**Study species**

Dung beetles include species from the Scarabaeidae and Geotrupidae beetle families that use dung as a food source for adults and larvae (Matthews 1963). Dung beetles can be grouped into three functional groups: dwellers, tunnellers, and rollers (Floate *et al*. 2017). Dwellers live within the dung, tunnellers bury portions of the dung directly below the original dung pat, and rollers process the dung extensively, removing pieces of dung pats, rolling them away as balls, and then burying dung (Floate *et al*. 2017).

We collected body size measurements on two species of dung beetle. The first is *Canthon pilularius*, a widespread species native to North America (Matthews 1963). *C. pilularius* is a relatively large species of dung beetle (10-19 mm in length), a roller, and has several color phases (black, blue, bronze, and green) (Matthews 1963). The second species is *Onthophagus nuchicornis*, a tunneling Eurasian species that has been in the United States for over a century (Floate *et al*. 2017; Manning and Cutler 2020). This species is considerably smaller in size (6-8mm) than *C. pilularius*, and has yellow or brown elytra with black spots (Hoebeke and Beucke 1997). Males of this species have a single horn on their head making them easily distinguishable from the females.

**Field site and environmental data**

The study was conducted in the shortgrass prairies from late May to mid September of 2022 in Phillips county, Montana, USA on land owned or leased by American Prairie, Bowdoin National Wildlife Refuge, Charles M Russell National Wildlife Refuge, and the Bureau of Land Management. We sampled dung beetles on 24 total sites with 5 treatment levels: bison grazed, cattle grazed, ungrazed, prairie dog town in the bison area with insecticide treatment, and prairie dog town in the bison area without insecticide treatment. Sites included 15 core sites (3 replicates per treatment level) where corresponding data on temperature and dung counts, and 9 supplemental sites (3 additional replicates of bison grazed, cattle grazed, and ungrazed treatments) where only beetles and no environmental data was collected. Land owned by American Prairie or leased by BLM was formerly plowed and used for crop plants and cattle ranching. In bison areas, the conversion from cattle grazing to bison grazing took place 7 to 20 years before our study began. In core sites, temperature data was collected with HOBOs …. Dung was quantified in

**Dung beetle sampling**

Dung beetles were collected in four pitfall traps per site, with traps arranged in a 50 m x 50 m square ordinated by cardinal directions. Dung beetle pitfall traps were baited using one tablespoon of homogenized pig dung rolled into balls and bound by 4” X 4” pieces of cheesecloth. Pig dung was sourced from the Swine Teaching and Research Center operated by the Department of Animal Sciences and Industry at Kansas State University and was frozen before deployment. The traps were made of 0.65 L plastic cups (9cm diameter, 15 cm depth) and were filled ¼ full with soapy water, baited with pig dung using binder clips to attach cheesecloth balls to pitfall trap cups, and left open for 48 hours during each trapping period. Following exposure, the traps were collected and samples were washed three times using plain water. The specimens were then stored in 99.7% ethanol.

**Sorting and size measurements**

,We measured 10 specimens of *C. pilularius*, 10 *Onthophagus nuchicornis* males, and 10 *O. nuchicornis* females from each sample. If fewer than 10 individuals of any group were found in a trap, all specimens available were measured. On each specimen, we measured head length, forearm length, central thorax length, and central elytra length using electronic calipers (0.01 mm accuracy). For *O. nuchicornis* males, we additionally measured horn length.

**Statistics**

We first calculated body size estimates of each of the three groups of C. pilularius, O. nuchicornis females, and O. nuchicornis males for each treatment and collection month. Next we examined environmental driver effects on body size of each of the three groups. For all analyses, we used Bayesian linear models fitted with the R package brms (Bürkner 2021). Models were run using four chains for 5000 iterations (50% burn-in) and default brms priors. The form of the body size model was:

XX

The form of the driver model was:

XX

Code for all analyses is available at: https://github.com/Ewelti/AmongTheDung/tree/main/R