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DRY WEIGHT BIOMASS DATA FOR FOUR ABUNDANT GRASSHOPPER SPECIES OF THE PAWNEE SITE

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ABSTRACT

Data are presented for the oven-dry weights of adults and juvenile instars of each sex for four species of acridid grasshoppers on the Pawnee Site: *Opeia obscura* Thomas, *Psolessa texana* Scudder, *Xanthippus corallipes* Haldeman and *Melanoplus gladstoni* Scudder.

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INTRODUCTION

One of the primary goals of orthopteran research at the Pawnee Site is to estimate the energy flow through grasshoppers, assuming that they are a very major component of the primary consumer trophic level. To accomplish this, several kinds of data are necessary. One vital group of data is biomass of the various species, sexes, and stadia of orthopteran insects.

METHODS

With respect to orthopteran species whose life cycle is of the type called incomplete metamorphosis, a detailed, accurate analysis of biomass cynamics requires the separation of individuals of each species into sex and stadium. In most species the life cycle consists of the egg stage, five juvenile stages or instars (designated ①, ②, ③, ④, and ⑤) and the adult stage (ad.)

Eggs must eventually be considered in biomass calculations, but because of the difficulty in collection and recognition, the collection of egg biomass data is postponed.

There are, then, six stadia times two sexes to consider exclusive of the egg stage. However, individuals of most orthopteran species in the first instar stage ((①)) are difficult to separate as to sex. Also, cursory examination shows that males and females of these early instars ((① and ②) do not differ much in size and biomass. For these reasons, all individuals of the first instar stage are lumped together in our tables.

The strategy adopted for gathering data has been to start with the most abundant species for which the most specimens are available. Data for three of the most abundant species are given in the present report. These are: *Opeia obscura* (Thomas), a smaller late-season species, *Psoloessa texana* Scudder, a small early summer species, and *Melanoplus gladstoni* Scudder, the most abundant of all species and a late-season species. Available data is also given for *Xanthippus corallipes* Haldeman, a common species, but the largest species at the Pawnee Site, and an early summer species.

All the specimens utilized for these biomass calculations were collected during 1968 and 1969 in Sections 21, 22, 23, 24 and 26. All specimens were labeled as to date, specific location and method of collection prior to being frozen and stored in glass vials. They were all identified as to species, sex, and age (stadium) in most cases prior to the initial freezing, using a binocular dissecting microscope or, for larger specimens, a 7S optivisor (optical glass binocular magnifier).

Prior to weighing, each sample was separated into a separate vial. Thus each vial had specimens of only one species, sex and age. Each sample was then oven-dried at 110°C. for 12 hours. Initially a few batches were dried for 12 hours, weighed, then dried for 12 hours longer and then weighed again. There was no further weight loss as a result of the extra 12 hours of drying, so we settled on 12 hours as the standard drying time.

Individual insects were weighed to 0.0001 g. A total of 30 individuals of each age and sex was weighed wherever possible. If any specimen had either hind leg missing, or if more than one of the fore legs or mid legs was missing, that specimen was rejected.

The initial data sheets contain information on the data and pasture from which the specimen was taken (see sample data sheet at end of report). This will enable us to make a further analysis of weights to determine whether there is any significant weight gain or loss during a stadium.

The mean ($\bar{x}$), the standard deviation (σ) and the variance (σ^2) of each sample have been computed. These have been entered into the tables of this report as well as the sample size (n). Some of the samples are very small.

As more specimens become available through future collecting, they will be dried, weighed and the data added to that given here. The statistics will be recalculated on the basis of the larger samples.

Some age classes for *Opeia* and *Psolessa* simply were not available for weighing during the first phase (October and November, 1969). As specimens of these ages are collected during 1970, they will be analyzed.

RESULTS

The summarized data for four species of short-horned grasshoppers at the Pawnee Site are given in Table I. The absence of entries for certain stadia of *Opeia* and *Psolessa* reflects the lack of specimens of these instars in our collecting.

Although the incompleteness of the data for two species make generalizations risky at this time, the weight gains during the juvenile stadia for *Xanthippus corallipes* and *Melanoplus gladstoni* suggest that the two sexes are quite similar in weight during the early stadia (① through ② or ③) but begin to differ at an increasing rate through the later juvenile stadia and in the adult stage with the female being heavier than the male. This tendency is quite apparent in *Xanthippus corallipes* where the adult female weighs nearly 3.1 times as much as the male. However, it should be noted that this tendency is far less evident in *Melanoplus gladstoni*, the most abundant species at the Pawnee Site. The adult female does weigh more than the adult male, but only 1.3 times as much. And, surprisingly, the 4 female weighs somewhat less than the 4 male.

FUTURE BIOMASS ANALYSIS

Obviously the generalizations given above need further support. The data for the four species of this report will be supplemented in all cases where, at present, the sample size (n) is less than 30, when further specimens are collected.

On hand are frozen specimens of several more species to be weighed during the early months of 1970. Two priority groupings are:

Priority 1: To be weighed before 1 Feb 1970

Phlibostroma quadrimaculatum
Arphia conspersa
Arphia pseudonietana
Encoptolophus sordidus
Melanoplus packardii

Priority 2: To be weighed before 1 Mar 1970

Litaneutria minor
Eritettix simplex
Mermiria maculipennis
Trachyrhachis sp.
Melanoplus infantilis
Melanoplus sanguinipes
Melanoplus bivittatus

Another form of biomass analysis that is in progress is the gathering of daily (or every second or third day) wet weights from living, marked, individuals of juveniles of *Psoleasa texana, Xanthippus corallipes* and *Arphia conspersa* that have been and will be collected from the Pawnee Site and reared in cages supplied with native Blue Grama and Buffalo grass. These are the three major species that over-winter as juvenile instars at the Pawnee Site. This data should help to determine how much, if any, weight is gained during a juvenile stadium.

Table I: Dry-Weight Biomass Values For Four Pawnee Acridid Grasshoppers

Species	age	sex	n	$\bar{x}$	σ	σ^2
Opeia obscura	ad	♂				
	ad	♀				
	⑤	♂				
	⑤	♀				
	④	♂	37	0.0074	0.00190	0.000003
	④	♀	46	0.01159	0.00327	0.00001
	③	♂				
	③	♀	13	0.0040	0.00202	0.000004
	②	♂	19	0.0028	0.0087	0.0000007
	②	♀	60	0.0029	0.00144	0.000002
	①	♂ & ♀	15	0.0017	0.00085	0.0000007
Psolessa texana	ad	♂	12	0.02450	0.00377	0.00001
	ad	♀	27	0.05860	0.01995	0.00039
	⑤	♂	22	0.0187	0.00718	0.00005
	⑤	♀	10	0.02119	0.00944	0.00009
	④	♂				
	④	♀	20	0.01543	0.00595	0.00003
	③	♂				
	③	♀	6	0.0079	0.00155	0.000002
	②	♂	11	0.00381	0.00167	0.000002
	②	♀	12	0.0025	0.00122	0.000001
	①	♂ & ♀				

Table I (Continued)

Species	age	sex	n	$\bar{x}$	σ	σ^2
Xanthippus corallipes	ad	♂	4	0.18824	0.01592	0.00025
	ad	♀	7	0.57831	0.07160	0.00512
	(5)	♂	43	0.13177	0.02565	0.00065
	(5)	♀	23	0.2088	0.03207	0.00103
	(4)	♂	39	0.07448	0.01623	0.00026
	(4)	♀	36	0.11150	0.02559	0.00655
	(3)	♂	3	0.04122	0.01446	0.00021
	(3)	♀	11	0.04968	0.01896	0.00036
	(2)	♂	2	0.02665	0.0051	0.00002
	(2)	♀	10	0.02069	0.01090	0.00011
	(1)	♂ & ♀	8	0.00507	0.00143	0.000002
Melanoplus gladstoni	ad	♂	25	0.0887	0.0170	0.00029
	ad	♀	23	0.1178	0.03114	0.00096
	(5)	♂	10	0.0358	0.013558	0.00018
	(5)	♀	10	0.0587	0.01402	0.00019
	(4)	♂	30	0.0261	0.0078	0.00006
	(4)	♀	20	0.0198	0.0055	0.00003
	(3)	♂	30	0.0104	0.00410	0.000016
	(3)	♀	30	0.0102	0.00382	0.000014
	(2)	♂	30	0.0075	0.00297	0.0000088
	(2)	♀	30	0.0062	0.0023	0.000005
	(1)	♂ & ♀	60	0.00149	0.00058	0.0000003