<u>Food Arthropod Abundance Associated with Rest-Rotation Livestock Grazing</u>

Hayes B. Goosey

Department of Animal and Range Sciences

Montana State University

We have completed the second season of investigation into the response of food arthropods of sage-grouse to rest rotation grazing as implemented by the Sage-grouse Initiative (SGI) in central Montana. We collected both pitfall trap and sweep net samples to most accurately estimate both ground and vegetation dwelling arthropod abundances. These data presented here represent an 'Order' view and were tabulated from specimens collected using pitfall traps which represents the activity densities of ground dwelling taxa. We did identify all specimens to 'Family' and some to 'Species', which may add necessary resolution to analyses.

Furthermore, we also deployed sweep net sampling to collect weekly abundances of above ground and more vegetation dwelling arthropods. The taxa collected using sweeps are more representative of song-birds food items and will help to complete the entire picture of arthropod abundance, diversity, and activity in sagebrush steppe habitats. We also collected data on vegetation structure and species frequency at our trapping locations. Analyses of those data are forthcoming.

Sage-grouse chicks are nearly dependent on food arthropods as a sole energy source during the first 21 to 28 days of life (early brooding period). Our initial research objective was to evaluate if the SGI rest rotation grazing program influences the abundance and diversity. Therefore, our past two field seasons focused on sampling and capturing key food arthropods from pastures which were either rested/deferred or grazing by livestock during the early brooding period of late May to early July of each field season.

The arthropods we classified as food for sage-grouses chicks are:

- Beetles (Coleoptera)
- Butterfly and Moth immatures (Lepidoptera larvae)
- Grasshoppers and Crickets (Orthoptera)
- Spiders (Araneae)
- Ants (Hymenoptera: Formicidae)

The report which follows in not comprehensive in what will be our final efforts to effectively summarize these data; rather it is a large picture view of the past two field seasons. The intent of this report is to provide all individuals and entities both private and public with scientific evidence on which to engage in debate on how to conserve sage-grouse and sage-brush steppe habitats while keeping livestock on the landscape and family ranches profitable. Without profitable ranch operations on the landscape, sage-brush steppe habitats are highly threatened for conversion to farming operation.

To begin, average arthropod catches, across all taxa, were greatest from trapping locations located in rested/deferred pastures when compared to catches from locations in pastures containing livestock during 2012 (Fig. 1 A) and 2013 (Fig. 1 B). At this point it is unclear what mechanism is driving this difference and further analyses our data while incorporating vegetative structure and diversity and annual environmental factors may elucidate further understanding. Although food arthropod catches were greatest in rested/deferred pastures, discrepancies did occur between sampling years and taxa within sampling year. For example, in 2012, Beetle (Coleoptera) catches were greatest in rested/deferred pastures (Fig. 1 C); however no differences were recorded in 2013 (Fig. 1 D). In contrast, catches of Butterfly and Moth immatures (Lepidoptera larvae) from locations in rested/deferred and grazed pastures did not differ in 2012 (Fig. 1 E); however more Butterfly and Moth immatures were collected from locations in rested/deferred pastures in 2013 (Fig. 1 F).

The abundance of Grasshoppers and Crickets between rested/deferred and grazed locations did not differ in either year of investigation (Fig. 1 G & H). The abundances of Spiders (Araneae) and Ants (Hymenoptera: Formicidae) did not differ between rested/deferred and grazed locations in 2012 (Fig. 1 I; Fig. 1 K); however more spiders and ants were collected from locations in rested/deferred pastures in 2013 (Fig. 1 J; Fig. 1 L).

Polynomial regressions suggest that the greatest food arthropod abundance is associated with live grass heights between approximately 13 and 32 cm (Fig. 2 A), sage-brush heights of 30 to 52 cm (Fig. 2 B), and areas with less than 50 percent bare ground (Fig. 2 C). Increased sagebrush height also correlates significantly and positively with arthropod abundance. Taller vegetative structure correlating with increased arthropod abundance could be due to both grasses and arthropods being ectothermic and develop based on accumulate heat; with warmer temperatures producing more rapid spring time development and growth when compared to relatively cooler temperatures. Alternatively, taller vegetative structure, in general, should produce favorable microclimates gradients at the site level allowing arthropods to more effectively thermo-regulate. Also, vegetative structure could indicate a change in one or several life cycle events of ground dwelling arthropods including, but not limited to, reproductive, predator avoidance, or food acquisition requirements.

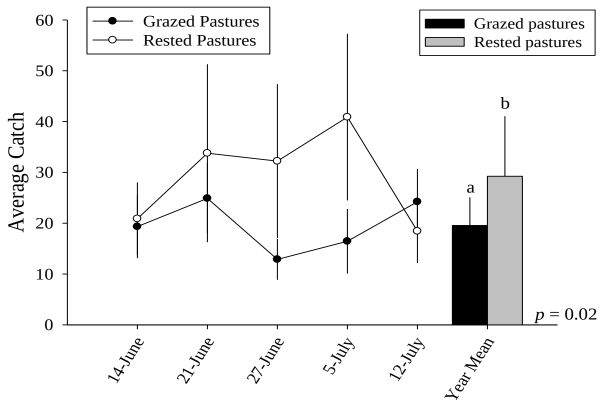
Soil nutrient differences, should they exist, could also play a significant role with areas of relatively greater nutrients or increased nutrient availability producing increased plant and subsequent arthropod diversities and abundances. The percentage of bare ground on the landscape is also a significant part of arthropod abundance in that as bare ground increases above 50%, arthropod abundance decreases.

Linear regressions suggest similar relationships exist between total arthropod catches and live grass height (Fig. 3 A) and live sagebrush height (Fig. 3 B); however R^2 values are lower than reported for polynomial relationships. To the contrary, a linear relationship does not exist between total catches and the percent bare ground at each sampling location (Fig. 3 C).

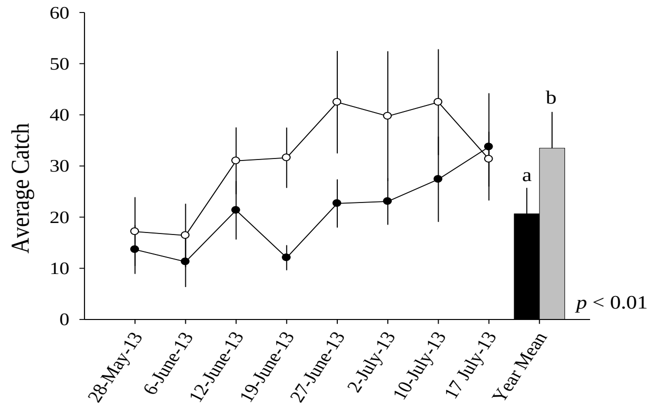
From a livestock production perspective, no grazing system has been shown to be universally superior to any other in terms of its ability to enhance livestock production. As a results, grazing systems like rest rotation can be beneficial to range conditions and livestock operations if the percentage of bare ground is decreased. This not only increases the carrying capacity (AUMs) and potential net returns for livestock enterprises but as evidenced in this report it appears to potentially increase the conservation value for selected food arthropods of sage-grouse chicks. These results suggest that rested/deferred pastures harbor an increased abundance of food arthropods and given that rested pastures also exhibit taller residual vegetative structure it is possible that a deferment during early brooding may increase chick survivorship. On a landscape scale, however, pastures which are either grazed or rested/deferred during the early brooding period represent varying percentages of the total landscape. How arthropod abundances in pastures which are neither rested/deferred nor grazed during early brood rearing remains unknown at this time. Lastly, analyzing the arthropod diversities between pastures may provide additional evidence on which sound land management decisions can be made.

All Taxa

A.

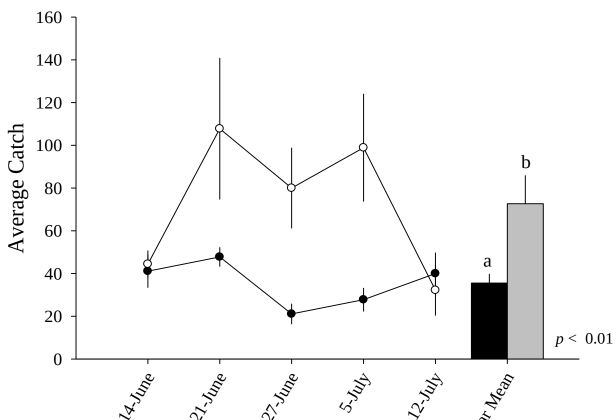


B.

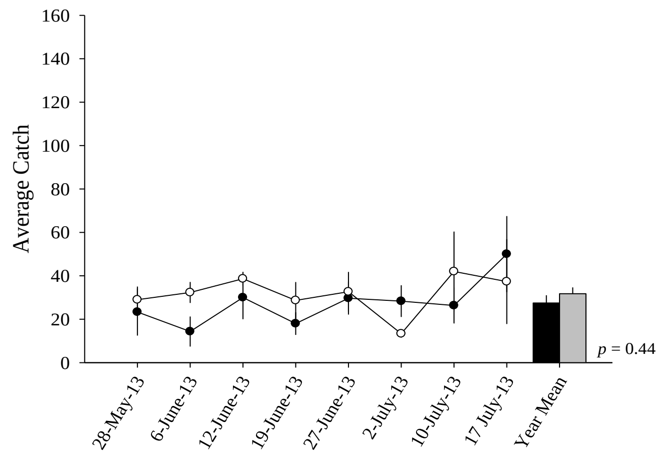


Coleoptera (Beetles)

C.

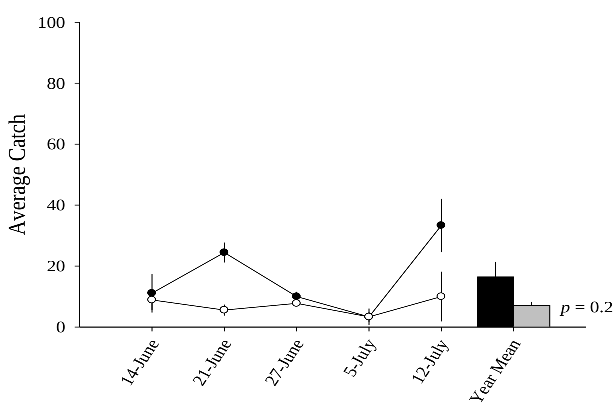


D.

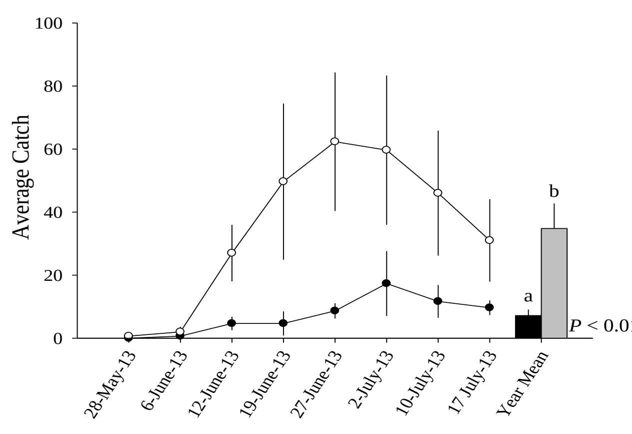


Lepidoptera Larvae (Butterfly and Moth Caterpillars)

E.

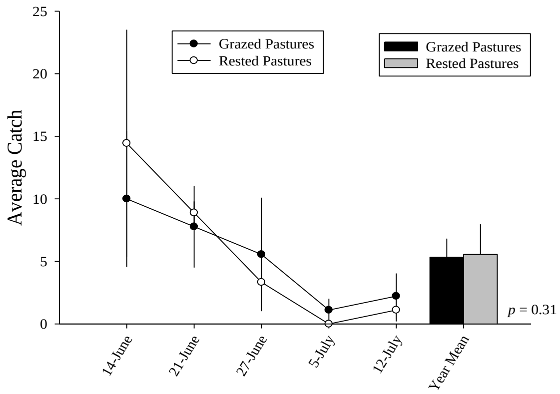


F.

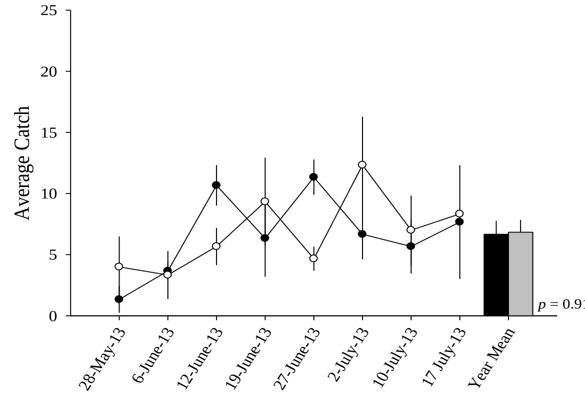


Orthoptera (Grasshoppers and Crickets)

G.

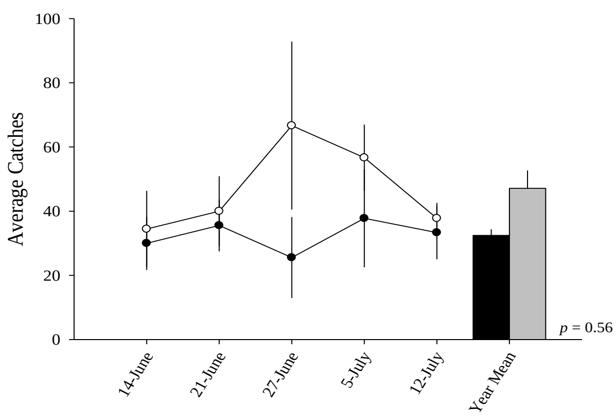


H.

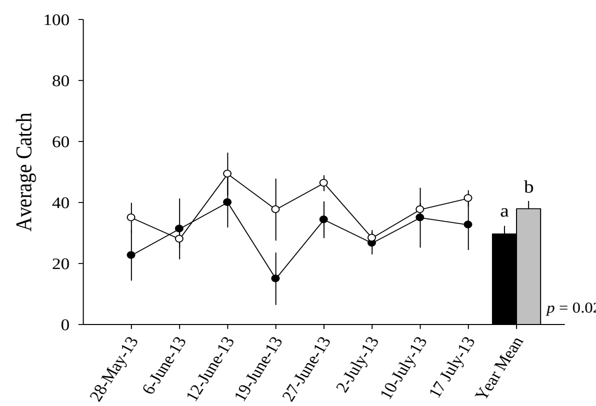


Araneae (Spiders)

I.

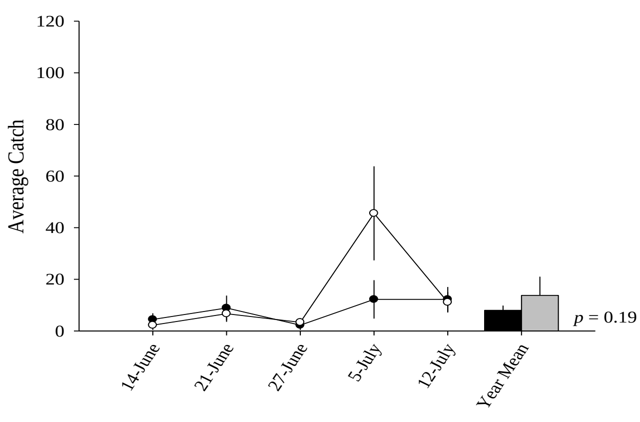


J.



Hymenoptera: Formicidae (Ants)

K.



L.

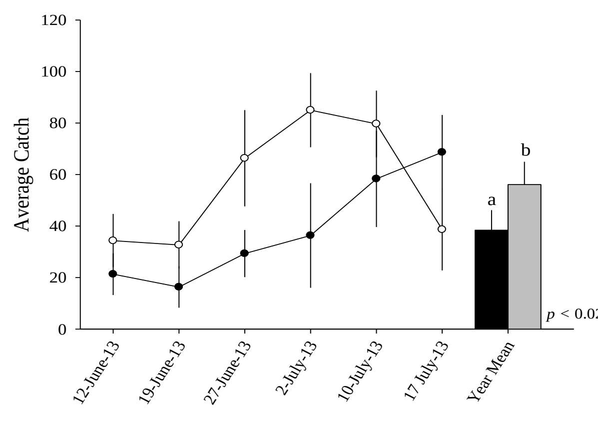


Fig. 1. Averaged catches across all taxa (A & B), Coleoptera (C & D), Lepidoptera (E & F), Orthoptera (G & H), Araneae (I & J), and Hymenoptera: Formicidae (K & L) during 2012 (left column) and 2013 (right column) in pastures which were either rested/deferred or grazed during the early brooding period of late May to early July. Lines represent the average weekly catches, bars represent the averaged catch for the sampling year, and error bars represent the SEM.

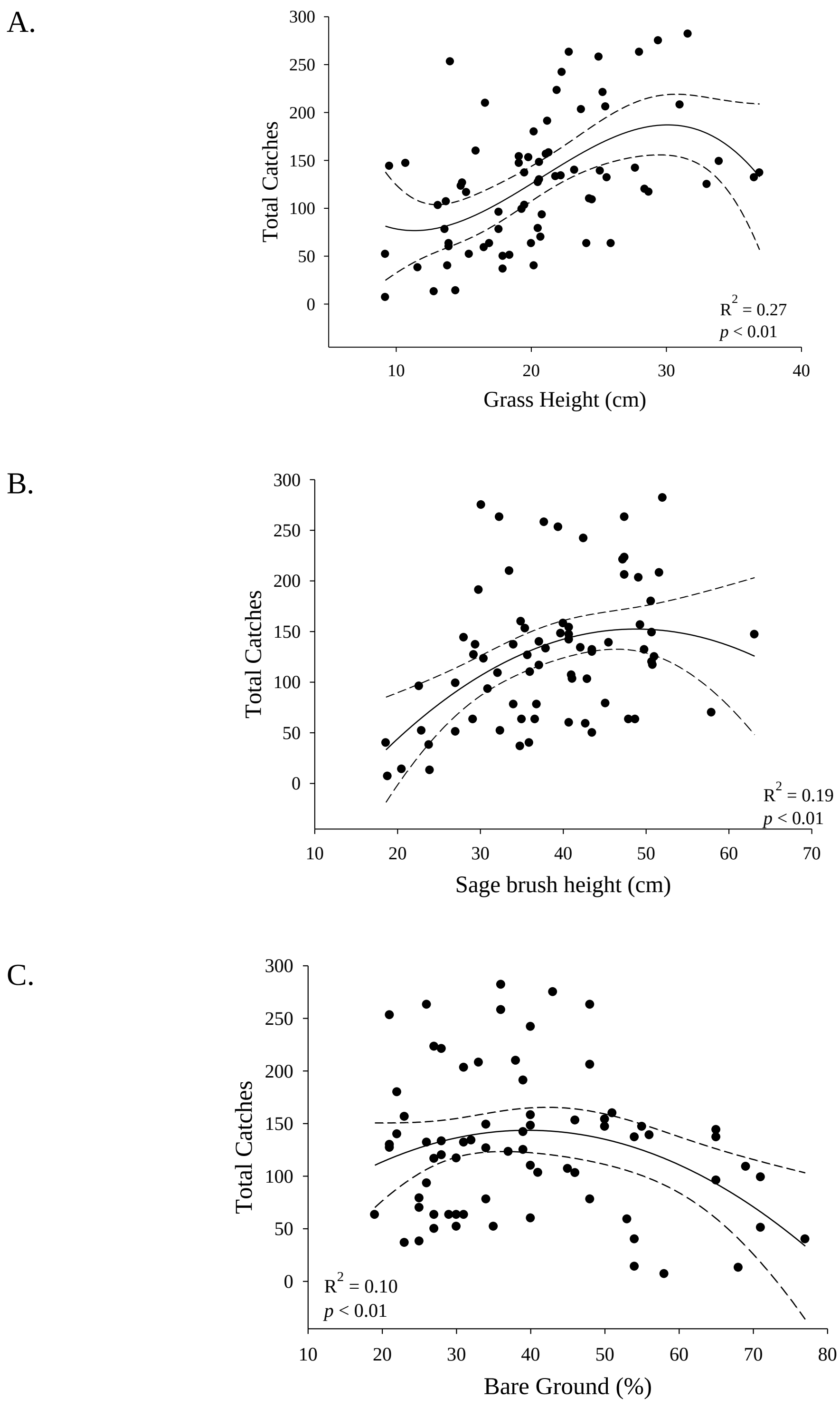
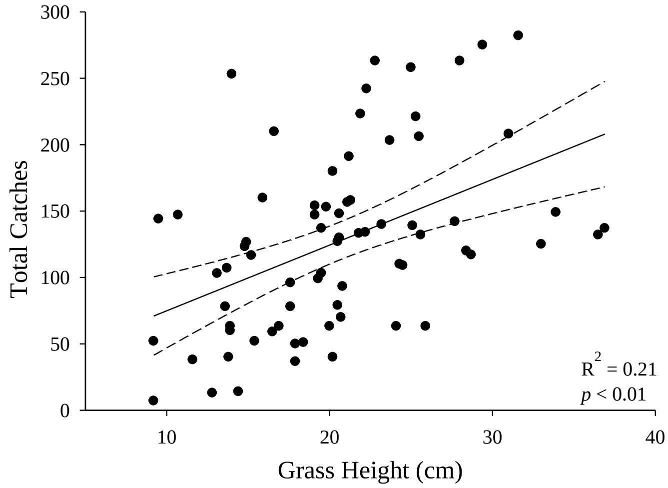
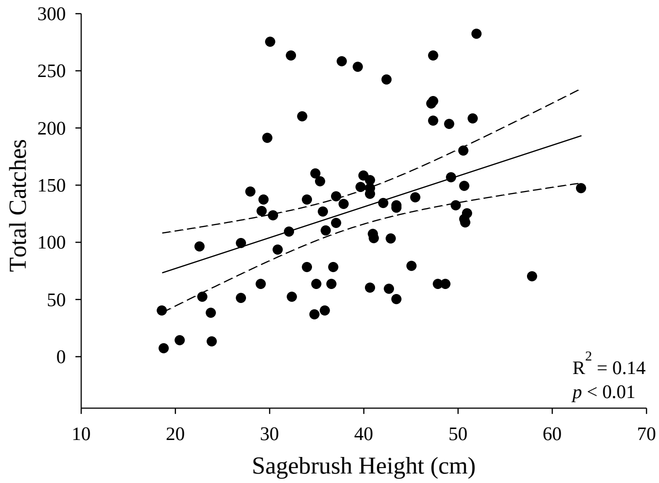


Fig. 2. Polynomial relationships (solid lines), with 95% confidence intervals (dashed lines), between the total pitfall trap catches collected across all dates and A) live grass height, B) live sagebrush height, and C) percent bare ground from sampling locations located in rested/deferred and livestock grazed pastures. The relationship of each regression is highly significant (*p*-value); however the predictive capability (R^2) of each equation is low.

A.



B.



C.

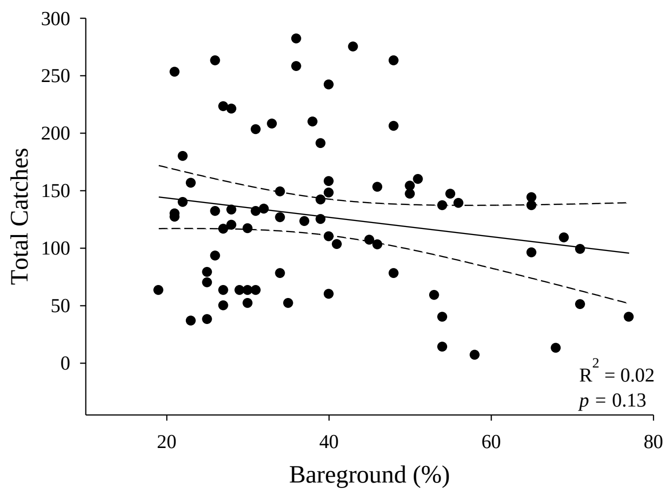


Fig. 3. Linear relationships (solid lines), with 95% confidence intervals (dashed lines), between the total pitfall trap catches across all dates and A) live grass height, B) live sagebrush height, and C) percent bare ground at each of the sampling locations collected from both rested/deferred and livestock grazed pastures. The linear relationships between live grass and sagebrush heights and total arthropods catches are highly significant (*p*-value); however the predictive capability (R^2) of each regression equation is low. The linear relationship between the percentage of bare ground and the total seasonal catches is not significant.