

FOODPLANT OF ALPINE *EUPHYDRYAS ANICIA*
(NYMPHALIDAE)

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ABSTRACT. Alpine *Euphydryas anicia* use *Besseya alpina* as their foodplant during pre- and post-diapause development.

Until 1974 the foodplant of alpine *Euphydryas anicia* Doubleday & Hewitson was unknown. Discovery of the use of *Besseya alpina* Rydberg (Scrophulariaceae) by a population at Cumberland Pass (Gunnison Co., Colorado) was mentioned by Ehrlich et al. (1975). My purpose here is to document the more widespread use of this plant by alpine *E. anicia* and to elicit observations by other workers in the field.

Figure 1 shows the distribution of alpine populations investigated to date. Table 1 shows evidence for the use of *B. alpina* by these populations. At the present time two things are known about alpine *E. anicia* populations: first, they occur on almost every peak above 3,660 m elevation above sea level in Colorado; second, the oviposition plant and post-diapause larval foodplant is *B. alpina* for all populations studied.

Unfortunately, we know nothing of the factors that limit the sizes of populations of alpine *E. anicia*, though we have learned something of their movement patterns (Cullenward et al., 1979). Since slow-melting snowbanks make early access to the alpine very difficult and since larvae are difficult to find, few post-diapause larvae have been collected. A few parasitoids have been reared from the 70 larvae collected to date. These are currently being identified. Few observations have been made on these larval populations in August and none in September, when predation and starvation of pre-diapause larvae might be seen. One can, however, infer something about the plant-herbivore relationship by observing the distribution and habit of plant growth and the magnitude of post-diapause feeding damage (Table 1).

Besseya alpina is perennial and strictly alpine, known from 3,500 to 4,350 m in Wyoming, Utah, Colorado and New Mexico. The distribution often includes points of greatest local elevation (sites 1, 3, 11, and 12), but often does not, apparently due to lack of soil just beneath the scree at some of these points. Often the plants grow right up to edge of exposed ridges and sometimes on the ridge tops themselves.

In general, the sparse populations of *Besseya* that are often prostrate in form and hidden among rocks suffer less feeding damage than

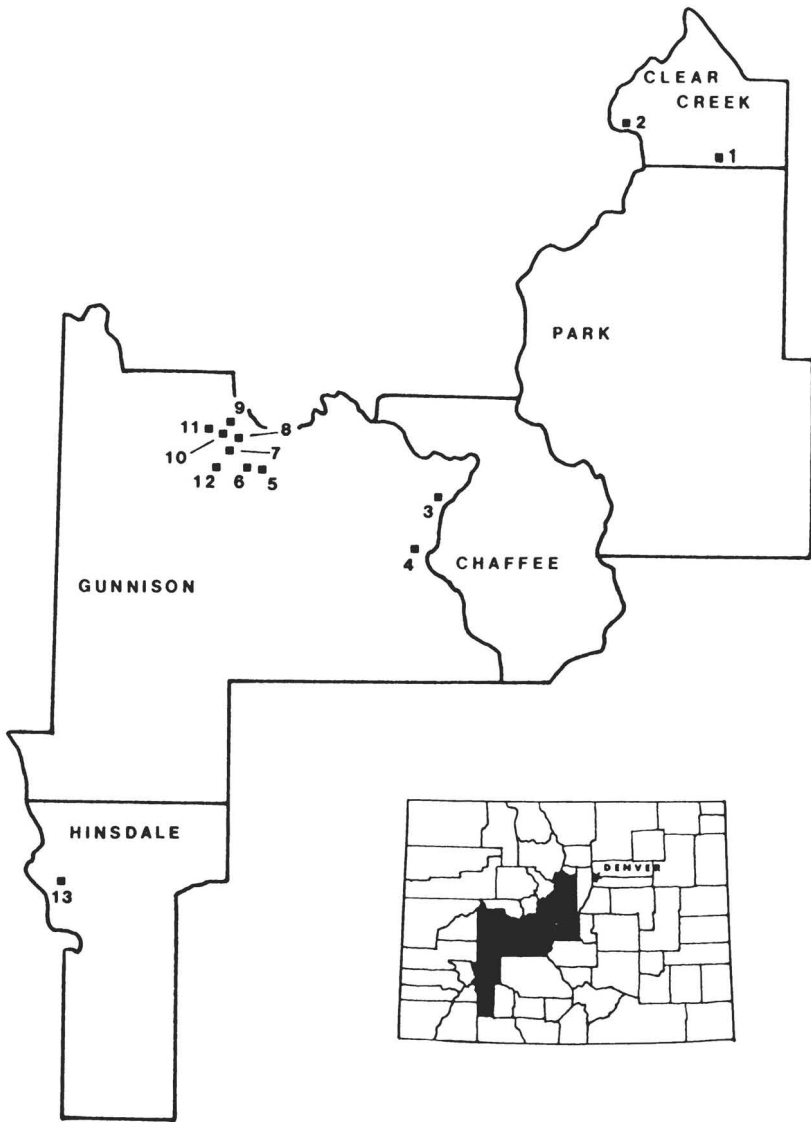


FIG. 1. Map of Colorado showing peaks investigated. Names on map refer to counties. 1, Mt. Evans; 2, Loveland Pass; 3, Cottonwood Pass; 4, Cumberland Pass; 5, Double Top; 6, Crested Butte; 7, Gothic Mtn.; 8, Avery Peak; 9, Mt. Bellview; 10, Mt. Baldy; 11, Cinnamon Mtn.; 12, Ruby Peak; 13, Rock Ridge.

TABLE 1. Distribution and habit of *Besseya* growth, with post-diapause feeding damage. Locality numbers refer to Fig. 1 map.

| Locality | Proportion of crop consumed by post-diapause larvae | Number of egg masses found | Number of post-diapause larvae | Number of plants sampled | Plant density | Plant habit | Food plant? |
|----------|---|----------------------------|--------------------------------|--------------------------|--------------------------|-------------|-------------|
| 1 | 0.002 | 0 | 0 | 125 | very sparse | 1 | No |
| 2 | 0.007 | 0 | 0 | 299 | sparse | 1 | No |
| 3 | — | 2 | 0 | 50 | sparse | 2 | Yes |
| 4 | 0.09 | 23 | 15 | 1,000 | dense in places | 3 | Yes |
| 5 | 0.01 | 0 | 0 | 130 | very sparse | 1 | No |
| 6 | 0.15 | 0 | 0 | 6 | very sparse | 1 | No |
| 7 | 0.04 | 3 | 1 | 130 | sparse | 2 | Yes |
| 8 | 0.02 | 0 | 0 | 172 | common in places | 3 | No |
| 9 | 0.08 | 2 | 1 | 102 | common | 3 | Yes |
| 10 | 0.06 | 1 | 2 | 114 | common in places | 3 | Yes |
| 11 | 0.09 | 5 | 3 | 100 | common over a small area | 3 | Yes |
| 12 | 0.09 | 3 | 1 | 222 | common | 3 | Yes |
| 13 | 0.06 | 4 | 2 | 132 | common | 2, 3 | Yes |

Plant habits: 1—among rocks, small and prostrate; 2—in scree, but not inconspicuous; 3—in the open, erect.

do the denser, more conspicuous populations. Three alternative hypotheses may explain this phenomenon: first, some environmental variable may curtail both plant and butterfly growth; second, the butterflies may not be able to generate large populations where the plants are scarce due to some factor other than the butterfly itself; third, the butterflies may cause the observed pattern by over-grazing conspicuous populations of *Besseya*. Further work is planned to learn which of these hypotheses is correct.

The magnitude of pre-diapause larval feeding damage and therefore its importance to the *Besseya* populations remains unknown. The magnitude, however, is likely to exceed substantially that of post-diapause feeding damage (Table 1). The eggs are laid in clusters of 50–100, so a large number of larvae feed on a single plant. The larvae must reach a diapause weight of 5–10 mg each. Since the conversion rate of *Besseya* biomass to larval biomass is probably about ten to one (White, 1973), each brood may consume 2.5–10 g [(50–100) × (5–10) × (10)] of *Besseya*. This amount, according to a small sample of *Besseya* leaves, is comparable to the size of the average *Besseya* plant (2.7–9.5 g, varying by year and by population). Pre-diapause larval growth appears to be so slow at these elevations that significant plant growth

might occur during the feeding period. Thus, pre-diapause feeding might usually be completed on a single plant without larval migration or its consequent starvation. Since it appears that *Besseya* plants either bloom and set seed early in a growth season or not at all that season, larval feeding during the growing season does not affect seed set in that year. Sufficient defoliation in one year may suppress seed set in the future or may cause death of the plant. About 20% of the plants set seed in a given year. Presumably this proportion varies with a number of factors, including the extent of defoliation.

One frequently finds significant numbers of both sexes of *E. anicia* flying 100–300 m below the lowest part of *Besseya* distribution (sites 4, 5, 7, 8, and 12) and sometimes some distance away. Mark-release-recapture work at Cumberland Pass (site 4) showed that at least several hundred individuals fly in, and tend to stay in, an area several hundred meters from the nearest *Besseya*. At Double Top (site 5) numerous individuals occupy large areas apparently devoid of *Besseya*. Also, at some alpine sites (1, 2, 5 and 8 of Fig. 1) where *E. anicia* is known to maintain populations, no egg masses were found on *Besseya* and feeding damage was light. Why these things should be so if these populations are utilizing *Besseya* and represent the same ecotype as do the others remains mysterious. One can only suspect that superficially similar local populations are in fact ecologically rather heterogeneous.

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LITERATURE CITED

- CULLENWARD, M. J., P. R. EHRLICH, R. R. WHITE & C. E. HOLDREN. 1979. The ecology and population genetics of an alpine checkerspot butterfly, *Euphydryas anicia*. *Oecologia* 38: 1–12.
- EHRLICH, P. R., R. R. WHITE, M. C. SINGER, S. W. MCKECHNIE & L. E. GILBERT. 1975. Checkerspot butterflies: An historical perspective. *Science* 188: 221–228.
- WHITE, R. R. 1973. Community Relationships of the Butterfly, *Euphydryas editha*. Ph.D. dissertation, Stanford University.