Of Cheatgrass, Cutworms, and Bears



Cindy Salo, cindy@cindysalo.com Feb. 9, 2023 - U of AZ Herbarium Feb. 19, 2023 - Cascabel, AZ Cheatgrass (Bromus tectorum) is an exotic annual grass that moves into disturbed areas and fuels wildfire in the West. Wildfire kills sagebrush and perennial grasses weakened by human activities. Sagebrush steppe is home to sage grouse (Centrocercus urophasianus), a species in decline.



Land managers often point to cheatgrass as the sole cause of wildfire, which overlooks humans' role in the disturbance that allows cheatgrass to spread and thrive. Cheatgrass cannot invade vigorous stands of perennial grasses.



In June, 2003, a Bureau of Land Management employee in Winnemucca, NV called me at the USGS about missing cheatgrass. He sent this photo of bare soil with gray litter and robust perennial grasses.



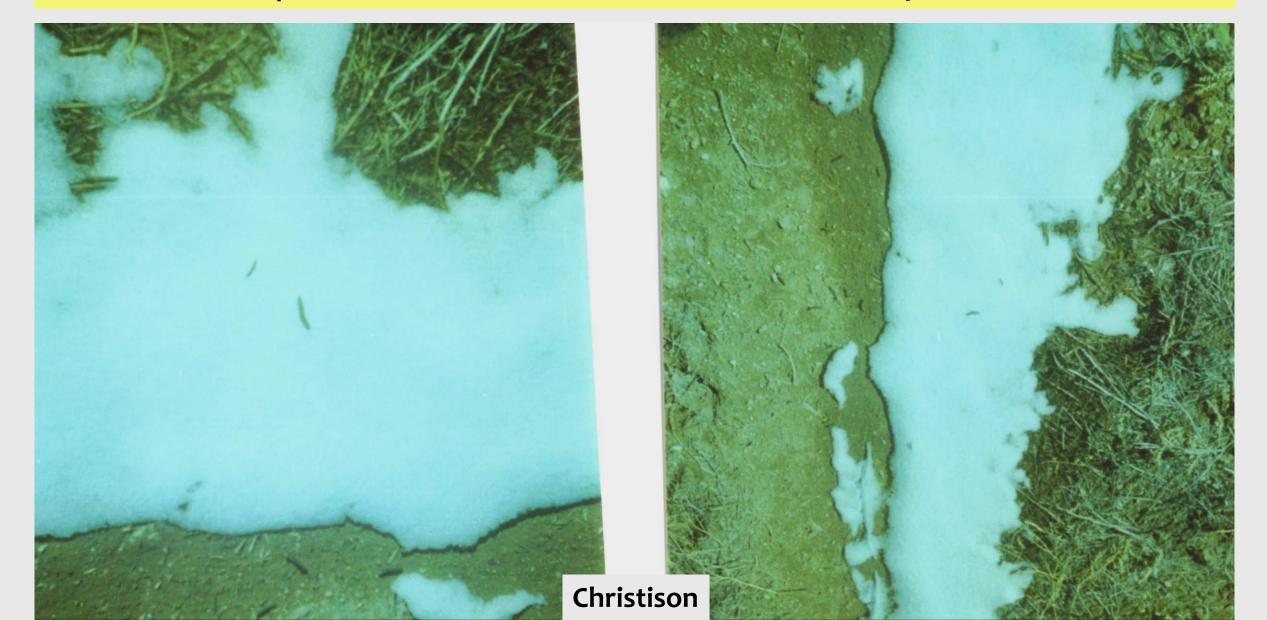
I visited and found bare areas with sharp boundaries surrounded by normal-appearing cheatgrass stands. I didn't know what caused the die-offs.



This die-off included healthy-looking shrubs, with a nearby ranch. A woman there told me her son said army cutworms caused the die-offs.



Jim Christison saw larvae eating every green shoot one night in January, 2014. He took pictures and identified the larvae as army cutworms.



Army cutworms are native insects and well-known pests of (exotic) crops such as wheat on the Great Plains. The adult moths migrate from the Great Plains to the northern Rockies in summer. Much less is known about ACW in the West.

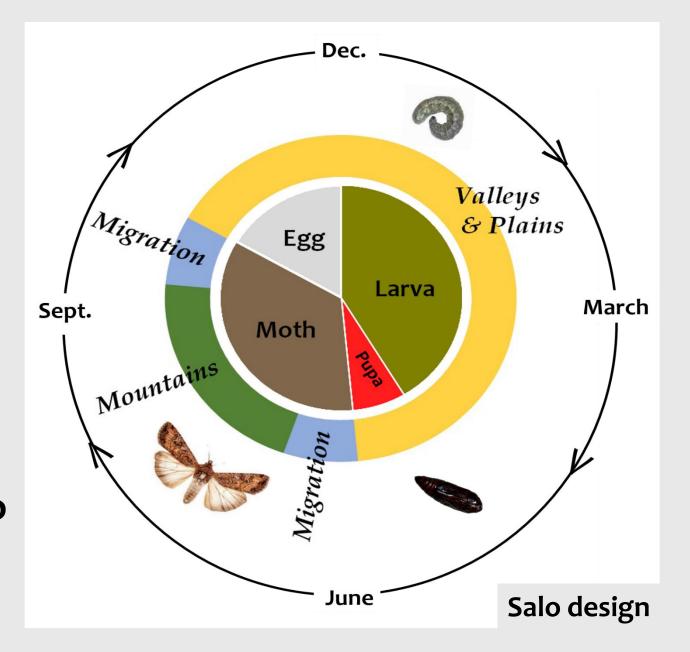


Army cutworm moths are an important food for grizzly bears in the northern Rockies. Bears find the fat-filled insects congregating in talus slopes during the day. See recent research at BearButter.org.



Army cutworm lifecycle SW Idaho and NW Nevada

Army cutworms have one generation per year. Adult moths lay eggs at low elevations, where larvae feed until they pupate. **Emerged adults migrate to** higher elevations for the summer.

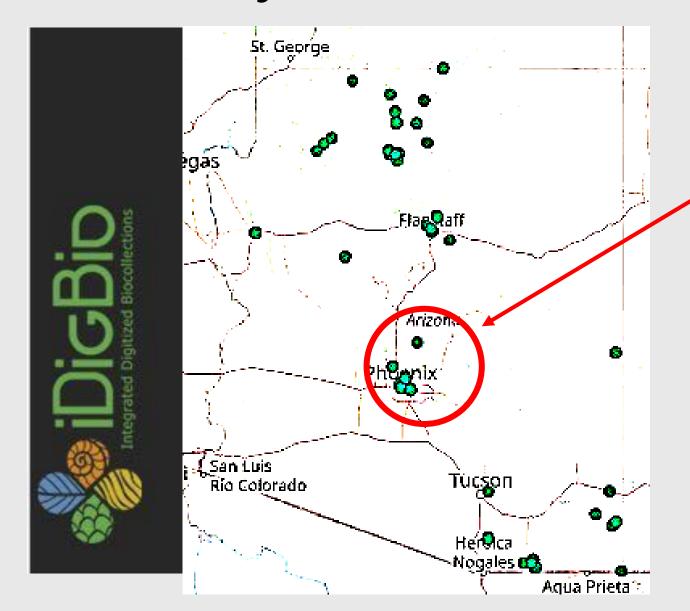


These are not army cutworms



ACW are larvae only during the winter.

Army cutworms in Arizona



Army cutworm larvae and red brome overlap?

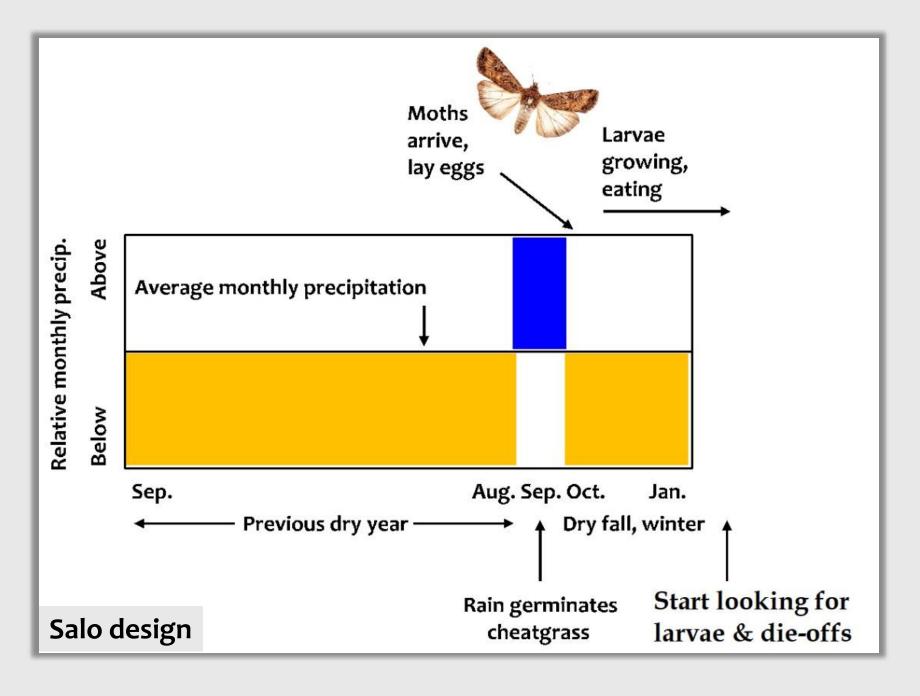
Do army cutworms also eat red brome?

Bob Hammon, at Colorado State University Extension in Grand Junction, saw serious crop damage from army cutworms in early 2003.



Army cutworm outbreaks

Bob Hammon recorded the conditions that led to the army cutworm outbreak in 2003.



Nancy Shaw, at the Forest Service Research Station in Boise, spotted photos of cheatgrass die-offs from the 1930s-1960s in F.S. archives. Conditions before each were similar to those Hammon recorded.



9/21/60 J. O. Klemmedson Deadman Flat, $3\frac{1}{2}$ mi. east of Saylor Cr. Experimental Range, Idaho

Photo shows extensive winte kill of cheatgrass on the north edge of Deadman Flat. Slopes in the background ar predominately south. Light areas in immediate foregrou and left center are patches of cheatgrass which did not winterkill. Russian thistlis the only living plant in the winterkill area.

My poster at the Society for Range Management national meeting, early 2004.





Cheatgrass dieoffs: of drought, cutworms, and bears?

L.F. Salo¹ and M. Zielinski² ¹ UGSG Forest and Rangeland Ecosystem Science Center, Snake River Field Station,
Boise, ID and ² Bureau of Land Management, Winnemucca District Office, Winnemucca, NV

Abstract

Periodic dieoffs of cheatgrass (Bromus tectorum) have occurred in the western U.S.A. for decades. These fluctuations. compounded by variations in productivity. make this exotic annual grass an unreliable forage and periodically increase grazing pressure on perennial species. Understanding these fluctuations is critical for managing these areas. Although risk of fire is reduced on dieoff areas, there is increased risk of erosion and of invasion by other weeds. These declines are commonly attributed to drought. Cheatgrass dieoffs occurred in Colorado, Utah, Nevada, and Idaho In 2003, a year of record heat and drought. Mormon crickets (Anabrus simplex) were common in some areas, but have not been linked to cheatgrass dieoffs. Native miller moths (Euxoa auxiliaris) were also recorded and their army cutworm larvae were observed feeding on exotic cheatgrass. Although the exact role of insects in dieoffs is not clear, sharp borders between bare areas and unaffected cheatgrass suggest a blotic agent, rather than a widespread climatic factor. We are monitoring moths and cutworms in Idaho and Nevada and investigating interactions between these Insects and climate. Cutworms likely act in concert with drought and heat, which produce barren areas for egg-laying, stressed plants that are susceptible to damage, and rapid growth of larvae. These putative interactions may be part of a complex web of interactions, which includes bears that feed on miller moths over-summering at high elevations. The cheatgrass dieoffs of 2003 may foreshadow other changes in Interactions between native and exotic species as a result of predicted global environmental change.

Background Cheatorass dieoffs occurred in Nevada, Idaho, Utah, and Colorado in 2003.

- Areas of cheatgrass dieoffs (pink), Winnemucca, NV BLM district
- Established perennial grasses & shrubs unaffected.
- Reduced risk of fire, but increased risk of erosion & invasion by other weeds.
- Summer annual weeds colonized dieoff areas: Salsola, Amaranthus. Atriplex.



Perennial grasses in dieoff area, NV.



Summer annuals in dieoff area. NV.



Summer annuals in dieoff area. ID.

- Miller moth's (Euxoa auxillaris) army cutworm larvae observed feeding on
- Declines commonly attributed to drought, but sharp borders between dieoffs & unaffected cheatgrass do not support widespread abiotic cause.



Adult miler moth

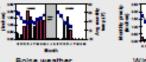


Army cutworm larvae Sharp borders of dieoff

Approach This work investigates links between cheatgrass dieoffs and army cutworms at Boise, ID and Winnemucca, NV Monitored adult miller moths, Boise and Winnemucca, Sept.-Oct. 2003, data posted on Cutworm.org 100 km richard Brits Janua Barboli South Brists

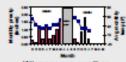
 Will monitor army cutworm larvae, Boise and Winnemucca, March-May 2004

- · Will install larvae exclusion plots at Boise
- Mild winters allow higher survival of larvae



Bolse weather. Sept. 2002-Jan. 2004

Moths trapped, Bolse



Moths trapped, Winnemucca

Winnemucca weather. Sept. 2002-Jan. 2004

Growing degree day models predict larval size



Growing degree days model, 22 Jan. 2004

Resources



http://www.outworm.org

- Data from fall moth surveys and spring larvae surveys
- Growing degree day models
- IPM Information

Contact: Will Lanier, wianier@montana.edu

Army cutworm life cycle

- Eggs laid late summer/early fall, hatch
- · Overwinter as larvae, may congregate in large numbers and damage vegetation in spring
- Pupate in soil
- · Moths emerge late spring. migrate to mountains.

summer in talus slopes. Per anythere are important food of grizzly bears. return to lower elevations late summer

Acknowledgements

Thank you to: J. Christison, L. D. Humphrey, W. Cranshaw, R. Hammon, W. Lenlar, B. Simko, N. Matteson, J. Miler, R. Himyeck, M. Pelant, D. Pyke, and C. Melnke.

Meanwhile, federal research funding supported studies of fungi as the cause of cheatgrass die-offs.

A Race for Survival: Can *Bromus tectorum* Seeds Escape *Pyrenophora semeniperda*-caused Mortality by Germinating Quickly?

JULIE BECKSTEAD1,*, SUSAN E. MEYER2, CHE

Cheatgrass (*Bromus tectorum*) Biocontrol Using Indigenous Fungal Pathogens

Mycelial growth rate and toxin production pathogen *Pyrenophora semeniperda*: reso temporally varying selection

pathogen Pyrenophora semeniperda: resc Susan E. Meyer, David L. Nelson, Suzette Clement, and Julie Beckstead

S. E. Meyer^{a*}, M. Masi^b, S. Clement^a, 1

The quick and the deadly: growth vs virulence in a seed bank pathogen

Susan E. Meyer¹, Thomas E. Stewart² and Suzette Clement¹

Indirect effects of an invasive annual grass on seed fates of two native perennial grass species

Susan E. Meyer · Katherine T. Merrill · Phil S. Allen · Julie Beckstead · Anna S. Norte

The research failed to find a link between fungi and die-offs. Owen Baughman continued to study cheatgrass die-offs.

Invasive Plant Science and Management 2013 6:105-111



Is Pyrenophora semeniperda the Cause of Downy Brome (Bromus tectorum) Die-offs?

Owen W. Baughman and Susan E. Meyer*

Downy brome (cheatgrass) is a highly successful, exotic, winter annual invader in semi-arid western North America, forming near-monocultures across many landscapes. A frequent but poorly understood phenomenon in these heavily invaded areas is periodic 'die-off' or complete stand failure. The fungal pathogen *Pyrenophora semeniperda* is abundant in cheatgrass seed banks and causes high mortality. To determine whether this pathogen could be responsible for stand failure, we quantified late spring seed banks in die-off areas and adjacent cheatgrass stands at nine sites. Seed bank analysis showed that this pathogen was not a die-off causal agent at those sites. We determined that seed bank sampling and litter data could be used to estimate time since die-off. Seed bank patterns in our recent die-offs indicated that the die-off causal agent does not significantly impact seeds in the persistent seed bank.

Nomenclature: Downy brome, *Bromus tectorum* L.; black fingers of death, *Pyrenophora semeniperda* (Brittleb. &

D.B. Adam) Shoemaker.

Key words: Cheatgrass, Great Basin, seed bank, seed pathogen, stand failure.

In January 2014, I recognized the same conditions **Bob Hammon** recorded before the 2003 army cutworm outbreak. I sent out Wanted posters; ACW were first spotted in southwest Idaho in February.

Help solve a mystery and foil cheatgrass:

Watch for flocks of birds on the ground in the Boise foothills this winter

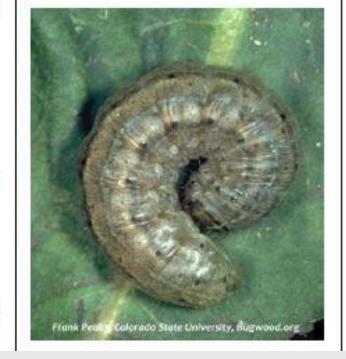
While you're hiking, biking, or commuting in the foothills on cloudy winter days, watch for birds feeding on the ground; they might be eating army cutworms. The cutworms might be eating cheatgrass. Let's find out.

Army cutworms hide in the soil and come above ground to eat young plants at night or on cloudy days—and they love cheatgrass. Birds eat the larvae and are much easier to see than the ½- to 1-inch long insects. We had a bumper crop of adult miller moths last fall. The moths laid eggs in the soil, which hatched into army cutworms. I want to find the larvae to learn where they feed and how much cheatgrass they eat.

Why this is important Cheatgrass sprouts from seeds in winter and turns the Boise foothills brown in summer. It carries fires that burn our native plants.

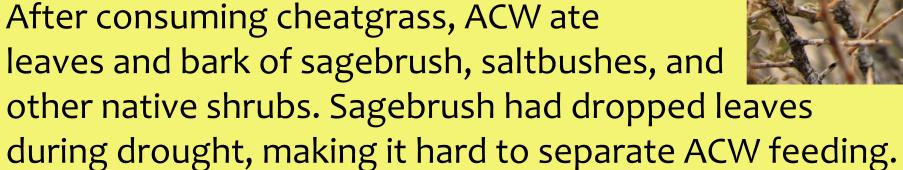
A large hatch of army cutworms can eat every cheatgrass plant in an area. If we know how to find the larvae, we can be ready to reseed areas where they've removed the cheatgrass. With the cheatgrass gone, native

WANTED: Army Cutworm



March 1 and 4, 2014









All, Salo



A site with saltbushes was almost completely defoliated. ACW avoided one branch on most shrubs. Do shrubs always produce anti-feedants in one branch? Or did they produce them in response to ACW feeding?

The saltbushes leaved out again by June, presumably using the leaves on untouched branches to restart photosynthesis.







One sagebrush site produced a second crop of cheatgrass in April. The seeds germinate in fall or spring.



Another sagebrush site was still devoid of cheatgrass and sagebrush leaves the following spring. Cheatgrass and sagebrush recovered there by that summer.

Army Cutworm Outbreak Produced Cheatgrass Die-offs and Defoliated Shrubs in Southwest Idaho in 2014

By Cindy Salo

Salo. (2018) Army cutworm outbreak produced cheatgrass "die-offs" and defoliated shrubs in southwest Idaho in 2014. Rangelands 40(4), 99-105.

RANGELAND NEWS

A QUARTERLY PUBLICATION OF SRM

2018 ISSUE NO. 3

Rangelands Highlight

Army Cutworm Outbreak Produced Cheatgrass Die-off.

Idaho in 2014

My paper on the ACW outbreak got a nice shout-out from the journal editor.

"...establishes a baseline and proposes a meaningful research direction...the first stages of the scientific method."

"The field of rangeland management would be well served by more of this type of article."

Owen Baughman's study in 2014 found that reseeding cheatgrass dieoffs can give perennial grasses a head start on cheatgrass.

Cheatgrass Die-Offs: A Unique Restoration Opportunity in Northern Nevada

By Owen W. Baughman, Robert Burton, Mark William Thomas E. Dilts, and Elizabet A Loger

On the Ground

- The phenomenon of cheatgrass die-off is a con and naturally occurring stand failure tha eliminate the presence of this annual grass year or more, affecting tens of thousand hectares in some years.
- We designed a study to determine if the temporary lack of cheatgrass caused by die-offs is a restoration opportunity. We seeded native perennial species at three die-offs in the Winnemucca, Nevada, area.
- Native grass establishment in die-offs was almost

Many more sown
perennial grasses grew
in die-offs than
in die-offs than
adjacent areas.
adjacent areas.

year or two. 25

difficult to understand how common they are. However, their distinct color and patterns make them perfect for detection with aerial or satellite imagery. In a recent remote sensing study focused on a highly invaded region of north-central

Baughman et al. (2017) Cheatgrass Die-Offs: A Unique Restoration Opportunity in Northern Nevada. Rangelands 39(6), 165-173.

"Blizzards" of ACW moths were found summering in eastern Nevada mountains after the 2014 outbreak.

Lepidoptera BioBlitz Nets Hundreds of Additional Species

By Paul Opler, Colorado State University

Great Basin National Park held its sixth annual Bioblitz on July 12-14, focusing on Lepidoptera (butterflies and moths). The purpose of the BioBlitz was to discover as much as possible about the diversity of Lepidoptera in Great Basin National Park and to engage citizen scientists of all ages so that they learn about and foster a relationship with Lepidoptera in Great Basin National Park.

Prior to the BioBlitz, 88 butterfly species were known in the park,



Dr. Paul Opler leads a trip to identify butterflies near Stella Lake.

Opler. (2014) Lepidoptera BioBlitz Nets Hundreds of Additional Species. The Midden, newsletter of Great Basin National Park, summer, 8-9.

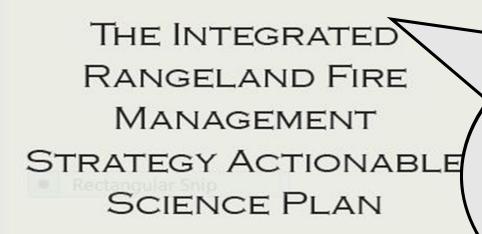




Science Framework for Conservation and Restoration of the Sagebrush Biome: Linking the Department of the Interior's Integrated Rangeland Fire Management Strategy to Long-Term Strategic Conservation Actions

Part 2. Managemen

ations



 Cheatgrass die-offs are a good time to reseed with perennial plants.

 Cheatgrass die-offs are caused by fungi.



October 2016

Beneral Technical Report RMRS-GTR-369 May 2019

Federal reports in 2016 and 2019 recognized that cheatgrass die-offs are opportunities for reseeding, but both said die-offs are caused by fungi.

Chapter 7 Community Ecology of Fungal Pathogens on *Bromus tectorum*

Susan E. Meyer, Julie Beckstead, and JanaLynn Pearce

Abstract Bromus tectorum L. (cheatgrass or downy brome) presents a rich resource

Meyer et al. (2016)
Community Ecology
of Fungal Pathogens
on Bromus tectorum.
In: Germino et al.
(eds) Exotic BromeGrasses in Arid and
Semiarid Ecosystems.

Both federal reports cite the same source, which overlooks research results and knowledge of ACW, fungi, and die-offs.

Army cutworms vs. fungi		
	Army cutworms	Fungi
Weather	Dry	Wet
Damage	Complete	Spotty
Persistence	Migratory	Resident

Of Cheatgrass, Cutworms, and Bears Cindy Salo

- Army cutworms are native insects that feed on exotic crops and weeds, including cheatgrass.
- ACW are well-know pests of crops in the Great Plains and create cheatgrass die-offs in the West during their periodic outbreaks.
- ACW moths summer in mountains and are an important food of grizzly bears.
- ACW outbreaks in the West follow a year of dry weather, late summer rains, a large number of adult moths returning in fall, and dry weather through winter.
- Cheatgrass die-offs are opportunities to reseed cheatgrassdominated areas with desirable species.
- · I continue to study army cutworms eating cheatgrass in the West.

Cindy@CindySalo.com armycutworms.org cindysalo.com