mecopteran, *Harpobittacus nigriceps*, heavily predated a newly introduced Cinnabar population and a nuclear polyhedral virus assured the failure of the attempted introduction (Bornemissza, 1966). The causes for the lack of success of other introductions are not known (Hawkes, 1968, Harris *et al.* 1975, Isaacson 1973).

Van der Meijden (1971) records an almost perfect correlation between the log % mortality of Cinnabar larvae and log density of *Lasius alienus*, a predaceous ant. Further studies of *Lasius* predation led Van der Meijden (1973) to conclude that this ant may limit Cinnabar numbers in some sand dune areas of the Netherlands.

The following observations on predation by ants were made as a by-product of experiments designed to investigate larval dispersal in the Cinnabar moth.

Study Area and Methods

The study was carried out in Linn County, Oregon which lies between the western slope of the Cascade Mountains and the eastern edge of the Willamette Valley. Larvae were collected from the Silbernagel population which was studied by Isaacson (1973), and were transported to an area about 10 miles to the south on Neal Creek Road. This area was logged within the last 10 years so that stumps and fallen logs were abundant on the steep hillsides. Tansy ragwort is a common component of the herb-

TABLE 1. Survival after 2 days of 3rd and 4th instar Cinnabar larvae introduced to tansy ragwort plants in groups of approximately 20 individuals.

	Percent Survival				
	0-10%	11-25%	40%	65%	80-90%
Frequency	8	3	2	1	3

Total Survival = 98/329 = 30%

aceous vegetation which has invaded this area, and moth populations occur sporadically along the road.

We chose the particular site for the study because while abundant, large ragwort plants occurred there, Cinnabar moth larvae were lacking. We placed third and fourth instar larvae on plants in groups of approximately 20 individuals, and recorded their movement from the central plant to surrounding plants.

Results

The disappearance rate of larvae from tansy ragwort plants was exceedingly high (Table 1). Observations revealed that the reason for this disappearance was the activity of carpenter ants, *Camponotus* sp., which nested in surrounding stumps. Ants were seen to attack and carry off the Cinnabar moth caterpillars but to verify that the high rate of disappearance was due to ant predation we set up groups of larvae on plants with the base coated with "stickum" which prevented ants from crawling onto the plants. The comparative rates of disappearance of larvae on ant-free plants and those to which ants had access are compared in Table 2.

TABLE 2. A comparison of Cinnabar larval survival on tansy ragwort plants to which ants had access and those which were ant-free. Larvae placed on plants in groups of 10.

	Plants Without Ants	Plants With Ants
Original Number	49	40
Number After 2 Days	43	9
Percent Survival	86	23

We observed that those Cinnabar larvae which dispersed from the original plant had better short term survival than those which remained behind (Table 3). The effect of group size was further tested by comparing the survival of single larvae to those in groups of 10. While the survival of these individual larvae was not as high as that of the natural dispersers (Table 3), it was almost double that of larvae in groups of 10 (Table 2) over a 2 day observation period.

Discussion

The relationship of the carpenter ant to the Cinnabar larvae is an interesting one. The Cinnabar larvae feed preferentially at the tops of the plants on the flower buds. Their feeding activity releases sap and the carpenter ants will feed beside the caterpillars taking the sap from the freshly cut surface. The two species have been observed to coexist in this way. However, suddenly an ant may attack a caterpillar. The usual result is that the caterpillar falls from the plant, sometimes taking its attacker with it. If other ants are nearby they too will join in the attack. On one occasion eight larvae lived two days on a plant that was occasionally visited by ants. Suddenly the attack began, and within one hour only three remained the others having been carried off

TABLE 3. Survival after 2 days of Cinnabar larvae which dispersed naturally from original tansy ragwort plants or were placed individually on plants.

	Larvae Dispersed Naturally	Larvae Placed On Individual Plants
Original Number	10	31
Number After 2 Days	9	13
Percent Survival	90	42

by the carpenter ants.

Tansy ragwort is common in Oregon on the extensively logged slopes of the Cascades and of the Coastal mountains to the West. Although in many areas Cinnabar moths have become established (Nagel and Isaacson, 1974) the presence of carpenter ants in this environment will undoubtedly influence the success of the natural spread of the moth to tansy ragwort areas. This will interfere with the attempt to destroy the source for tansy ragwort seed which these areas provide.

Predation by carpenter ants gives rise to a situation in which dispersal of Cinnabar larvae could be at a strong selective advantage. The general interpretation has been that in areas of high predation, survival of dispersing larvae will be low (Green, 1974). However, although larvae are exposed to predation while traversing from one plant to another, abandonment of the usual clumped distribution of Cinnabar moth larvae might make the difference between success and failure of establishment. If there is a genetic component to dispersal one might predict strong selection for dispersal in these areas.

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