Colorado fires and firemoths

Typical members of the large and common moth family Noctuidae are drab, dark-colored, and mottled, so they are well camouflaged when they rest on tree bark, rocks, or lichens. Picture gray, brown, black, and salt-and-pepper moths. But members of a unique subfamily of noctuids – the flowermoths, subfamily Heliothinae – are camouflaged on the flowers of their larval host plants and adult nectar plants. Imagine pink, purple, red, yellow, and white moths. Colorful camouflage may sound contradictory, but not for flowermoths (Figure 1).

I saw my first flowermoth in early June 1987, near Boulder, Colorado. The half-inch-long moth was dallying on a blossom of blanketflower (*Gaillardia aristata*); the flower's burgundy and yellow colors reminded me of a split, ripe peach. The wine-colored wings and yellow head and thorax of the moth were a perfect match. I was amazed and delighted, and I began to look into what was known about this species. I learned that it had no common name, only its scientific name *Schinia masoni*. The type specimen was held in the University of Colorado Museum, placed there by TDA Cockerell, a prominent early Colorado naturalist. Cockerell first noted the distinctive camouflage of *S masoni* in a 1910 paper (Cockerell 1910), and wrote later that this species "was discovered by Mr J Mason, formerly of Denver, through the picking of a *Gaillardia* flower on which a moth happened to be resting" (Cockerell 1927).

I then investigated and described its host plant and life cycle (Byers 1989). Captive females that I brought into my lab commonly laid more than one egg in a blossom, and one female laid seven eggs in a single blossom. In the field it was not uncommon to find two or three eggs or small larvae in a flower. Newly hatched larvae tunneled into the disk-flowers, eating the developing seeds. Blossoms with larvae showed patches of brown and shrunken disk-flowers where the developing seeds had been consumed, and larger larvae pushed up patches or ridges of disk-flowers, making it easy to identify flowers with larvae. After about 3 weeks of larval life, mature fifth instar larvae dropped from the flowers and burrowed into the soil to pupate. This species appeared to have only one generation per year.

Almost all of the small number of specimens of *S masoni* deposited in museums came from the northern Front Range of Colorado, with only a handful from nearby southern Wyoming. Apparently, this was a rather rare, narrowly endemic moth. Searching for adults in the ponderosa pine (*Pinus ponderosa*) woodlands near Boulder reinforced my impression that these moths were rare. Sometimes I looked at hundreds of widely scattered blanketflower blossoms before finding an adult moth.

But my impression that *S masoni* is rare changed completely during a field trip with a class of ecology students in June 1991. We visited an area above Boulder that had burned in the 1989 Black Tiger Fire, and discovered a profusion of blanketflowers under the charred pines. In 10 minutes my students and I found more moths than I had in years of searching in unburned pine forests.

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Figure 1. *Colorado firemoth* (Schinia masoni*) on* Gaillardia aristata*, Mt Galbraith, Colorado, July 2015.*

That discovery eventually led to a study of the relationship between fire history and the abundance of blanketflowers and *S masoni*, funded by the US Forest Service (USFS) Rocky Mountain Research Station from 2002 to 2004. In that study, the abundance of blanketflowers and moth larvae were recorded at ten burned and adjacent unburned areas, representing a range of 1 year to approximately 100 years since a fire. The research clearly demonstrated that blanketflower is a fire-dependent species. Blanketflower populations increase exponentially at most sites within 1 year after a fire, apparently because of post-fire germination of seeds waiting in the soil (Figure 2). Blanketflower abundance declines during the first several decades following a fire, and it becomes uncommon in areas that have not burned in many decades. Blanketflower may persist at some sites for up to about 50 years without a new burn to release it, but it essentially disappears within a century after the last fire.

We found that *S masoni* colonized blanketflower populations on some, but not all, burned sites within 2 years. The moth could be common in dense post-fire blanketflower populations. Moths were found even as blanketflower populations declined over 50 years after a fire, but because blanketflowers virtually disappear from unburned pine forests within a century, to persist in this landscape the moth must disperse and colonize blanketflower populations in newly burned areas. A few recently burned sites had no moths despite an abundance of fire-released blanketflowers. These sites were far from other recently


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Figure 2. *Blanketflower release 2 years after a fire, Bobcat Gulch, Colorado.*

burned areas, isolated islands in an ocean of fire-suppressed, blanketflower-less forest, and apparently beyond the flying range of dispersing moths.

Because of its dependence on a fire-dependent host plant, and because it is found only in the Front Range of Colorado (barely into southern Wyoming), I proposed to call this species the Colorado firemoth. I argued that it was an indicator of the historically natural, landscape-scale heterogeneity of Colorado Front Range ponderosa pine and mixed conifer forests caused by fires (Kaufmann *et al.* 2000). The colors of blanketflower and of the colorfully camouflaged Colorado firemoth reflect the hues of the fiery flames that have shaped their coevolution in the foothills of the Front Range.

A burned forest does not really need an "indicator" to show that it has burned – dead, blackened trees do that. But neither burned trees nor the abundance of blanketflowers that always follow a fire are an indicator of the patchwork landscape that was maintained by the historically natural fire regime in Front Range forests before the era of fire suppression. For the Colorado firemoth to persist in the landscape, populations in old burns must eventually colonize newly burned areas. Blanketflower can persist for long intervals between fires because of its soil seed bank, but the moth has no such strategy available to it. Instead, it can survive only if fires are frequent enough and close enough together. The dependence of this moth on a fire-dependent host plant, and its limited dispersal ability, may make this species an effective indicator of the natural heterogeneity of Front Range forests before fire-suppression policies disrupted their ecological dynamics.

The historically unnatural landscape patterning caused by recent fire suppression policies increases the fire risk, especially the risk of large and intense fires. So it is in this context that the natural history of a brightly camouflaged moth inserts itself into the controversial public policy debate about how to manage fires in Front Range forests. A little tidbit of fascinating natural history actually means something a lot more – and something more relevant to people and to public policy – than might appear at first glance.

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