

A Migration of Adult Army Cutworms, *Euxoa auxiliaris* (Grote) (Lepidoptera: Noctuidae) at High Elevation

PAUL HENDRICKS

Montana Natural Heritage Program, 909 Locust Street, Missoula, Montana 59802, USA

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A large migration of adult Army Cutworms, *Euxoa auxiliaris* (Grote) crossed the Beartooth Plateau above treeline (3000-3360 m elevation) on the Montana-Wyoming border during 2-8 July 1989. Thousands of moths were in flight throughout the daylight hours, and many paused to nectar from willow (*Salix nivalis* and *S. glauca*) flowers. Density of moths on *S. nivalis* mats was about 30 m⁻² on 6 July, during peak abundance. Migratory movement corresponded to a temporary warming period in the alpine. Flocks of up to 75 Common Ravens (*Corvus corax*) appeared during the migration to feed on moths, and some remained in the alpine two weeks after the moth migration had passed. No diurnal migration of moths occurred on the Beartooth Plateau during July 1983, 1984, 1987, 1988, but a similar movement was noted in July 1963. Moths were probably in transit to summer aggregation sites in the nearby Absaroka Mountains of northern Wyoming.

Key Words: Army Cutworm, *Euxoa auxiliaris* (Grote), Common Raven, *Corvus corax*, insect migration, alpine, Wyoming.

The Army Cutworm, *Euxoa auxiliaris* (Grote), a noctuid species widely distributed in western North America from Canada to Mexico (Cook 1927; Pruess 1967), has been of considerable economic interest as a pest of cereal crops. On the Great Plains, adult moths disappear by early summer following spring emergence, and reappear in late summer. Formerly, it was assumed that adults aestivated until fall (e.g., Cook 1927). Now it is known that adult moths in some regions undertake massive migrations in early summer to adjacent mountains (Pepper 1932; Pruess 1967), where they feed on nectar and accumulate fat stores (Pruess 1967). A second mass movement occurs in late summer when adults return to the Great Plains to mate and lay eggs. More recently, additional interest in the biology of Army Cutworms developed after wildlife biologists documented that aggregations of adult moths above treeline in the Rocky Mountains are important ephemeral food during summer for some populations of Grizzly Bears, *Ursus arctos horribilis* (Chapman et al. 1955; Craighead et al. 1982; Servheen 1983; Mattson et al. 1991; D. White personal communication).

Most of our knowledge of the biology of Army Cutworms has been acquired on the prairies, where egg-laying occurs, or at summer aggregation sites above treeline. Descriptions of migratory movements while moths are in transit to summer aggregation sites are largely lacking (but see Pepper 1932), and little is known about migrations once they are in the mountains at high elevations.

During 2-8 July 1989 I observed a large migration of Army Cutworms cross the Beartooth Plateau (3000-3360 m) at Beartooth Pass (45°00'N 109°30'W) near the border of Carbon County, Montana and Park County, Wyoming. Beartooth Plateau, one of a series of uplifts with extensive

alpine habitat (>200 km²) above 3000 m elevation, has been the focus of several ecological studies of alpine flora and fauna (e.g., Johnson and Billings 1962; Pattie and Verbeek 1966). Thousands of moths were noted throughout the day flying towards the southwest, generally within 10 m of the ground. The migration appeared to peak on 6-7 July, and few Army Cutworms were noted at Beartooth Pass after 9 July.

The migration corresponded to a temporary warming trend above treeline. During the migration (2-8 July) daily temperature maxima and minima (mean \pm SD) at Beartooth Pass were 19.1 \pm 2.0°C and 7.7 \pm 2.1°C, respectively, significantly warmer than for the preceding and following seven-day periods (respective maxima and minima were 13.8 \pm 3.7°C and 2.2 \pm 2.6°C for 25 June-1 July, and 16.9 \pm 2.5°C and 4.3 \pm 1.4°C for 9-15 July). Weather for the week preceding and during the migration was sunny and mostly calm, while the week following the migration was accompanied by frequent rain, some graupel and fog. There are no additional data relating migratory activity of Army Cutworms to local climatic conditions at high elevations, so the correlation between timing of migration and weather conditions reported here may have been due to chance.

Thousands of moths paused during migration to nectar from flowering catkins of alpine willow (*Salix nivalis* and *S. glauca*). Density estimates were difficult to make in stands of *S. glauca*, as hundreds of moths would take flight when stands were entered; density of moths on mats of *S. nivalis* between the east and west summits of Beartooth Pass was 30.6 \pm 6.2 m⁻² (n = 10 plots) on 6 July. Prior to the moth migration, Beartooth Pass was visited frequently by a nesting pair of Common Ravens (*Corvus corax*). Flocks of ravens appeared at the pass on 5 July, during the peak of moth migration, and

remained in the area until 26 July; flock size ranged from 10-75 birds. Ravens were observed on the ground at all hours during the day, feeding on moths while walking across the tundra in loose groups of up to 40 individuals. Large numbers of ravens continued to frequent the area after the migration of Army Cutworms had passed; by mid-July there was an increasing abundance of grasshoppers and other insects at the pass (Hendricks 1993) and ravens may have switched their diet to include these taxa.

The timing and nature of the migratory movement across the Beartooth Plateau was consistent with previous observations at lower elevations and high-elevation aggregation sites. Migration occurred in early July when adults typically disappear from prairie sites in Montana and Wyoming (Cook 1927; Pepper 1932; Pruess 1967). Grizzly Bear activity at nearby high-elevation moth aggregation sites begins to increase in mid-July (Mattson et al. 1991), just after the time of the migratory passage noted. Adult Army Cutworms tend to be most active at night (e.g., Pepper 1932), although Pruess (1967) noted that diurnal activity is sometimes reported at high elevations in southern Wyoming, as was the case on the Beartooth Plateau. Orientation of early summer migrations to the southwest has been noted previously in Montana (Pepper 1932), but feeding during migration has not been reported, to the best of my knowledge.

Large diurnal migrations of moths were not detected at Beartooth Pass during July in 1983, 1984, 1987 and 1988, indicating that the annual migration of adult Army Cutworms does not follow a fixed route to their summer aggregation sites in the Absaroka Mountains. Even if migration sometimes occurred at night, moths would have been detected, because migrations apparently last several days and many individuals would have flushed from tundra vegetation during my morning traverses of the site. This did not occur during the other four summers of my residency at Beartooth Pass. Gross fluctuations in moth populations could also account for failure to detect migrations during those four summers, especially if years of apparent absence corresponded to years of low moth population size. Large fluctuations in moth populations did not appear to occur at nearby aggregation sites in the Absaroka Mountains during 1987-1989. Frequency of Grizzly Bear scats containing Army Cutworms (Mattson et al. 1991) ranged from 64.0-92.1% (ingested volume of moths ranged from 66.6-92.1%); the years of lowest and greatest moth presence in bear scats were 1987 and 1988, respectively, during which I did not detect movements of moths at Beartooth Pass. The Beartooth Plateau is crossed with some degree of regularity, however, as Pattie and Verbeek (1966)

probably witnessed a similar Army Cutworm migration at Beartooth Pass on 11 July 1963, when they reported 13 ravens feeding on large numbers of moths. Much remains to be learned of the migration of Army Cutworms, but their movement through any high-elevation site probably depends on temporary local weather patterns and the source of the migratory populations on the plains, both of which can vary from year to year (Pruess 1967, personal observation).

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