



The structure and performance of an adult population of *Aulocara elliotti* (Thomas) (Orthoptera, Acrididae) near Billings, Montana
by Gerald Louis Mussgnug

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of
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Abstract:

The structure and performance of an adult population of *Aulocara elliotti* (Thomas) were studied during 1970 and 1971 on a grassland site near Billings, Montana. Distribution, density, and movement were investigated by using a capture-recapture technique. Fluorescent marking paints and pretarsal clipping were used to identify individuals. A total of 728 males and 451 females were marked for study, and of these, 139 males and 140 females were recaptured. Both field and field-cage conditions were used to study behavior patterns and to measure longevity, fecundity, and survival. In both years densities remained below one grasshopper per square yard. Distribution was non-random. Interaction among individuals, oviposition sites, and habitat selection were important factors determining distribution. Males exhibited higher displacement distances and rates than did females early in the season, although no predominant direction of displacement was noted. Patterns of behavior followed a diurnal rhythm. Adults were noted in the field from June 29 to August 20 in 1970 and from June 21 to August 20 in 1971. Females on the average produced an estimated 24.0 to 28.8 eggs each during their lifetime. A greater percentage of eggs hatched from pods chilled at 3° to 5°C for 80 days than those receiving the same temperatures for only 50 days. Hatching was primarily confined to the forenoon hours of the day. Temporary barriers to mating of 3 to 4 days, imposed by the female, were noted between individuals from different sub-populations under field-cage conditions. It is hypothesized that changes in population structure act in regulating population numbers and performance.

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AULOCARA ELLIOTTI (THOMAS) (ORTHOPTERA, ACRIDIDAE)
NEAR BILLINGS, MONTANA

by

GERALD LOUIS MUSSGNUG

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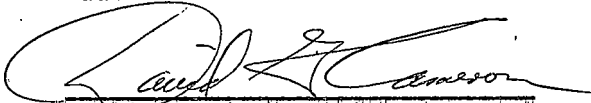
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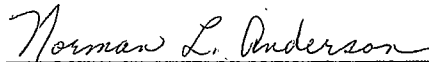
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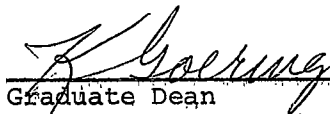
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ABSTRACT

The structure and performance of an adult population of *Aulocara elliotti* (Thomas) were studied during 1970 and 1971 on a grassland site near Billings, Montana. Distribution, density, and movement were investigated by using a capture-recapture technique. Fluorescent marking paints and pretarsal clipping were used to identify individuals. A total of 728 males and 451 females were marked for study, and of these, 139 males and 140 females were recaptured. Both field and field-cage conditions were used to study behavior patterns and to measure longevity, fecundity, and survival. In both years densities remained below one grasshopper per square yard. Distribution was non-random. Interaction among individuals, oviposition sites, and habitat selection were important factors determining distribution. Males exhibited higher displacement distances and rates than did females early in the season, although no predominant direction of displacement was noted. Patterns of behavior followed a diurnal rhythm. Adults were noted in the field from June 29 to August 20 in 1970 and from June 21 to August 20 in 1971. Females on the average produced an estimated 24.0 to 28.8 eggs each during their lifetime. A greater percentage of eggs hatched from pods chilled at 3° to 5°C for 80 days than those receiving the same temperatures for only 50 days. Hatching was primarily confined to the forenoon hours of the day. Temporary barriers to mating of 3 to 4 days, imposed by the female, were noted between individuals from different sub-populations under field-cage conditions. It is hypothesized that changes in population structure act in regulating population numbers and performance.

INTRODUCTION

The big-headed grasshopper, *Aulocara ellioti* (Thomas), is a grassland species occurring throughout the Grassland Biome of North America (Pfadt, 1949). During its recorded history, it has become very abundant in many parts of its range at times. Cooley (1904) reported heavy infestations in eastern Montana during 1901, 1902, and 1903. Outbreaks again occurred from 1919 to 1923 (Cooley, 1919; Cooley *et al.*, 1923) and from 1934 to 1937 (Strand, 1937). White and Rock (1945) have reported *A. ellioti* to be the most important economic grasshopper in Alberta, while Ball *et al.* (1942) have included this species among the most injurious range grasshoppers in Arizona.

Variations in population density of *A. ellioti* have been noted from year-to-year over small geographic areas in Montana (Hastings and Pepper, 1964). These fluctuations in number have been the subject of investigation for over a decade at Montana State University. The majority of these studies have been designed to elucidate physiological mechanisms and developmental patterns in the laboratory. While such studies have added much to the knowledge of this species, the lack of accompanying field data has severely limited extrapolation of this information to real situations in nature.

To date there have been few observations made on the behavior of *A. ellioti* in nature and little is known about how its populations are structured and perform in the field. Its feeding habits have been

reported by Anderson (1964), Anderson and Wright (1952), Nerney and Hamilton (1969), and Pfadt (1949). Except for Nerney and Hamilton, these workers have found that early nymphal instars feed primarily on Sandberg bluegrass (*Poa secunda* Presl.) while older instars and adults feed mainly on western wheatgrass (*Agropyron smithii* Rydb.). Nerney and Hamilton state that sparse stands of blue gramma (*Bouteloua gracilis* (H.B.K.)) dominated by low growing weeds make up the preferred habitat of *A. elliotti* in Arizona.

Mating and oviposition behavior have been studied under caged conditions by Ferkovich *et al.* (1967). Otte (1970) has described the mating of *A. elliotti* in the field, with emphasis on the acoustical aspects. Anderson and Hastings (1966) have noted differences in selectivity in the mating behavior and oviposition media of caged females. Nerney and Hamilton (1969) have reported selection of open bare patches of soil as oviposition sites in the field and have shown how temperature is responsible for this species' roosting behavior. Information on field movements are limited to papers by Anderson (1964), Nerney and Hamilton (1969), and Smith *et al.* (1964).

The present investigations were undertaken in an attempt to provide some insight into the population structure and performance of *A. elliotti* in the field and to provide data on the environmental conditions of its habitat. It was also realized that in order to formulate future pest management strategies, a better working knowledge

of the population dynamics of this species as part of a life-system was necessary. Important components of a population's structure included such factors as distribution, density, movement, and behavior. Consideration of population performance included such factors as longevity, fecundity, and survival under field and field-cage conditions.

DESCRIPTION OF THE AREA

A grassland area located about 5 mi. west of Billings, Montana, 45° 47' 50" N. and 108° 43' 0" W., at an elevation of 3,460 ft. was chosen for study. The area is bounded on the east by croplands and on the north and west by a rock escarpment. A prominent E-W ridge of this escarpment effectively divides the rangeland into two sections, while a small N-S corridor of less than one-quarter of a mile, bordering the croplands, serves to connect them. The major plots were located immediately north of this corridor at the terminus of a small drainage where a population of *A. elliotti* (Thomas) had been noted in previous years. A second comparable site was established .25 mi. S. W. of these plots in 1971.

Summer weather of the area is characterized by hot, dry, sunny days with occasional thundershowers. Occasionally afternoon storms produce hail and high winds. Table 1 summarizes the weather events for 1970 and 1971, while Table 2 lists precipitation data obtained from the U. S. Weather Bureau located at Logan Field just north of Billings. These data are considered to represent fairly accurately the precipitation received at the study site in that less than 5 mi. separate the two areas.

Table 1. Weather events at the study area.

Date		Date	
6/27/70	sunny, afternoon shower	7/30/70	sunny, cloudy and windy in afternoon
6/28	sunny		
6/29	P.C.,* thundershowers	7/31	sunny
6/30	sunny	8/1	sunny, windy
7/1	sunny	8/2	sunny
7/2	P.C.*	8/3	sunny
7/3	sunny	8/4	sunny
7/4	sunny, afternoon winds, thundershowers at night	8/5	P.C.*
7/5	P.C.* morning	8/6	sunny
7/6	cloudy	8/7	sunny
7/7	sunny	8/8	sunny
7/8	sunny	8/9	sunny
7/9	sunny	8/10	sunny
7/10	cloudy	8/11	sunny
7/11	sunny	8/12	sunny
7/12	sunny	8/13	P.C.*
7/13	sunny, 35 mph winds at night	8/14	sunny
7/14	sunny, 35 mph winds	8/15	sunny
7/15	sunny	8/16	sunny
7/16	sunny	8/17	sunny
7/17	sunny	8/18	sunny
7/18	sunny		
7/19	sunny		
7/20	sunny		
7/21	P.C.* morning, heavy rains, wind, hail in evening		
7/22	sunny		
7/23	P.C.* morning		
7/24	sunny		
7/25	sunny, high winds and shower in evening		
7/26	sunny		
7/27	sunny, windy and shower in evening		
7/28	cloudy morning, very windy, thunderstorms in evening		
7/29	sunny		

