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# STUDIES TO CONTROL GRASSHOPPER POPULATIONS

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## ABSTRACT

*Grasshoppers, which belong to the family Orthoptera and are known as Acrididae, are responsible for causing extensive damage across millions of hectares of western rangelands and crops. The use of chemical pesticides to areas where grasshoppers have established colonies is the primary strategy for curbing grasshopper populations. Chemical control poses significant dangers to people's health as well as to non-target creatures and the natural environment, despite the fact that it is generally inexpensive, quick, and effective. Biological control is an alternative to conventional pesticides made from synthetic materials that is safer for the environment. This will allow us to overcome this obstacle. This study examines many methods that have the potential to be utilized as efficient means of controlling such pests, with a particular emphasis on efficient bait formulations that have the potential to serve as a major model for the development of biological control strategies for the grasshopper population.*

***Keywords:*** *grasshopper; biological control.*

## INTRODUCTION

In grassland ecosystems all across the world, grasshoppers, which belong to the order Orthoptera and family Acrididae, are the most common herbivores. The western half of the United States (US) is made up almost entirely of grasslands, which total close to 262 million hectares. There are around 400 different species of grasshoppers that are known to inhabit the 17 states that are adjacent to one another in the western United States. The vast majority of grasshopper species are either useful or completely harmless to humans. Although grasshoppers can have a detrimental effect on other herbivores by outcompeting them for food, grasshoppers also boost rangeland production by stimulating plant development and speeding nutrient cycling. This is despite the fact that grasshoppers can have a negative effect on other herbivores. Grasshoppers are an important source of nutrition for a wide variety of rangeland predators. However, from time to time, certain species may reach exceptionally high populations and inflict economic damage to rangeland forage and cultivated crops, to the degree that grasshoppers are the most important agricultural pests in rangeland ecosystems across the western United States (US) in the United States. Chemical pesticides, particularly carbaryl, malathion, and diflubenzuron, are the most effective means of eradication that are now available. These chemical pesticides have a potentially severe impact on insects that are not their intended target, most notably pollinators, places that are sensitive to the environment, and endangered or vulnerable species. Due to the fact that biological management has only a negligible impact on the health of people and animals, it would be an especially useful tool if it were used to rangeland and natural environments. In this study, we will cover control tactics that concentrate on chemical and biological control, with an emphasis on the utilization of efficient bait formulations for grasshopper control.

In the western part of the United States, rangeland management faces a challenge in the form of recurrent grasshopper infestations. Extreme breakouts have the potential to cause damage not just to the quality of the rangeland but also to the crops that are grown. The pervasiveness and severity of the damage caused by grasshoppers led to the establishment of a control program by the United States Department of Agriculture (USDA). The Animal and Plant Health Inspection Service (APHIS) is allowed to undertake publically sponsored control programs on rangelands. There is a wide range in the amount of land that is treated each year, from zero to over 13 million acres, but on average, over two million acres are managed. The proportion of public land to private land within the treated area is almost equal. Dry years are more likely to have conditions that are favorable to big hatches of grasshoppers, although entomologists have not had much success in predicting the magnitude and location of any grasshopper epidemic (USDA). The APHIS uses an economic threshold of eight grasshoppers per square yard as the basis for its participation in the control of grasshopper populations (Parker). This threshold has been used for more than half a century. The value of the crop that has to be safeguarded or the productivity of the rangeland has no bearing on whether or not this nominal intervention level is implemented. Before therapies are implemented, however, program administrators do exercise a significant level of judgment and discretion in making treatment decisions. If, in response to an enquiry from resource users or managers, APHIS employees decide that the density of grasshoppers exceeds eight per square yard, the delimited area of the outbreak is evaluated for potential treatment with one of many approaches that have been approved for pest management. It is normally required that the region of the outbreak cover at least 10,000 acres for protection of the range forage.' To this day, the vast majority of control solutions include the use of chemical agents.

When treatments are carried out on federal land, APHIS is responsible for paying the full cost of those treatments. APHIS will cost-share for one-half of the cost for treating state lands if the state has agreements for cost-sharing, and it will cost-share for one-third of the cost for treating private lands. In order to prevent rangelands from being degraded as a result of the harm caused by grasshopper infestations, control initiatives that are funded by the public have been started. Concerns have been raised regarding the consequences that chemical control methods may have on the surrounding ecosystem due to the high expenses that are connected with grasshopper population management. A project known as Grasshopper Integrated Pest Management (GHIPM) (APHIS 1987) has received a significant amount of additional funding. The goal of the Grasshopper Integrated Pest Management (GHIPM) project is to find grasshopper control methods that are less harmful to the environment and more economically viable. As a consequence of this, the GHIPM is required to take into account (a) the appropriateness of the economic thresholds for publicly financed control measures and (b) the degree to which the costs and benefits connected with such control methods are taken into consideration. Specifically included in the latter is an analysis of the effects grasshoppers have on the ecosystem as well as methods for managing them. Only the application of the economic threshold idea in its current form will be discussed in this article.

The findings were derived from an investigation of the Little Missouri National Grasslands (LMNG), but they are applicable to other regions of the Northern Plains that are ecologically analogous. The direct expenses of therapies are compared to the direct benefits that treatments provide, which include the reduction or elimination of harm. The indirect evaluation does not take into account the advantages and costs of the environment, which may accumulate across time and space. The study that has been given does not take into account the long-term advantages that can be obtained by grasshopper control techniques beyond the current year. It has been observed that control programs do not have any multiple-year impacts (Blickenstaff, Skoog, and Daum; Hewitt and Onsager 1983). However, there is no empirical evidence to support the idea that treatments have effects that last for more than one year. Existing control efforts and this research solely examine the current year's mortality of treated grasshoppers, despite the fact that other entomologists believe that multiple-year impacts are occurring (Pfadt) and that private landowners anticipate multiple-year suppression. In addition, there is the possibility that non-target species may be harmed, there will be risks to human health, and an undesirable imbalance will be introduced into the ecosystem. The evaluation of the impacts of grasshopper treatment on both physical and biological systems is now hampered by a lack of data, which is despite the fact that research is being conducted on some of the external costs. Economic analyses of rangeland grasshopper management schemes have been reported by Torell and Huddleston, as well as by Mann, Pfadt, and Jacobs. Torell and Huddleston came to the conclusion that the economic foundation for control is contingent on the potential value of forage that may be spared, the cost of treatment, the treatment life, the treatment efficiency, and the dynamics of the pest population.

## OBJECTIVE OF THE STUDY

1. To the study of Grasshoppers
2. To the study of biological control.

### Purpose

In this work, a novel approach to evaluating the effectiveness of action by public agencies in the management of grasshoppers on public lands is proposed. An analytical system was developed to evaluate suitable treatment options as an alternative to the discrete-choice threshold of eight grasshoppers per square yard. These treatment options are dependent on the set of climatic, biological, and economic conditions that are prevailing at the time a treatment decision is being considered. The analytical system is a simulation model that may be utilized by a manager of a section of public property or by an individual who is responsible for the implementation of the control program. This analytical approach will be utilized to illustrate how intrinsic rangeland productivity, climate, and grasshopper densities do, in fact, impact the advantages and costs of various treatment choices. The analytical system is able to simulate the impacts of a wide number of other significant factors, which will not be covered in this article due to space limitations. Although analysis of these variables would assist to further establish the efficacy of the analytical method in comparison to the discrete-choice criterion, the findings given demonstrate that the financial rationale for treatment is sensitive to a number of crucial aspects.

### The Economic Breakpoint

A discrete-choice measure, known as Plant, is used to determine the applicable economic threshold for rangeland grasshoppers. When the number of grasshoppers in an area reaches eight per square yard or above, the process of implementing management techniques begins. This occurs often independent of rangeland productivity, fodder and livestock pricing, and the features of the grasshopper population. An economic threshold, also known as the notion of an economic injury level (EIL) developed by entomologists, is the level of pest population at which the harm caused by pests becomes equivalent to the expense of controlling them (Stern et al.; Headley 1972a; Hall and Norgaard; Hall and Moffitt; Mann, Pfadt, and Jacobs). The economic threshold may be thought of as a variable that changes based on the benefits and the costs. Although there are others who believe that a discrete-choice threshold is sufficient for the management of grasshoppers on rangeland (Torell and Huddleston), one of the primary objectives of the GHIPM is to improve upon the discrete-choice threshold that is currently being used in the industry. Instead, the economic threshold need to be variable depending on the quantity and value of fodder conserved in addition to the expense of protecting that forage from being destroyed by grasshoppers. The productivity of rangelands, the pricing of animals, the availability and cost of alternative sources of pasture, as well as the cost, efficacy, and timing of treatments to manage grasshopper populations can all be important factors in determining whether or not a treatment is economically justifiable.

### Structure Designed for Analyses

There are three primary components that make up the simulation model known as HOPRAN, which was created to examine the advantages and costs of managing grasshopper populations on public rangelands. The first part of this simulation is modeling the production of range forage in the Northern Great Plains. According to Berry and Hanson's research, the RangeMod model is largely driven by the amount of daily precipitation present in a specific soil and range type. Temperature is the most important factor in determining when spring forage growth begins and when plants reach maturity. The availability of fodder on the range is simulated using the second component, which mimics the consequences of grasshopper infestations. The grasshopper population dynamics model known as HopMod was developed by Kemp and Berry and is predicated on the observed behavior of grasshoppers in both rangeland and laboratory settings. When a certain species mix of grasshoppers is provided, levels of fodder damage may then be measured. Grasshopper species differ in their eating habits as well as the kind and amount of forage that they destroy. Temperature is another factor that can influence grasshopper populations, according to Kemp and Onsager. Given the temperature and the natural mortality of grasshoppers (Hewitt; Hewitt and Onsager 1982; Onsager; Parker), HopMod calculates the amount of fodder that grasshoppers consume as they develop through their many nymphal stages and mature into adults. According to research conducted by Hewitt and Onsager in 1983, an annual fodder loss occurs for each unit increase in the grasshopper population per square yard as grasshopper densities rise.

In addition to simulating the dynamics of grasshopper populations and the accompanying eating behaviors, HopMod also models the effectiveness (mortality rates) of the various treatment approaches that are currently available. The treatment that was applied, the timing of application, the application method, and the effectiveness of the application all have an impact on the grasshopper mortality and residual densities. The projected efficacy of a therapy as measured by its ability to kill significant numbers of grasshoppers is used to calculate the mortality rate that treatment will produce. When grasshopper populations are brought under control, more feed is available for the cattle ranch to use. The interaction between HopMod and RangeMod helps to establish the treatment that is most suited for the conditions that have been experienced with regard to the species of grasshopper, the life stage of grasshoppers, the canopy cover, the closeness to water, and other parameters that serve to choose the choice of treatments. The HOPRAN system also includes a ranch decision model as its third component. The Little Missouri National Grasslands (LMNG) in western North Dakota are the focus of the RanchMod model, which is a linear programming simulation of a typical ranch in the region. The model is utilized to assess how the damage of fodder caused by grasshoppers would affect the money generated by the ranch. The numbers, varieties, and potential productivity of land that are available to ranchers in the region are used as the foundation for RanchMod, which also displays the animal herd management procedures that are typical in the area. The typical ranch consists of 1,505 acres of privately owned property that is adjacent to the LMNG allotments that are put to use (Carson). The ranch receives more than half of its animal unit months (AUMs) from public rangeland. The remaining animal unit months come from hay grown on the ranch, private rangeland, and a very minor proportion from crop leftovers. The production of native hay on 265 acres meets the requirements for winter feed, whilst the LMNG are put to use for grazing during the warmer months of the year. Forage that may be used for late-fall grazing comes in the form of crop residue left over from hay fields that have been harvested. The current lease fee for LMNG property is $2.86/AUM, and the land is leased out entirely by a grazing organization. A typical ranch's lease encompasses 3,120 acres of property owned by the Forest Service and 150 acres of land owned by the state. The average amount of feed that may be produced per acre is 924 pounds.

According to Carson, allotments on the LMNG typically supply enough feed for cattle for eight months out of the year. Beginning on May 1st, cattle are moved onto the leased area, where they will remain until December 31st, when they are then relocated to private property. The length of the grazing season can change based on factors such as the state of the range, the amount of moisture present in the soil, the number of grasshoppers present, and so on. Both a preliminary estimate of the carrying capacity of the range and the AUM price that will be paid to the permittee (Obermiller and Lambert) will be developed on an annual basis. Carrying capacity on the LMNG varies from 3.3 acres per AUM for poor and fair classes of rangeland to 2.2 acres per AUM for fine and outstanding classes of rangeland (Shaver; Carson). These numbers were determined based on projected range condition categories. Adjustments to the appropriate usage factors are carried out in order to prevent an overgrazing of the total fodder that is generated on the rangeland. The stockpiles of native hay that are grown on the ranch are used to feed the livestock during the months of December, January, February, and March. If we believe that an acre will produce one ton of native hay, then we will have 874.5 AUMs available.

This is because one ton of native hay is equivalent to 3.3 AUMs of fodder. According to Burs et al., crop aftermath grazing generates 13.25 AUMs and is calculated based on the assumption that one AUM requires 20 acres of afterwards. A cow-calf business with a foundational herd size of 200 cows is characteristic of the typical ranch. The ability to keep the size of the herd at a consistent level requires the storage of replacement heifers. The assumptions used for the basic cow herd predict that there will be a 90% conception rate and a 95% birth rate from those females that get pregnant. This will result in an 85.5% calf crop that is evenly distributed between steers and heifers. Cows have a mortality rate of 3% on average. Weaned steer calves are sold at a price of $95 per hundredweight, and heifer calves that are not kept for herd replacement are also sold at a price of $90 per hundredweight. It is estimated that the replacement heifers will have a culling rate of 35% (Ensminger); hence, only 26 of the 40 that are kept will be added to the base herd as milk cows. Additionally, cull replacement heifers, cull cows, and cull bulls are sold at prices reflective of the representative market. As the number of grasshoppers in an area increases and consumes more of the available pasture, it is necessary to find other sources of feed for the cattle. The alternatives of rented private rangeland and purchased hay are both taken into consideration by RanchMod as potential sources of fodder. Hay may be acquired at a price of one hundred dollars per ton. The alternative is for ranchers who use the LMNG to relocate their animals to other leased rangeland when the amount of grazed grass available on the property becomes restricted. This range-leasing practice is accounted for in the model, despite the fact that the location of such forage and its availability may shift from one year to the next. Within 50 miles of the ranch, it is presumed that up to 25 percent of the base monthly grazing capacity of the ranch can be leased out on a monthly basis. It is possible to lease an additional 25% of the available grazing space within 150 miles, and it is presumed that there is an endless supply of grazing land beyond 150 miles.2 The private lease rate takes into account the standard lease fee of $8.50 per AUM (Joyce), in addition to a transportation price to the leased pasture that varies according to the distance, as well as an additional veterinary expenditure for the livestock that is kept on off-ranch leased rangeland. When a herd is moved further away from the ranch headquarters, there is an increase in the amount of labor that is required.

## CONCLUSION

Infestations of grasshoppers are notoriously difficult to define, despite the fact that they are typically relatively localized. According to Pfadt and Hardy, when an epidemic takes place, large regions may be badly afflicted while other areas remain free of hazardous concentrations in those locations. The most recent big epidemic, which occurred in 1985, required the treatment of contiguous regions that totaled more than one million acres. On the other hand, during the majority of years when there is an infestation that has to be treated, the treatment of isolated blocks of 10,000 acres is more usual. 2 The Little Missouri Grazing Association, which leases grazing space on the Little Missouri National Grassland, may have a monopoly on this characteristic due to the fact that it is rather unique. For instance, ranchers relocated their animals across substantial distances in order to find adequate grazing space during the recent drought that occurred from 1988-1990. If it is not possible to graze the animals, then hay should be acquired as an alternate source of feed. Because purchased hay is a more expensive source of forage, the financial rationale for treating grasshoppers will occur at lower population densities than it will when leased grazing area is a possibility. This is because purchased hay is a higher quality supply of forage.

## REFERENCES

1. Branson, D.H.; Sword, G.A. An experimental analysis of grasshopper community responses to fire and livestock grazing in a northern mixed-grass prairie. Environ. Entomol. 2010, 39, 1441–1446. [CrossRef] [PubMed]
2. Pfadt, R.E. Field Guide to Common Western Grasshoppers; Wyoming Agricultural Experiment Station: Laramie, WY, USA, 1994; Volume 912.
3. Dakhel, W.H.; Latchininsky, A.V.; Jaronski, S.T. Efficacy of two entomopathogenic fungi, Metarhizium brunneum, strain F52 alone and combined with Paranosema locustae against the migratory grasshopper, Melanoplus sanguinipes, under laboratory and greenhouse conditions. Insects 2019, 10, 94. [CrossRef] [PubMed][Green Version]
4. DeBrey, L.; Brewer, M.J.; Lockwood, J.A. Rangeland Grasshopper Management; Extension Bulletin B-980; College of Agriculture, University of Wyoming: Laramie, WY, USA, 1993.
5. Latchininsky, A.; Sword, G.; Sergeev, M.; Cigliano, M.M.; Lecoq, M. Locusts and grasshoppers: Behavior, ecology and biogeography. Open Access 2011. [CrossRef][Green Version]
6. Hostetter, D.L. Natural enemies attacking grasshopper nymphs and adults. In Grasshopper Integrated Pest Management User Handbook; Cunningham, G.L., Sampson, M.W., Eds.; U.S. Department of Agriculture: Washington, DC, USA, 2000; pp. I.8-1–I.8-7.
7. Pfadt, R.E. A Field Guide to Common Western Grasshoppers, 3rd ed.; Wyoming Agricultural Experiment Station Bulletin 912; Wyoming Agricultural Experiment Station: Laramie, WY, USA, 2002; p. 228.
8. Murray, D.W. The Biology, Ecology, and Management of the Migratory Grasshopper, Melanoplus sanguinipes (Fab.); Distance Master of science in Entomology Project 13; University of Nebraska: Lincoln, NE, USA, 2016.
9. Zhang, L.; Lecoq, M.; Latchininsky, A.; Hunter, D. Locust and grasshopper management. Annu. Rev. Entomol. 2019, 64, 15–34. [CrossRef] [PubMed]
10. Lee, J.C.; Bernays, E.A. Food tastes and toxic effects: Associative learning by the polyphagous grasshopper Schistocerca americana (Drury) (Orthoptera: Acrididae). Anim. Behav. 1990, 39, 163–173. [CrossRef]
11. Branson, D.H.; Sword, G.A. Grasshopper herbivory affects native plant diversity and abundance in a grassland dominated by the exotic grass Agropyron cristatum. Restor. Ecol. 2009, 17, 89–96. [CrossRef]
12. Hastings, J.D.; Latchininsky, A.V.; Schell, S.P. Sustainability of grasshopper management and support through CARMA. In Proceedings of the 2009 42nd Hawaii International Conference on System Sciences, Waikoloa, Hawaii, 26 June 2009; pp. 1–10.
13. Lockwood, J.R. The fate of the Rocky Mountain locust, Melanoplus spretus Walsh: Implications for conservation biology. Terr. Arthropod Rev. 2010, 3, 129–160. [CrossRef]
14. Skinner, K.M. The past, present, and future of rangeland grasshopper management. Rangel. Arch. 2000, 22, 24–28. [CrossRef][Green Version]

15. Davis, R.M.; Skold, M.D.; Berry, J.S.; Kemp, W.P. The economic threshold for grasshopper control on public rangelands. J. Agri. Resour. Econ. 1992, 17, 56–65.