

Note

First known observations of migratory Army Cutworm Moth (*Euxoa auxiliaris*) in the southern Canadian Rocky Mountains

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Abstract

Army Cutworm Moth (*Euxoa auxiliaris*) migrates long distances to mountain talus slopes where they aggregate in prodigious numbers over summer. Composed of ~70% lipid and ~25% protein at the height of summer, the moths attract Grizzly Bear (*Ursus arctos horribilis*) to talus slopes in certain mountain ranges in the contiguous United States to forage at aggregations. We present the first known observations of migratory Army Cutworm Moths aggregating on talus slopes in the southern Canadian Rocky Mountains of British Columbia and Alberta. Because this is a potential food resource for the bears, managers may wish to evaluate suitable moth habitat.

Key words: Army Cutworm Moth; *Euxoa auxiliaris*; lipid; protein; aggregation; talus slope; food resource; Grizzly Bear; *Ursus arctos horribilis*

Army Cutworm Moth (*Euxoa auxiliaris* (Grote, 1873), Lepidoptera: Noctuidae) is known for its aggregating behaviour (Powell and Opler 2009). The moths are migratory, splitting their one-year life cycle (Figure 1a) between lower elevation agriculture-dominated habitats of North America's Great Plains and Intermountain West, where they may be considered a pest (Strickland 1916; Pruess 1967; Hardwick and Lefkovich 1971; Burton *et al.* 1980; Blodgett *et al.* 2010; Floate 2017), and high elevation talus slopes of the Rocky Mountains, often hundreds of kilometres away, where they are potential food for Grizzly Bear (*Ursus arctos horribilis*) in the contiguous United States (Chapman *et al.* 1955; Klaver *et al.* 1986; Mattson *et al.* 1991; French *et al.* 1994; O'Brien and Lindzey 1998; White *et al.* 1998a; Robison 2009; Bjornlie and Haroldson 2021; Peterson 2022a). In their mountain habitat, the moths aggregate by day in prodigious numbers in the subsurface interstitial space (air pockets) of talus matrices and forage at night on

wildflower nectar (French *et al.* 1994; White *et al.* 1998b; Robison 2009; Peterson 2022a). Over summer, the moths increase their mass and change body composition from ~15–20% lipid to ~65–70%, while their protein content remains stable but proportionally declines from ~70% to ~25% of their mass because of the surge in their lipid content (Pruess 1967; Kevan and Kendall 1997; White *et al.* 1998b).

In certain areas of the Rocky Mountains, Grizzly Bears ascend to talus slopes to feed on aggregating Army Cutworm Moths during July–September (White 1998b; Robison 2009; Peterson 2022a). With a gross energy content of nearly 8 kcal/g dry weight in late summer, the moths are one of the richest foods available to mountain-dwelling Grizzly Bears (Pritchard and Robbins 1990; French *et al.* 1994; White *et al.* 1998b; Gunther *et al.* 2014).

Despite their well-documented premigration natal presence on the plains of Alberta (Strickland 1916; Floate 2017), the presence of migratory Army

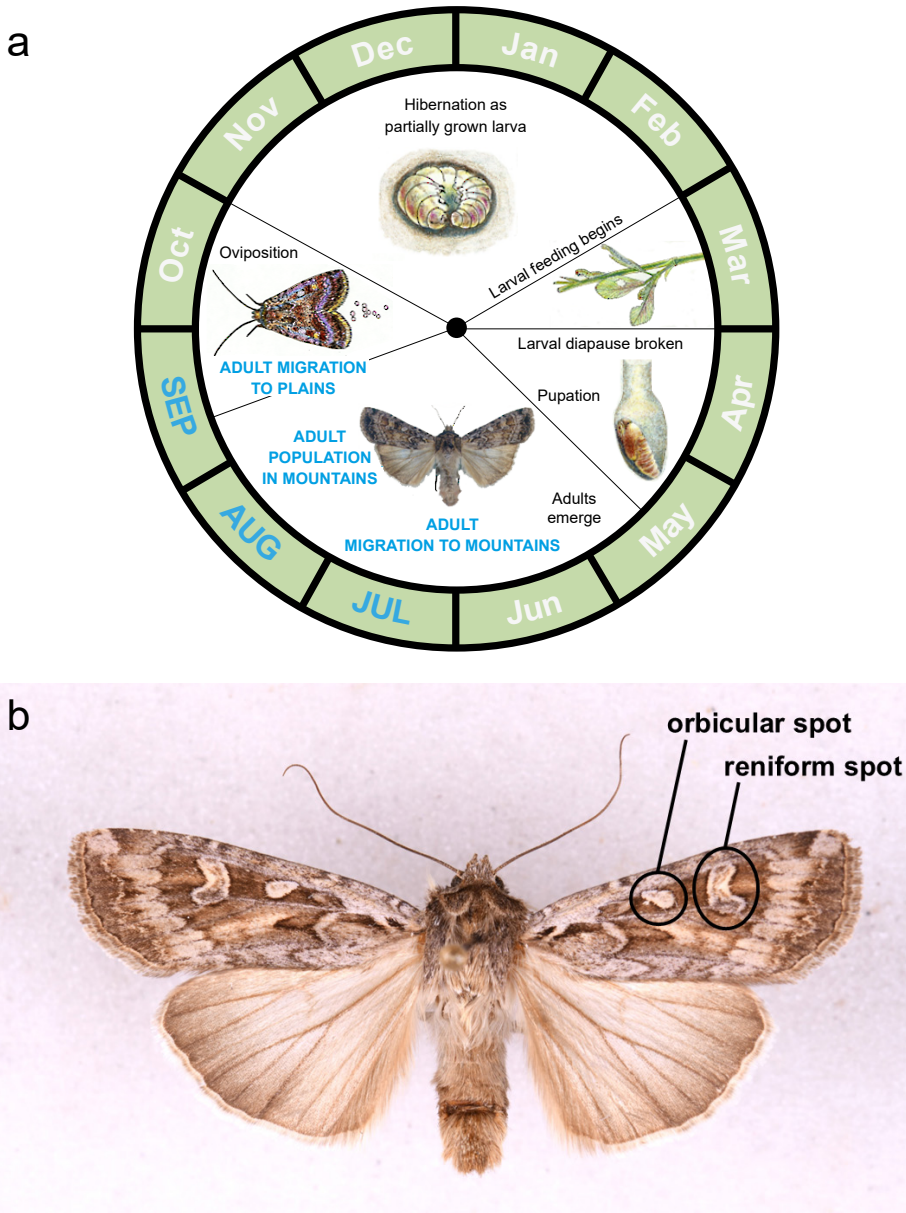


FIGURE 1. a. The Army Cutworm Moth's (*Euxoa auxiliaris*) one-year life cycle begins and ends in low elevation, agriculture-dominated areas. From July into September the moths are found in distant mountain talus slopes. b. The orbicular and reniform spots are diagnostic markings for identifying Army Cutworm Moth (Powell and Opler 2009). Diagram a: Don White, Jr. Photo b: M.T. James Entomological Collection, Washington State University.

Cutworm Moths in the southern Canadian Rockies of Alberta and British Columbia (BC) was previously undocumented. Oku (1983) proposed that the moths may lose the impetus to migrate north of 50° latitude. However, Dittmore *et al.* (2023) suggested that the moths may originate substantially further north. To

date, Grizzly Bears have not been documented foraging on moths in Canada (Hamer *et al.* 1991; McLellan and Hovey 1995; Munro *et al.* 2006; Nielsen *et al.* 2017).

In summer 2022 and 2023, during recreational hikes in the southern Canadian Rockies, we oppor-

tunistically examined probable talus slopes for Army Cutworm Moths. These trips followed an initial modelling exercise of probable Army Cutworm Moth habitat and a cluster analysis of Grizzly Bear telemetry data (Peterson 2022b). We documented Army Cutworm Moths in two ways: by observing moths flying out from talus underfoot in response to our travel across a talus slope and by excavating rocks from talus slopes (Figure S1, Video S1) that possessed characteristics consistent with suitable moth habitat (Peterson 2022a). We identified Army Cutworm Moths at talus slopes by their aggregating nature within talus matrices and their diagnostic forewing reniform and orbicular spots (Figure 1b; Powell and Opler 2009).

Army Cutworm Moths were initially observed in Canada on 20 August 2019 on a talus slope in Waterton Lakes National Park, Alberta (49.0935°N, 114.0365°W), during transboundary graduate field research (Figure 2; Peterson 2022a). Photographs were taken (Figure 3a) and specimens were collected and provided to Dittmore *et al.* (2023) for analysis.

On 1 September 2022, we observed migratory

Army Cutworm Moths aggregating at three locations between 3000 m and 3300 m elevation on a talus slope near the headwaters of the Bull River (50.0587°N, 115.2145°W), northeast of Cranbrook, BC (Figures 2, 3b, S2a). We searched this site because of its potential for finding the moths. We next observed aggregating moths at two locations between 2600 m and 2785 m elevation on 16 August 2023 on a talus slope near the headwaters of the Crownsnest River (49.7042°N, 114.5736°W), northwest of Coleman, Alberta (Figures 2, 3c, S2b), during recreational travel. Then, on 19 August 2023, we observed aggregating Army Cutworm Moths during travel and excavated numerous locations between 2900 m and 3000 m elevation on a talus slope near the headwaters of the Fording River (50.3153°N, 114.8014°W), northeast of Elkford, BC (Figures 2, 3d, S2c). We investigated this area based on previously identified Grizzly Bear telemetry data clusters that were consistent with moth foraging. We documented all 2022–2023 moth observations with photographs that showed their diagnostic traits but did not collect vouchers.

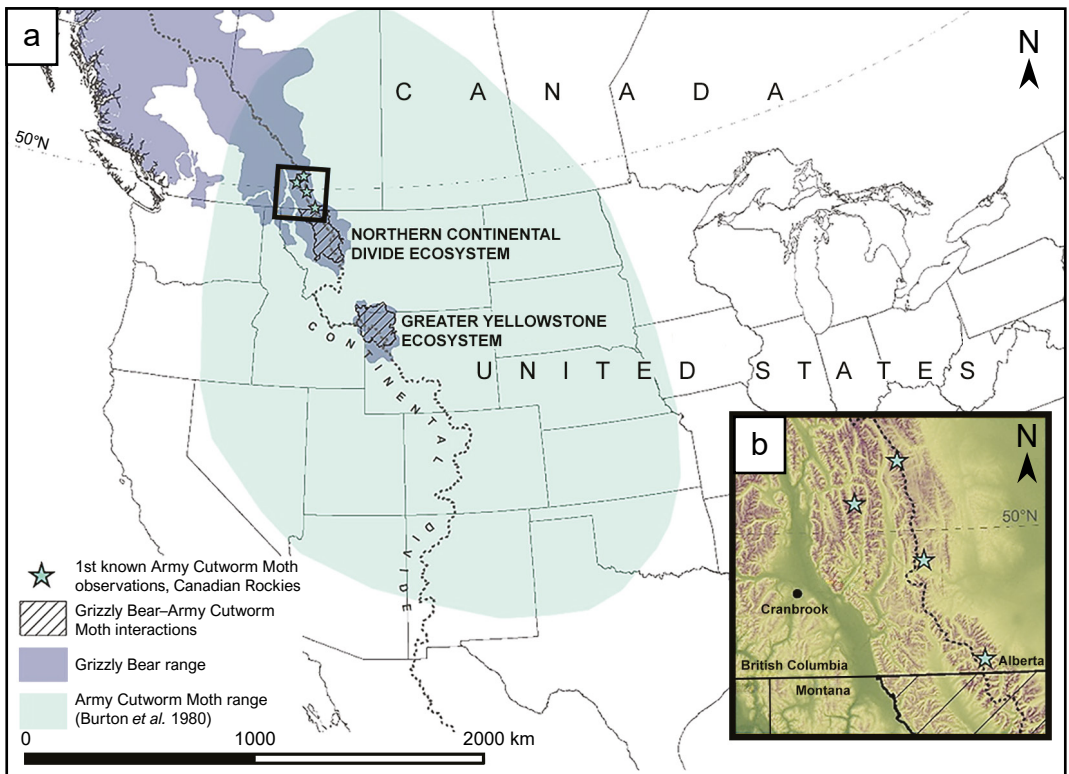


FIGURE 2. a. Approximate annual ranges of Army Cutworm Moth (*Euxoa auxiliaris*) and Grizzly Bear (*Ursus arctos horribilis*; from McLellan *et al.* 2017) showing possible overlap and areas where bears are known to feed on these moths in the contiguous United States. b. Close-up of observed Army Cutworm Moth locations in the southern Canadian Rockies of Alberta and British Columbia.

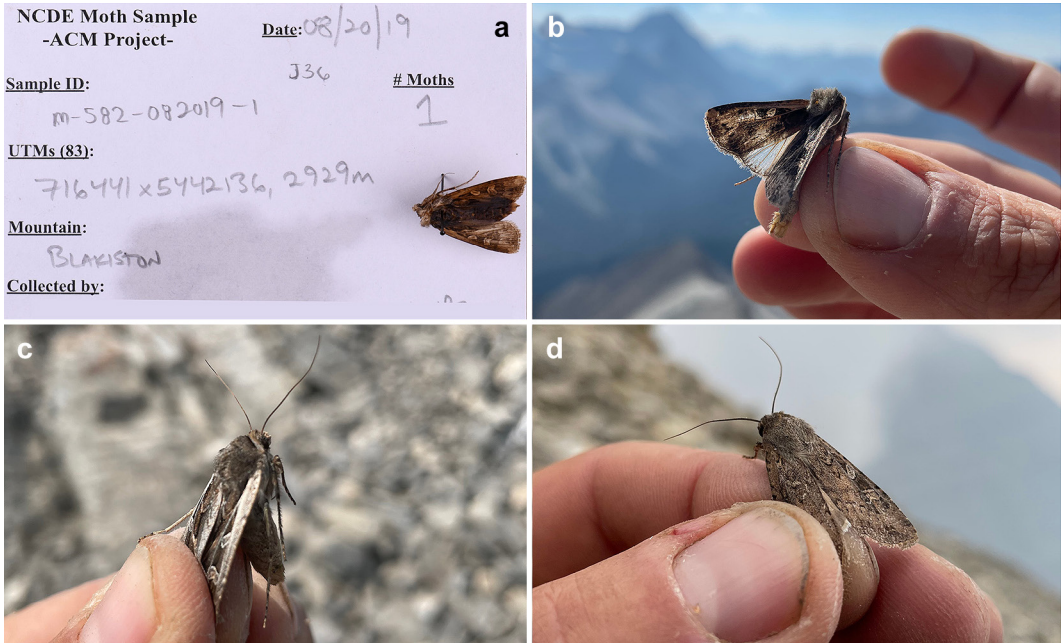


FIGURE 3. Photo evidence of Army Cutworm Moth (*Euxoa auxiliaris*) on talus slopes in: a. Waterton Lakes National Park, Alberta (49.0935°N, 114.0365°W), on 20 August 2019, Washington State University Collection Catalogue #WSUC00018396 (<https://ecdysis.org/collections/individual/index.php?occid=5216140&clid=0>); b. near the headwaters of the Bull River, British Columbia (50.0587°N, 115.2145°W), on 1 September 2022; c. Crowsnest River, Alberta (49.7042°N, 114.5736°W), on 16 August 2023; and d. Fording River, British Columbia (50.3153°N, 114.8014°W), on 19 August 2023. Photos: Erik Peterson.

Our observations indicate Army Cutworm Moths do in fact migrate into the southern Canadian Rockies as far north as 50° and that their aggregations are generally consistent with occupied moth habitats in the Northern Continental Divide (White *et al.* 1998b; Peterson 2022a) and Greater Yellowstone Grizzly Bear Recovery Ecosystems (French *et al.* 1994; Robison 2009) in the contiguous United States. The presence of the moths north of the international border at 49° also suggests they may be a summer food for Grizzly Bears in the southern Canadian Rockies. Other animals observed feeding on aggregations of migratory Army Cutworm Moths include Raven (*Corvus corax*), Clark's Nutcracker (*Nucifraga columbiana*), Gray-crowned Rosy Finch (*Leucosticte tephrocotis*), Black Rosy Finch (*Leucosticte atrata*), Black Swift (*Cypseloides niger*), American Pipit (*Anthus rubescens*), Mountain Bluebird (*Sialia currucoides*), owls (unknown spp.), bats (unknown spp.), Black Bear (*Ursus americanus*), Coyote (*Canis latrans*), mustelids (unknown spp.), and Wolf Spider (Lycosidae; French *et al.* 1994; White 1996; Coop *et al.* 2005; Robison 2009; pers. obs. E.P.). Regardless of whether bears in Canada currently forage for Army Cutworm Moths, the expected northward range shift of mobile species

because of climate change (Parmesan and Yohe 2003) may mean the moths will become increasingly available as a food for Grizzly Bears in Canada.

Given the potential for human disturbance at sites where Grizzly Bears forage for Army Cutworm Moths (White *et al.* 1999), there is value in determining the moth's occurrence in the southern Canadian Rockies. Thus, we suggest a systematic survey for Army Cutworm Moth occurrence across talus slopes in the southern Canadian Rockies to inform managers. Potential moth aggregations with high human use, such as climbing or hiking areas in national and provincial parks, may be highest priority for survey. The research could be guided by recently established methods for assessing moth occurrence (Peterson 2022a) and archived location data from Grizzly Bear radiotelemetry studies in the region (Boulanger and Stenhouse 2014; Lamb *et al.* 2020), which could reveal past moth-feeding sites used by bears.

Author Contributions

Writing – Original Draft: E.P.; Writing – Review & Editing: E.P. and G.M.; Conceptualization: E.P.; Investigation: E.P.; Methodology: E.P.; Funding Acquisition: G.M.

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SUPPLEMENTARY MATERIAL:

FIGURE S1. Screenshot from video of our 1 September 2022 observation of Army Cutworm Moth (*Euxoa auxiliaris*) aggregating in a mountain talus slope near the headwaters of the Bull River, British Columbia (50.0587°N, 115.2145°W).

FIGURE S2. Army Cutworm Moth (*Euxoa auxiliaris*) observations from 2022 to 2023 showing their aggregating behaviour near the headwaters of: a. Bull River, British Columbia (50.0587°N, 115.2145°W), on 1 September 2022; b. Crowsnest River, Alberta (49.7042°N, 114.5736°W), on 16 August 2023; and c. Fording River, British Columbia (50.3153°N, 114.8014°W), on 19 August 2023.

VIDEO S1. Video from our 1 September 2022 observation of Army Cutworm Moth (*Euxoa auxiliaris*) aggregating in a mountain talus slope near the headwaters of the Bull River, British Columbia (50.0587°N, 115.2145°W), posted at <https://youtu.be/D98pK-QspL0>.