A PITFALL TRAPPING SURVEY OF DARKLING BEETLES IN DESERT STEPPE VEGETATION[1]

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Abstract. A pitfall trapping survey of autumn emergent darkling beetles was conducted on the Hanford Reservation, Benton County, Washington, in 1963. Forty-nine pitfall traps were arranged in a grid pattern in greasewood and sagebrush communities. Quantitatively, the beetle catch was composed almost entirely of two species, *Pelecyphorus densicollis* and *Stenomorpha puncticollis*. These appeared in the traps in September and reached a peak of abundance in mid-October. Trap catches declined until early December when the beetles were killed by the onset of cold weather.

A total of 4,378 beetles was captured, marked, and released. An estimate of beetle population indicated that about one thousand more beetles were present in the sagebrush community. *Stenomorpha* was more abundant than *Pelecyphorus* in either community, but more *Pelecyphorus* occurred in sagebrush than in greasewood. A dense sward of cheatgrass in the greasewood community appeared to reduce the catch of *Pelecyphorus* but not *Stenomorpha*. *Pelecyphorus* showed a predilection for open ground between shrub canopies but *Stenomorpha* predominated on ground beneath the shrub canopies. On the average, *Stenomorpha* weighed more than *Pelecyphorus*. This resulted in a beetle biomass of approximately the same magnitude in both communities.

INTRODUCTION

Autumn emergent darkling beetles are a conspicuous component of the insect fauna of desert steppe ecosystems of southeastern Washington but information concerning the time of appearance of adults and the duration and magnitude of these populations is not available. Estimates of population densities of ground-dwelling arthropods of the desert regions of North America are scarce in the published literature. The studies of Allred, Beck and Jorgenson (1963) and those of Turner (1962) are examples of recent North American studies.

The purpose of this survey was to obtain information on the time of appearance, duration and magnitude of emerging populations of darkling beetles. Such information is needed for the planning of comprehensive ecological studies of mineral cycling, bioenergetics and the effects of gamma radiation upon animal populations.

Two sites were selected for study in adjacent plant communities on the Hanford Reservation, Benton County, Washington. One was dominated by a pure stand of big sagebrush, *Artemisia tridentata* Nutt. The other was dominated by greasewood, *Sarcobatus vermiculatus* (Hook) Torr. The herbaceous understory plants to the widely spaced shrubs of both sites were floristically similar, but the greasewood community supported a dense sward of cheatgrass, *Bromus tectorum* L. By contrast, the sagebrush community supported a sparse discontinuous stand of herbs with much bare ground. Although protected from grazing since 1961, both sites have been intensively grazed by livestock in the past. The soils of the two sites were similar with respect to physical and chemical properties at least in the upper 4 dm of profile. The surface soil beneath greasewood shrubs, and the soil profile below 4 dm in the greasewood site was distinctly sodic (Rickard 1965).

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The climate of the reservation is semiarid. Annual precipitation averages only 6.73 in. mostly confined to late fall and winter months. Summers are characteristically hot and dry. Maximal temperatures in summer exceed 100°F and winter minimum temperatures range below zero. Soil moisture is near minimal annual values in September when the upper 4 dm of soil profile contains only 2 to 4% moisture by weight.

METHODS

In each site 49 pitfall traps were installed in the early summer of 1963. These consisted of metal cans 10 cm in diameter and 25 cm in height buried to their rims. Cans were spaced systematically in a 7- × 7-m grid with 3-m spacing between cans. Traps were visited in the morning twice weekly through November. Beetles taken in each can were identified and marked dorsally with a dab of quick-drying but long lasting paint (dope), and then released at a point approximately midway between adjacent cans. The same marking was used on all beetles at all trapping periods. A taxonomic series of beetles was deposited in the insect collection at Washington State University, Pullman, Washington.

RESULTS AND DISCUSSION

Pelecyphorus densicollis Horn. and *Stenomorpha puncticollis* LeC. were abundant autumn emergent beetle species and first appeared in the traps in early September (Fig. 1). *Pelecyphorus* appeared a few days earlier than *Stenomorpha*. Both species in both sites reached a peak of abundance in mid-October. Catches then declined until early December when the adult beetles were killed by the onset of cold weather (Fig. 1). As air temperatures declined after mid-October, the mobility of beetles slowed noticeably. The reduction of catch was a reflection of this decreased mobility as well as of increased mortality. In the sagebrush site, *Pelecyphorus* was trapped more abundantly than *Stenomorpha* until the last part of October, but thereafter *Stenomorpha* was more abundant. The persistence of relatively large *Stenomorpha* catches later in the season suggested that these beetles were more cold hardy or perhaps more adept at seeking protective cover than was *Pelecyphorus*. At the peak of

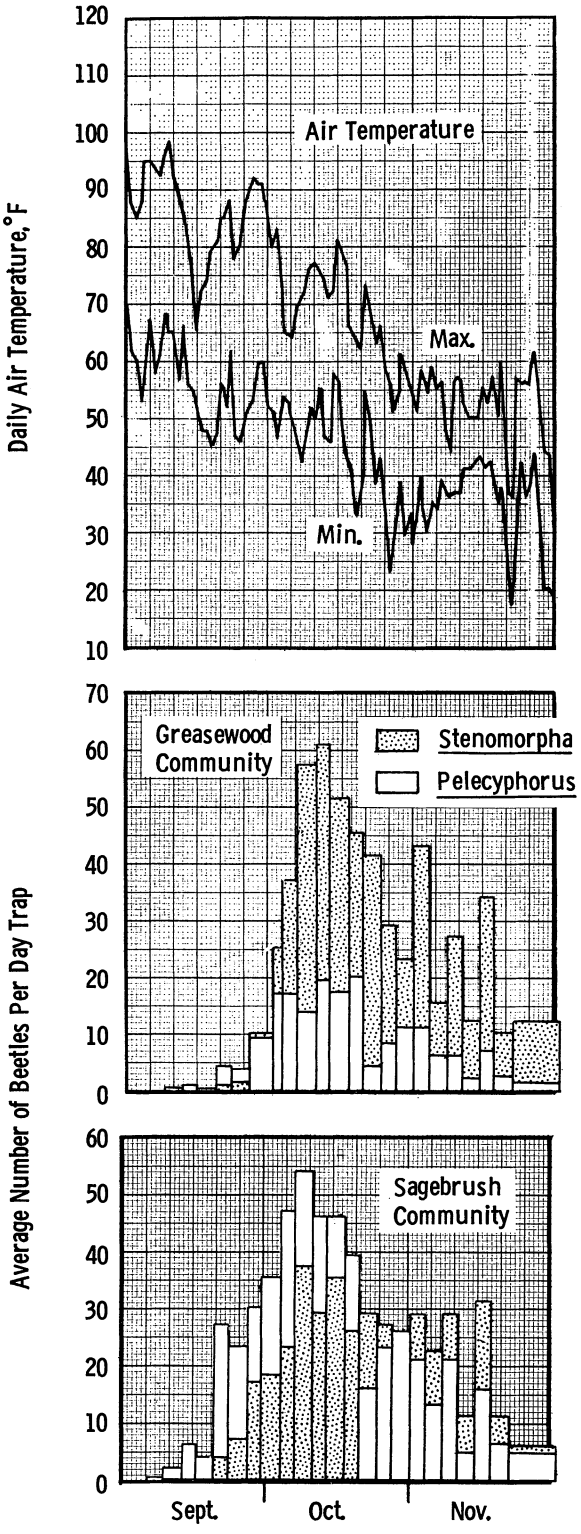

FIG. 1. Pitfall trap catch of darkling beetles, averages per day trapped, in greasewood and sagebrush communities during the autumn of 1963 in relation to the autumnal decline of air temperature. Average values for *Stenomorpha* and *Pelecyphorus* read from base zero. On the trap period ending October 31, both species of beetles were trapped in equal abundance in the sagebrush community.

emergence the catch of *Pelecyphorus* averaged 54 beetles per day in the sagebrush site as compared to only 20 per day in the greasewood site (Fig. 1). The peak emergence period in the greasewood site averaged 61 *Stenomorpha* per day as compared to only 37.5 in the sagebrush site. The weather during these peaks was characterized by moderate air temperatures and lack of precipitation.

A total of 4,378 beetles was captured, marked and released (Table I). Of these, 2,458 were taken in the sagebrush site and 1,920 in the greasewood site. *Stenomorpha* and *Pelecyphorus* were about equally represented in the catch from the sagebrush site, but three times more *Stenomorpha* than *Pelecyphorus* were taken in the greasewood site.

The general physiognomy, size and spacing of the vegetation at each site was similar. The most obvious vegetative difference between the two sites was the dense sward of dried cheatgrass litter in the greasewood site. For comparative purposes the density of grass stems measured in spring was 47/dm^2 on 24 randomly selected plots in the greasewood site as compared to only 1.4 plants/dm^2 on 36 random plots in the sagebrush site. Litter, as an impediment to beetle mobility, has been attributed as a factor in reducing the pitfall trap catches of carabid beetles (Greenslade 1964). This seemed to be the case in this investigation in respect to the catch of *Pelecyphorus* but not *Stenomorpha*. In the more litter-free sagebrush site, 46% of the marked *Pelecyphorus* were recaptured as compared to only a 36% recovery in the greasewood site. The percentage of recaptures of *Stenomorpha* was about equal in both vegetation sites (Table I).

Stenomorpha showed a predilection for shrub cover, associated leaf litter and shade while *Pelecyphorus* showed a predilection for more open ground. These differences were revealed in the data shown in Table I. In this table the cans with an overhanging shrub canopy are designated as "shaded" while those removed from the canopy edge are "unshaded." These data indicate that the "shaded" cans captured fewer *Pelecyphorus* and more *Stenomorpha* than the adjacent "unshaded" cans.

Assuming that the proportion of marked and subsequent recaptures of beetles was the same as the proportion of marked to unmarked beetles, an estimate of the total population was made over the entire emergence period:

	Sagebrush	Greasewood
Pelecyphorus	2,680	1,260
Stenomorpha	4,530	4,970
Total	7,210	6,230

About a thousand more beetles were estimated to have been present on the sagebrush site. From these figures and the assumed 441 m^2 effective trapping area (21 $\times$ 21 m) of each site, the number of beetles per m^2 was estimated:

	Sagebrush	Greasewood
Pelecyphorus	6.1	2.9
Stenomorpha	10.3	11.3
Total	16.4	14.2

From the fresh weights of beetles captured on December 3, 1963, it was determined that *Stenomorpha* weighed more on the average than *Pelecyphorus*.

	Sagebrush
Pelecyphorus, mg	139 ± 6.2(SE), n = 21 82% moisture

TABLE I. Total catch of darkling beetles in 49 pitfall traps in greasewood and sagebrush communities during the Autumn of 1963

Category	Sagebrush community		Greasewood community	
	Pelecyphorus	*Stenomorpha*	*Pelecyphorus*	*Stenomorpha*
Total marked	1,235	1,223	449	1,471
Total recaptures	568	330	160	431
Per cent recaptured	46	27	36	29
Average catch/ shaded can[a]	13.2	28.7	2.8	33.4
Average catch/ unshaded can[b]	32.2	22.8	12.0	28.5

[a]The number of shaded cans was 18 in the sagebrush and 15 in the greasewood community.
[b]The number of unshaded cans was 31 in the sagebrush and 34 in the greasewood community.

Stenomorpha, mg 224 ± 1.1 (SE), n = 27, 75% moisture

Greasewood

Pelecyphorus, mg 171 ± 4.9 (SE), n = 9, 77% moisture

Stenomorpha, mg 242 ± 7.1 (SE), n = 25, 74% moisture

From the weight data the beetle biomass in grams per m^2 was calculated.

	Sagebrush	Greasewood
Pelecyphorus, g	0.85	0.50
Stenomorpha, g	2.31	2.73
Total, g	3.16	3.23

The trap data indicated that a sizeable population of darkling beetles comprised almost entirely of *Pelecyphorus* and *Stenomorpha* was present.

The catch of beetles by pitfalls was of sufficient magnitude to encourage more refined mark and recapture procedures for population estimates and the definition of dispersal movements.

Because of the lack of quantitative data concerning beetle populations in pristine desert steppe ecosystems, it is not possible to evaluate the effect of vegetation changes upon populations. Cheatgrass has become widely spread as a result of overgrazing of native grasses during the past 100 years, and the presence of cheatgrass at least in dense swards may favor *Stenomorpha* populations over those of *Pelecyphorus*.

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THE FREQUENCY AND MAGNITUDE OF INTRASPECIFIC PARASITISM IN *TRIATOMA SANGUISUGA* (LECONTE) (HEMIPTERA)[1]

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Abstract. *Triatoma sanguisuga* (Leconte) will feed upon their own species in the laboratory. Some of these insects passed from the first to the fourth instar without any nourishment except haemolymph from other bugs. One insect was maintained 556 days on haemolymph alone. All stages of the insect, including adults, parasitized each other. It required 17 to 24 mg of haemolymph taken in 5 to 8 feedings for the insect to pass through the second instar and 57 to 65 mg of haemolymph taken in 8 to 13 feedings to pass through the third instar. One nymph took 106 mg of haemolymph in the fourth instar, but it did not molt to the fifth instar. *Trypanosoma cruzi* was not passed from infected to uninfected insects during parasitism.

Feeding of Triatominae on their own species has been known since 1914 when Brumpt referred to the process as "cannibalism." Ryckman (1951) referred to the same process as kleptohemodeipnonism. Phillips (1960) proposed that the term be retained as haematoklepty to indicate that blood was removed from the gut of the host. The process in *Triatoma sanguisuga* (Leconte), as observed at this laboratory, appears to be one of intraspecific parasitism, since one insect inserts its mouthparts into the body of another of the same species and withdraws fluids without much discomfort and usually without death to the host.

Although the mechanics of intraspecific parasitism are well documented, no one has attempted to determine the magnitude or frequency of this type of parasitism. This investigation was concerned with determining the percentage of this species resorting to parasitism in the absence of a warmblooded host, quantity of fluid withdrawn from the host, frequency of parasitism, and relative importance of this practice as a survival mechanism.

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