

THE SPECIES AND DISTRIBUTION OF GRASSHOPPERS RESPONSIBLE
FOR THE 1934 OUTBREAK

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In connection with the grasshopper control campaign of 1934, an adult grasshopper survey was made in the more heavily infested States during the latter part of July and the month of August to determine the results of the poisoning operations and to locate areas where grasshoppers were still abundant and where eggs might be found during the fall egg survey. Considerable data were also obtained regarding the species responsible for the outbreak and their relative abundance in some of the more common grasshopper habitats.

DOMINANT SPECIES IN MONTANA, NORTH DAKOTA, SOUTH DAKOTA, AND WYOMING

In Montana, North Dakota, South Dakota, and Wyoming, specimens were collected in typical environment by State leaders and their assistants. From 5 to 20 collections, representative of the grasshopper population of a certain habitat, were made in each county. The specimens were killed in radiator alcohol and dried and preserved between sheets of paper toweling. A record was kept of the location and kind of environment. These specimens were later identified and counted to determine the percentage of each species in the total number collected in each habitat. The collections from these four States included 44,700 specimens. The data were then grouped according to the geographical distribution and habitat.

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Each of the four States was subdivided into districts. This subdivision was based on a general knowledge of the difference in topography, crops, climatic conditions, plant associations, and differences in the normal distribution of dominant species of grasshoppers.

North Dakota

District 1. Eastern. Counties east of the 99th meridian. Prairie or tall-grass region.

District 2. Northern and western. Counties north of 48° latitude and west of 99° longitude. Plains or short-grass region.

District 3. Southern and western. Counties south of 48° latitude and west of 99° longitude. Plains or short-grass region.

South Dakota

District 1. Northeastern. Counties east of 99° longitude, and north of 44.2° latitude. Prairie or tall-grass region.

District 2. Southeastern. Counties east of 99° longitude, and south of 44.2° latitude. Prairie or tall-grass region.

District 3. Central. Counties between 99° longitude and 102° longitude. Short-grass region.

District 4. Western. Counties west of 102° longitude. Short-grass and yellow pine region, also Black Hills area.

Wyoming

District 1. Eastern. Counties east of the Big Horn Mountains and 107° longitude in the northeast, and east of the Laramie Mountains and 106° longitude in the southeast. Short-grass region.

District 2. Western. Counties west of district 1. Sagebrush region.

Montana

District 1. Western and mountain. Counties immediately east of the Continental Divide to the 118th meridian in the north, then south to the Missouri River, east to 108.5° longitude, and south to the border. Short-grass and lodgepole pine area.

District 2. Northern and eastern. Counties north of the Missouri River from the 112th meridian east. Short-grass region.

District 3. Eastern. Counties south of the Missouri River and east of 108.5° longitude.

TYPICAL ENVIRONMENTS IN WHICH COLLECTIONS WERE MADE

Collections were made only in the most common grasshopper habitats in each district. These were:

1. Small grain.--Wheat, oats, rye, barley.
2. Legumes.--Alfalfa, sweetclover, peas.
3. Corn.
4. Flax.
5. Roadside.--Native grasses, Russian-thistle (Salsola pestifer), ragweed (Ambrosia sp.), wild lettuce (Lactuca sp.), lambsquarters (Chenopodium sp.), sunflower (Helianthus sp.), pigweed (Amaranthus sp.), gumweed (Grindelia squarrosa), sagebrush (Artemisia sp.)
6. Weedy patches.--Native grasses and the same weeds as in roadside environments.
7. Russian-thistle mats.--Mostly pure stands.
8. Plains grassland (native grasses of the open range).--Grama grass (Bouteloua gracilis), buffalo grass (Bulbilis dactyloides), western wheatgrass (Agropyron smithii), western needlegrass (Stipa comata), wiregrass (Aristida longiseta), nigger-wool (Carex filifolia), junegrass (Koeleria cristata).
9. Low-mountain grassland.--Mostly grama grass (Bouteloua gracilis) with an abundant admixture of nigger-wool (Carex filifolia) and junegrass (Koeleria cristata).
10. Pasture grassland.--Fenced and smaller areas of native sod, surrounded by cropped fields. Here are found the native grasses of the plains grassland and also some of the tall prairie grasses, bluestem bunch grass (Andropogon furcatus), bluestem sod grass (A. scoparius), needlegrass (Stipa spartea), and slender wheatgrass (Agropyron tenerum).

The greatest differences are between the cultivated crop environments and the grassland habitats. There were two reasons for considering the crops separately: First, the species of grasshoppers show distinct preferences for certain crops. By separating the crops important preferences are emphasized. Secondly, crops vary in their importance and abundance from one district to another.

The grassland areas were divided into plains, low-mountain grasslands, and pasture grasslands. Plains and low-mountain grasslands include the open ranges and are kept separate because of their topography. The plains grasslands occur in lower and more level regions, whereas the low-mountain grasslands are in the higher and hilly regions. Pasture grassland consists of native sodlands, fenced into small units of less than 80 acres and surrounded by

cultivated crops. These small areas of native sod pasture are bound to be influenced by adjoining crops. Therefore, they are treated as distinct from open-range grasses.

Many collections were made along roadsides bordering two or more distinct types of vegetation. These roadsides contain a mixture of native grasses and weeds, with somewhat similar flora throughout. Because of this similarity, they are considered as a distinct habitat. Many farms contain waste land and weedy pastures covered with grasses and weeds. These are also considered as a distinct environment and are called weedy patches.

Most of the crops in the drought-stricken areas were destroyed early by the lack of moisture. Such heavy stands of pure Russian-thistle had sprung up that the original crops could not be recognized. There were thousands of acres of Russian-thistle mats all over the Dakotas. These were also treated as representing a separate environmental condition.

DISTRIBUTION BY STATES OF THE GRASSHOPPERS IN TYPICAL ENVIRONMENTS

The distribution for each State of the species in each of the ten environments and the frequency with which each species occurs are shown in tables 1 to 10. The distribution is given in terms of percentage of the total number of specimens collected in each habitat. The species are listed and their relative abundance given for each of the ten environments in all the districts.

Certain habitats are not listed for all States and districts. In some habitats such as corn and flax environments, the crop was of minor importance in certain regions. Practically no low-mountain grassland occurs in North Dakota and some of the other districts. In other places, collections were not made along roadsides and in pastures. Therefore, there are gaps for the districts where certain environments were not considered.

Table 1.--Distribution of grasshopper species in small grains (14,304 specimens).

Species	North Dakota			South Dakota			Wyoming			Montana		
	1-E	2-NW	3-SW	1-NE	3-U	4-W	1-E	1-W	2-NE	3-E		
Aeoloplus turnnuli Thos.	---	---	---	---	---	---	.71	---	---	---		
Aeneotettix deorum Scudd.	1.77	1.21	5.99	40.54	5.09	16.14	15.00	1.93	1.64	2.09		
Aulocara elliptici Thos.	---	---	.12	---	.23	1.11	10.71	---	---	---		
Amphitornus bicolor Thos.	.06	.33	.22	---	.23	---	1.42	1.09	---	1.39		
Arphia pseudonietana Thos.	.18	.03	.06	---	---	.37	---	.17	1.06	---		
Bruneria brunnea Thos.	.06	---	---	---	.46	---	.71	.50	---	---		
Caanula pellicuda Scudd.	54.02	8.49	8.49	5.41	.23	6.12	6.43	2.94	2.00	2.55		
Chorthippus curtipennis Harr.	.54	.03	---	---	---	---	---	---	.23	---		
Cordillacris crenulata Brun.	---	---	---	---	---	---	---	---	.06	---		
Dissosteira carolina L.	1.65	2.58	3.03	2.70	4.86	2.23	---	.76	4.75	5.10		
Drepanopterna femoratum Scudd.	---	.03	1.12	---	1.39	1.48	4.29	.25	.94	1.16		
Derotomona haydeni Thos.	---	---	---	---	---	.19	---	---	---	---		
Encoptolophus costalis Scudd.	1.38	1.30	1.09	---	---	.93	---	2.27	2.17	.23		
Gomphoceris clavatus Thos.	.09	---	---	---	---	---	---	1.09	---	---		
Hadrotettix trifasciatus Say.	---	---	.13	---	---	.37	---	.08	---	---		
Hesperotettix viridis Thos.	---	.09	.28	---	---	.37	2.14	.42	.06	---		
Hypochlora alba Dodge.	.15	---	---	---	---	---	---	.76	---	---		
Melanoplus angustipennis Dodge.	.69	.45	2.03	5.41	3.24	2.78	.71	---	.18	.23		
Melanoplus bivittatus Say.	6.49	1.46	4.37	---	2.08	4.82	13.57	2.61	.23	.23		
Melanoplus bowditchi Scudd.	.03	.03	.15	---	---	---	---	---	---	---		
Melanoplus dawsoni Scudd.	.42	.33	.22	---	.23	---	2.14	---	.76	---		
Melanoplus differentialis Thos.	.30	.15	3.74	---	8.33	2.41	---	---	---	---		
Melanoplus femur-rubrum Deg.	10.61	11.46	10.33	---	.69	5.75	10.71	6.31	8.75	4.18		
Melanoplus gladstoni Scudd.	.33	.52	1.06	---	---	2.41	---	2.02	4.35	1.16		
Melanoplus infantilis Scudd.	.12	.42	.75	---	.23	.56	.71	4.96	4.40	1.62		
Melanoplus lakinus Scudd.	---	---	---	---	.69	---	---	---	---	---		
Melanoplus mexicanus Sauss.	15.39	64.80	40.29	27.03	60.42	37.11	17.86	52.57	41.21	68.91		
Melanoplus packardii Scudd.	3.04	2.72	3.34	8.11	7.18	4.27	2.86	8.83	5.52	3.71		
Metatoprema kiowa Thos.	.51	.53	.97	5.41	.69	---	---	3.95	3.70	.23		
Mermiria maculipennis meclungi Rehn.	---	---	---	---	---	---	---	---	---	.23		
Metator pardalinus Sauss.	.09	.12	.61	---	.23	.56	1.42	.34	2.17	4.64		
Opeia obscura Thos.	.03	.09	3.59	---	---	.19	---	---	2.23	---		
Orphulella speciosa Scudd.	.21	---	1.09	---	---	---	---	---	---	---		
Phliostrota quadrimaculatum Thos.	---	.03	2.87	---	.46	.37	.71	2.78	2.08	---		
Phoetaliotes nebrascensis Thos.	.39	2.27	3.68	2.70	1.85	7.98	2.14	1.01	2.35	.70		
Pharagemon collaris Scudd.	1.41	.73	.31	---	.93	.92	2.14	---	.18	.70		

Table 1. (Cont'd.)

Species	North Dakota			South Dakota			Wyoming			Montana		
	1-E	2-NW	3-SW	1-NE	3-C	4-W	1-E	1-W	2-NE	3-E		
Spharagemon equalo Say----	--	--	.06	2.70	.23	.56	1.42	.17	2.06	.93		
Trimerotropis campestris McNeill--	--	--	--	--	--	--	2.14	--	--	--		
Trimerotropis pallidipennis Burm--	--	--	--	--	--	--	--	--	.06	--		

Table 2.--Distribution of grasshopper species in legumes (5,575 specimens)

Species	North Dakota			South Dakota			Wyoming			Montana		
	1-E	3-SW	1-NE	2-SE	3-C	4-W	1-E	2-W	1-W	2-NE	3-E	
Aeoloplus turnbullii Thos----	--	--	--	--	.78	--	--	.13	--	--	--	--
Ageneotettix deorum Scudd-----	5.59	3.09	25.00	11.57	3.88	15.83	12.95	.92	1.00	.93	.88	--
Aulocara elliotti Thos-----	--	--	--	--	--	4.02	2.16	--	--	--	--	--
Amphitornus bicolor Thos-----	--	--	--	--	--	.25	.24	.26	--	--	--	--
Arphia pseudonietana Thos-----	--	--	--	--	--	--	.36	--	--	1.39	--	--
Boopedon nubilum Say-----	--	--	--	--	--	--	--	--	--	1.39	--	--
Bruneria brunnea Thos-----	.70	--	--	--	.65	--	1.43	--	.11	--	--	--
Camnula pelucida Scudd-----	13.28	--	1.39	--	--	3.27	1.80	12.86	5.64	.93	4.84	--
Chloaelis conspersa Harr-----	--	--	--	--	--	--	.12	--	--	--	--	--
Chorthippus curtipennis Harr-----	--	--	--	--	--	--	--	.39	--	--	--	--
Jordillacris crenulata Brun-----	--	--	--	--	--	--	.12	--	--	--	--	--
Dissosteira carolina L-----	--	2.06	--	--	--	--	.60	2.49	2.59	12.04	.22	--
Drepanopterna femoratum Scudd-----	--	1.03	--	--	--	1.51	5.15	.13	.26	--	.11	--
Encoptolophus costalis Scudd-----	1.40	--	--	--	--	--	--	--	2.64	3.10	--	--
Gomphocerus clavatus Thos-----	--	--	--	--	--	--	--	--	.05	--	--	--
Hadrotettix tri-fasciatus Say-----	--	--	--	--	--	.25	--	--	--	--	--	--
Hesperoecetix viridis pratensis Scudd	--	--	--	--	--	--	.12	--	--	--	--	--
Hesperoecetix viridis Thos-----	--	--	--	--	--	.50	.60	.13	.05	--	--	--
Melanoplus angustipennis Dodge-----	21.68	1.03	--	28.92	--	8.04	1.56	.66	--	2.78	5.07	--
Melanoplus divittatus Say-----	2.10	27.64	--	--	5.43	5.28	9.47	4.99	3.85	3.10	.55	--
Melanoplus bowditchi Scudd-----	--	--	--	--	--	--	--	--	--	--	.22	--
Melanoplus dawsoni Scudd-----	--	--	--	--	--	--	.96	--	1.11	.46	--	--
Melanoplus diffringialis Thos-----	.10	--	--	3.31	6.98	.50	1.20	--	--	--	.88	--
Melanoplus femur-rubrum Deg-----	15.38	36.08	2.78	.83	.17	10.30	9.35	37.53	39.58	23.61	12.22	--
Melanoplus glaucocephalus Scudd-----	3.50	--	--	.83	--	.50	1.32	--	2.69	3.10	.33	--
Melanoplus infantilis Scudd-----	1.40	1.03	--	--	1.55	2.16	5.76	--	1.06	--	.22	--
Melanoplus mexicanus Sauss-----	23.78	12.37	30.55	46.27	19.06	39.20	31.41	16.40	30.50	33.80	72.25	--
Melanoplus occidentalis Thos-----	--	--	--	--	--	--	.24	.13	--	--	--	--
Melanoplus packardii Scudd-----	9.09	10.31	29.17	1.65	--	3.01	2.16	22.44	5.75	6.48	1.43	--

Table 2 (cont'd.)

Species	North Dakota			South Dakota			Wyoming			Montana		
	1-E	3-SW	1-NE	2-SE	3-C	4-W	1-E	2-W	1-W	2-NE	3-E	
Mesobregma kiowa Thos-----	.70	--	4.16	--	--	.50	1.92	--	.26	.46	.11	
Metator pardalinus Gauss-----	--	--	--	--	--	--	.84	--	.11	.46	.11	
Opeia obscura Thos-----	--	1.03	--	--	--	--	.60	.13	--	--	.11	
Pardalophora haldemani Scudd-----	--	--	1.39	--	--	--	--	--	--	--	--	
Phidostroma quarimaculatum Thos---	--	--	--	--	--	1.26	--	--	.21	--	--	
Phoetaliotes neurascentis Thos---	--	4.12	--	--	--	1.00	4.56	--	.53	3.24	.11	
Spharagemon collare Scudd-----	.70	--	5.56	5.79	1.55	1.00	.12	.39	.32	.46	--	
Spharagemon equale Say-----	--	--	--	--	--	1.00	2.68	--	1.11	.46	--	
Trimerotropis pistrinaria Gauss---	--	--	--	--	--	--	--	--	--	--	.11	
Trimerotropis pallidipennis Burm---	--	--	--	--	--	--	--	--	.58	--	.22	

Table 3.--Distribution of grasshopper species in corn (851 specimens)

Species	North Dakota			South Dakota			Montana
	1-L	2-M	3-S	1-M	2-S	3-C	3-E
<i>Ageneotettix deorum</i> Scudd	18.31	--	5.52	21.66	--	18.06	--
<i>Ampitornus bicolor</i> Rhos	--	--	.32	--	--	--	--
<i>Arphia pseudonietana</i> Rhos	.94	5.55	.65	--	--	--	--
<i>Bruneria brunnea</i> Rhos	--	--	--	1.67	--	--	--
<i>Camnula pellucida</i> Scudd	13.61	--	2.27	--	--	--	1.16
<i>Chorthippus curtipennis</i> Harr	.94	--	--	--	--	--	--
<i>Dissosteira carolina</i> L	1.41	11.11	1.62	1.67	1.06	--	1.16
<i>Drepanopterna femoralis</i> Scudd	--	--	.32	--	--	--	--
<i>Encyrtolophus cosalis</i> Scudd	4.22	--	12.01	--	--	--	--
<i>Gomphoceris clavae</i> Rhos	.47	--	--	--	--	--	--
<i>Hesperotettix viridis</i> Rhos	--	5.55	--	--	--	--	--
<i>Hypochlora alba</i> Dodge	--	16.67	--	--	--	--	--
<i>Melanoplus angustipennis</i> Dodge	.47	16.67	--	13.33	7.45	16.66	5.81
<i>Melanoplus divittatus</i> Say	2.35	--	.65	1.67	8.51	8.33	1.16
<i>Melanoplus dawsoni</i> Scudd	--	--	6.82	--	--	--	--
<i>Melanoplus differentialis</i> Rhos	--	--	--	11.67	48.94	2.78	--
<i>Melanoplus femur-rubrum</i> DeG	22.54	--	10.71	--	--	1.39	17.44
<i>Melanoplus gladsioni</i> Scudd	.94	16.67	18.51	--	--	--	--
<i>Melanoplus iniantilis</i> Scudd	.94	5.55	.32	--	--	1.39	--
<i>Melanoplus mexicanus</i> Sauss	25.81	22.22	14.61	46.66	5.32	50.00	65.95
<i>Melanoplus packardii</i> Scudd	2.82	--	1.62	--	--	--	5.81
<i>Mestouregma kiowa</i> Rhos	.94	--	3.57	--	2.53	1.39	--
<i>Metator pardalinus</i> Sauss	.47	--	.91	--	--	--	--
<i>Opera obscura</i> Rhos	--	--	3.57	--	--	--	--
<i>Orphulella pallida</i> Burr	.47	--	--	--	--	--	--
<i>Orphulella speciosa</i> Scudd	.47	--	1.30	1.67	--	--	--
<i>Phliostrota quadrimaculatum</i> Rhos	--	--	1.95	--	3.19	--	--
<i>Phoealiotes nebrascensis</i> Rhos	.94	--	12.01	--	--	--	1.16
<i>Spharagemon collaris</i> Scudd	.47	--	.65	--	--	--	2.52

Table 4.--Distribution of grasshopper species in flax (530 specimens)

Species	North Dakota				Wyoming
	1-E	2-NW	3-SW	1-E	
<i>Ageneotettix deorum</i> Scudd--	1.53	--	2.65	12.00	--
<i>Arphia pseudonietana</i> Thos--	--	--	--	--	--
<i>Brunneria orumnea</i> Thos--	.31	--	--	--	--
<i>Tamnula pellucida</i> Scudd--	29.45	--	5.96	16.00	--
<i>Dissosteira carolina</i> L--	.92	3.57	6.62	--	--
<i>Encyptolophus costalis</i> Scudd--	2.15	--	4.64	--	--
<i>Melanoplus angustipennis</i> Dodge--	--	7.14	--	--	--
<i>Melanoplus divittatus</i> Say--	6.15	7.14	--	--	--
<i>Melanoplus femur-rubrum</i> DeG--	24.23	25.00	19.87	44.00	--
<i>Melanoplus glasgowi</i> Scudd--	3.37	7.14	1.39	4.00	--
<i>Melanoplus keeleri</i> Lurdaus Dodge--	--	--	1.32	--	--
<i>Melanoplus mexicanus</i> Sauss--	26.99	39.29	41.06	16.00	--
<i>Melanoplus packardii</i> Scudd--	3.68	10.71	3.97	--	--
<i>Metoecurus kiowa</i> Thos--	--	--	.66	--	--
<i>Matator pardalinus</i> Sauss--	--	--	--	4.00	--
<i>Opeia obscura</i> Thos--	--	--	1.32	--	--
<i>Orthocentrus speciosa</i> Scudd--	.61	--	--	--	--
<i>Thoealictes nebrascensis</i> Thos--	--	--	8.61	4.00	--
<i>Spharagemo collaris</i> Scudd--	--	--	1.32	--	--

Table 5.--Distribution of grasshopper species along roadsides (4,103 specimens)

Species	North Dakota			South Dakota			Montana		
	1-E	2-NW	3-SW	1-NE	2-SE	3-C	4-W	2-NE	3-E
<i>Ageneotettix deorum</i> Scudd	1.62	4.49	13.84	36.95	3.63	7.75	1.99	11.11	8.79
<i>Aulocara elliotti</i> Thos	--	--	--	--	--	.12	--	--	--
<i>Amphitornus bicolor</i> Thos	--	.20	4.24	.40	--	--	--	--	--
<i>Arphia pseudonietana</i> Thos	.30	--	--	--	--	.12	--	3.49	--
<i>Bruneria crumena</i> Thos	.20	--	--	1.20	--	2.98	1.70	.22	--
<i>Samnula pellucida</i> Scudd	11.63	4.09	1.12	6.83	--	.12	--	2.61	1.69
<i>Diesssteira carolina</i> L	.81	2.89	7.81	1.61	--	5.24	6.53	9.59	--
<i>Drepanopterna femoralis</i> Scudd	--	.20	5.13	--	--	1.19	--	1.96	2.20
<i>Encyrtolophus costalis</i> Scudd	.30	1.20	.45	--	--	--	--	5.01	--
<i>Hesperotettix viridis</i> Thos	--	.90	.89	--	--	--	--	.65	2.20
<i>Hippiscus rugosus</i> Scudd	--	--	--	--	--	--	--	--	--
<i>Melanoplus angustipennis</i> Dodge	--	1.69	7.14	6.02	5.84	3.93	5.41	5.49	2.20
<i>Melanoplus altitudinum</i> Scudd	--	--	--	--	--	--	--	.44	--
<i>Melanoplus bivittatus</i> Say	5.77	2.09	4.46	1.61	14.88	4.17	6.53	1.09	1.10
<i>Melanoplus dawsoni</i> Scudd	--	--	--	--	--	.11	--	--	--
<i>Melanoplus differentialis</i> Thos	--	.40	.89	--	48.90	13.11	18.47	--	--
<i>Melanoplus femur-rubrum</i> DeG	5.74	9.07	--	--	7.30	2.03	9.09	3.49	--
<i>Melanoplus gladsioni</i> Scudd	.30	.78	--	--	--	.24	--	.44	--
<i>Melanoplus infantilis</i> Scudd	--	.80	1.79	--	--	.24	.85	7.84	3.30
<i>Melanoplus mexicanus</i> Sauss	5.06	63.40	34.15	34.94	6.57	43.50	19.32	13.93	50.54
<i>Melanoplus packardii</i> Scudd	3.03	5.48	3.35	2.41	.73	10.37	19.03	8.71	2.20
<i>Metastourus kiowa</i> Thos	.20	.40	8.93	4.82	.36	2.50	6.53	8.93	6.59
<i>Metator pardalinus</i> Sauss	--	.10	3.57	.40	--	--	--	2.18	9.89
<i>Opeia obscura</i> Thos	--	.10	.67	--	--	--	--	3.27	--
<i>Orphulella pelidna</i> Burm	.10	--	--	--	--	--	--	--	--
<i>Orphulella speciosa</i> Scudd	.30	.10	.45	--	--	--	.28	.44	--
<i>Phibostroma quadrimaculatum</i> Thos	--	--	.67	--	--	1.19	.57	4.79	--
<i>Phoetaliotes nebrascensis</i> Thos	.10	1.00	.22	.40	1.09	.24	1.14	1.09	--
<i>Spharagemon collaris</i> Scudd	.51	.70	.22	2.41	7.66	--	.57	1.09	1.10
<i>Spharagemon equale</i> Say	--	--	--	--	--	.24	--	4.14	1.10
<i>Trimerotropis pallidipennis</i> Burm	--	--	--	--	--	--	--	--	4.10

Table 6.--Distribution of grasshopper species in weedy fields and pastures (4,035 specimens)

Species	North Dakota			South Dakota			Montana		
	1-E	2-NW	3-SW	1-NE	2-SE	3-C	2-NE	3-E	
Aeoloplus turnoullii Thos-----	--	--	--	--	--	--	.32	1.82	
Ageneotettix deorum Scudd-----	8.91	1.31	10.16	47.88	35.02	7.75	4.87	20.00	
Aulocara elliotti Thos-----	--	--	.28	--	--	.24	--	--	
Amphitornus oicolor Thos-----	--	--	.21	1.41	.68	--	--	--	
Arphia pseudonietana Thos-----	.56	--	.07	--	--	.12	1.95	--	
Bruneria brunnea Thos-----	--	--	.14	1.41	.92	.71	--	--	
Camnula pellicuda Scudd-----	15.88	3.19	1.48	--	--	.12	.65	3.63	
Chorthippus curtipennis Harr-----	1.11	--	--	--	--	--	--	--	
Dissosteira carolina L-----	11.70	.72	1.34	--	.34	1.07	--	--	
Drepanopterna femoratum Scudd-----	--	--	.21	--	.68	1.07	1.62	1.82	
Derotmena haydeni Thos-----	--	--	--	--	.68	.12	--	--	
Encoptolophus costalis Scudd-----	3.90	.58	2.96	--	--	1.19	2.92	--	
Hadrotettix trifasciatus Say-----	--	.14	--	--	.34	.24	--	--	
Hesperotettix viridis Thos-----	--	--	.07	--	--	.36	--	--	
Hippiscus rugosus Scudd-----	--	--	.14	--	.34	--	--	--	
Hypochlora alba Dodge-----	.28	--	.70	--	--	--	--	--	
Melanoplus angustipennis Dodge-----	2.78	.43	5.29	4.23	10.77	5.48	--	--	
Melanoplus altitudinum Scudd-----	--	--	--	--	--	--	.32	--	
Melanoplus bivittatus Say-----	6.68	.87	.99	2.82	3.03	1.19	--	--	
Melanoplus bowditchi Scudd-----	.56	--	--	--	--	--	--	--	
Melanoplus dawsoni Scudd-----	3.06	.58	1.41	--	--	--	.65	--	
Melanoplus differentialis Thos-----	--	--	.78	--	29.29	5.12	--	--	
Melanoplus femur-rubrum DeG-----	--	8.13	8.40	--	2.36	--	20.78	--	
Melanoplus gladstoni Scudd-----	1.39	.43	3.46	--	.34	--	--	1.82	
Melanoplus infantilis Scudd-----	1.95	.58	.85	--	--	.24	5.84	3.63	
Melanoplus keeleri luridus Dodge-----	.28	--	.21	--	--	--	--	--	
Melanoplus lakinus Scudd-----	--	--	--	--	--	.12	--	--	
Melanoplus mexicanus Saus-----	25.63	79.83	17.78	35.21	11.41	64.72	12.66	45.45	
Melanoplus packardii Scudd-----	4.46	1.31	1.48	--	--	5.24	1.62	5.45	

Table 6. (Cont'd.)

Species	North Dakota			South Dakota			Montana		
	1-E	2-NW	3-SW	1-NE	2-SE	3-C	2-NE	3-E	
Mesocoregma kiowa Thos-----	2.51:	.58:	2.12:	5.63:	2.36:	1.07:	2.92:	12.73	
Metator parvalinus Sauss-----	--:	--:	1.27:	--:	--:	.12:	--:	--	
Opeia obscura Thos-----	.56:	--:	3.60:	--:	.68:	--:	27.92:	1.82	
Orphulella speciosa Guenod-----	.83:	--:	.49:	--:	--:	--:	--:	--	
Paralophora haldemani Guenod-----	--:	--:	--:	--:	--:	.12:	--:	--	
Phliostrota quadrimaculatum Thos---	--:	--:	24.35:	1.41:	.34:	.48:	3.90:	--	
Phoetarioles neurascentis Thos---	3.06:	.29:	9.24:	--:	.68:	.71:	10.71:	--	
Spharagemon collare Guenod-----	3.90:	.87:	.35:	--:	--:	1.07:	--:	1.82	
Spharagemon equale Say-----	--:	.14:	.14:	--:	--:	1.07:	.32:	--	
Trimerotropis pistrinaria Sauss-----	--:	--:	--:	--:	--:	.24:	--:	--	

Species	1-M	2-M	3-M	1-M	3-M	4-M	1-M
Aeoloplus turnoulli Thos----	--	--	.16	--	1.30	.25	--
Aeneolettix deorum Scudd-----	6.10	2.74	2.70	9.86	7.97	3.94	--
Aulocara elliotti Thos-----	--	--	--	--	.46	--	--
Amphitornus bicolor Thos-----	--	.08	--	--	.04	--	--
Arphia pseudonietana Thos-----	--	.08	--	--	.04	.25	--
Brachystola magna Gir-----	--	--	--	--	.04	--	--
Bruneria brunnea Thos-----	--	--	--	--	.08	.86	--
Camula pellicula Scudd-----	4.88	3.96	3.17	--	.42	.12	--
Derotmena haydeni Thos-----	--	--	--	--	.04	--	--
Dissosteira carolina L-----	20.73	1.14	.16	--	1.43	2.34	--
Drepanopterna femoratum Scudd-----	--	--	--	2.82	.29	--	--
Encyrtolophus costalis Scudd-----	--	.61	3.17	2.82	.17	.99	--
Hadroneura trifasciatus Say-----	--	--	--	--	.29	.37	--
Hesperolettix viridis Thos-----	--	1.67	--	--	.04	--	--
Hippiscus rugosus Scudd-----	--	--	--	--	.04	--	--
Hypochlora alba Dodge-----	--	--	.16	--	--	--	--
Melanoplus albidus Scudd-----	--	--	--	--	.63	--	--
Melanoplus angustipennis Dodge-----	--	.84	4.76	--	3.06	7.03	--
Melanoplus divittatus Say-----	3.66	1.07	1.59	2.82	2.31	1.73	--
Melanoplus confusus Scudd-----	--	--	--	--	--	.12	--
Melanoplus dawsoni Scudd-----	1.22	.23	1.75	--	.25	.62	--
Melanoplus differentialis Thos-----	--	--	1.27	--	3.65	7.52	--
Melanoplus femur-rubrum Dodge-----	21.95	10.89	10.95	--	1.51	8.26	--
Melanoplus gladstoni Scudd-----	1.22	1.52	1.90	--	.46	2.47	--
Melanoplus infantilis Scudd-----	2.44	.61	.48	--	.08	.86	--
Melanoplus lakinus Scudd-----	--	--	--	--	2.18	--	--
Melanoplus mexicanus Scudd-----	21.95	68.85	55.40	67.60	63.02	43.16	64.26
Melanoplus packardii Scudd-----	12.19	2.66	2.06	8.44	4.15	8.38	33.33
Mestrobrogma kiowa Thos-----	--	.46	.63	1.41	1.42	1.11	--
Metator pardalinus Scudd-----	--	.23	.16	1.41	.17	--	--
Opeia obscura Thos-----	--	.15	1.43	--	.29	.12	--
Orphulella speciosa Scudd-----	--	--	1.11	--	--	.12	--
Fardalophora haldemani Scudd-----	--	--	--	--	.04	--	--
Phliostrota quadrimaculatum Thos-----	--	--	.32	--	.21	.37	--
Phaenotates nebrascensis Thos-----	--	1.52	6.03	--	1.68	7.89	--
Spharagemon collare Scudd-----	3.66	.61	.63	--	.71	.74	2.38
Spharagemon equale Say-----	--	.08	--	2.82	.71	.37	--

Table 6.--Distribution of grasshopper species in plains grassland (7,511 specimens)

Species	North Dakota			South Dakota			Wyoming			Montana		
	1-E	2-NW	3-SW	1-NE	3-C	4-W	1-E	2-W	1-W	2-NE	3-E	
Acrolophitus hirtipes Say	--	--	--	--	--	--	.26	--	--	--	--	--
Aeoloplus turnbullii Thos	--	--	.07	--	--	--	--	--	--	.09	.39	--
Aerochoreutes carlinianus Thos	--	--	--	--	--	--	--	--	--	.50	--	--
Ageneotettix deorum Scudd	--	5.65:19.71	42.86:29.70	30.50:43.73	28.57	5.53	6.22	8.88				
Amphitornus bicolor Thos	--	1.23:1.48	4.76:1.51	.81	.17	--	.62	.57				
Arphia pseudonietana Thos	--	.25	--	4.76	.50	.54	.43	--	1.00	.71	.76	--
Aulocara eliotti Thos	--	--	--	--	.50	--	1.89	5.56	4.02	--	1.51	--
Bruneria brunnea Thos	--	--	--	11.90	2.85	2.02	--	20.63	--	--	.19	--
Camnula pellicida Scudd	45.45:17.44	1.96	2.38	.56	--	.60	--	12.06	--	.53	.76	--
Chorthippus curtipennis Harr	--	7.36	--	.05	--	--	--	--	--	--	--	--
Cordillacris crenulata Brun	--	--	.29	--	.05	1.08	.17	--	--	.09	--	--
Dissosteira carolina L	--	1.47	.66	--	.45	.13	.09	--	--	.36	.19	--
Drepanopterna femoratum Scudd	--	--	8.57	2.38	8.45:14.44	7.97	2.38	2.51	3.46	11.71		
Encoptolophus costalis Scudd	3.03	9.34	2.56	--	2.07	2.70	.17	--	2.01	7.02	1.13	--
Gomphocerus clavatus Thos	3.03	.25	.07	--	--	--	--	--	--	--	--	--
Hadrotettix trifasciatus Say	--	--	--	--	--	.67	.09	--	.50	--	--	--
Hesperotettix viridis pratensis Scudd	--	--	--	--	--	--	.26	--	--	--	--	--
Hesperotettix viridis Thos	--	.25	.74	--	--	--	1.54	3.17	--	--	.39	--
Hippiscus rugosus Scudd	--	--	--	--	.05	--	--	--	--	--	--	--
Hypochlora alba Dodge	--	.49	--	--	--	--	--	--	--	--	--	--
Melanoplus altitudinum Scudd	--	--	--	--	--	--	--	--	--	.09	.94	--
Melanoplus angustipennis Dodge	--	--	.07	2.38	.39	.13	2.83	.79	--	1.33	--	--
Melanoplus oivittatus Say	--	--	.14	--	.11	.13	1.20	--	--	.09	--	--
Melanoplus powditchi Scudd	--	--	--	--	--	--	3.34	--	--	--	.19	--
Melanoplus confusus Scudd	--	--	--	--	--	--	.09	--	--	--	.39	--
Melanoplus dawsoni Scudd	12.12:10.81	.14	--	--	.28	--	.34	--	1.00	.36	--	--
Melanoplus differentialis Thos	--	--	1.18	--	.22	.13	--	--	--	--	--	--
Melanoplus femur-rubrum Deg	--	3.19	1.85	2.38	.11	.27	.69	1.59	4.52	2.75	1.13	--
Melanoplus fluvialilis Brun	--	--	--	--	--	--	.43	--	--	--	--	--
Melanoplus gladstoni Scudd	3.03	1.97	--	--	.22	--	.86	--	4.52	1.86	--	--
Melanoplus infantilis Scudd	3.03	2.70	4.14	--	.22	.54	5.92	6.35	25.63	9.68	3.97	--

Table 6. (cont'd.)

Species	North Dakota			South Dakota			Wyoming			Montana		
	1-E	2-NW	3-SW	1-NE	3-C	4-W	1-E	2-W	1-W	2-NE	3-E	
Melanoplus kennicottii Scudd---	--	--	--	--	--	--	.09	--	--	--	--	--
Melanoplus mexicanus Sauss-----	--	25.31	4.65	2.38	10.96	1.48	12.60	7.14	7.54	21.48	44.98	--
Melanoplus occidentalis Thos-----	--	--	--	--	--	--	.34	.79	1.00	--	--	--
Melanoplus packardii Scudd-----	--	2.21	.30	--	.50	.40	1.29	4.76	3.52	1.33	3.40	--
Melanoplus punctulatus Scudd-----	--	--	--	--	--	--	.09	--	--	--	--	--
Mercuria maculipennis mclungi Rehn--	--	--	--	--	--	--	--	--	--	.09	1.32	--
Mercuria neomexicana Thos-----	--	--	--	--	--	--	--	--	--	--	.19	--
Mestobregma kiowa Thos-----	27.27	2.46	10.12	21.43	26.96	25.78	3.34	--	12.56	7.28	4.35	--
Metator pardalinus Sauss-----	3.03	--	.89	--	2.40	.40	.77	--	1.00	--	1.13	--
Opeia obscura Thos-----	--	.74	24.00	--	2.52	2.43	3.17	--	.50	9.95	3.97	--
Orphulella pelidna Burm-----	--	--	.14	--	.11	.13	--	--	--	--	--	--
Orphulella speciosa Scudd-----	--	--	.37	2.38	.22	1.21	--	--	--	.18	3.02	--
Paropemala wyomingensis Thos-----	--	--	--	--	--	--	.09	--	--	--	--	--
Phlibostroma quadrimaculatum Thos--	--	2.70	15.36	--	6.10	13.49	3.34	1.59	4.02	17.23	.94	--
Phoetaliotes nebrascensis Thos-----	--	3.93	.52	--	1.34	.27	--	16.67	--	6.66	2.68	--
Pseudocymala brachyptera Scudd-----	--	--	--	--	--	--	.09	--	--	--	--	--
Spharagemon collare Scudd-----	--	.25	--	--	.17	.13	.94	--	2.01	.27	.39	--
Spharagemon equale Say-----	--	--	--	--	.34	.13	.69	--	4.02	.18	.94	--
Trimerotropis pistrinaria Sauss-----	--	--	--	--	.05	--	.09	--	--	--	--	--
Trimerotropis sparsa Thos-----	--	--	--	--	--	--	--	--	--	--	.19	--
Trimerotropis gracilis sordida Walk--	--	--	--	--	--	--	--	--	--	.09	--	--

Table 9.--Distribution of grasshopper species in low-mountain grassland (870 specimens)

Species	South Dakota		Wyoming		Montana	
	4-W	1-E	2-W	1-W	2-NE	
Ageneotettix deorum Scudd-----	26.26	6.60	2.78	48.94	1.61	
Amphitornus bicolor Thos-----	.95	.24	--	--	3.22	
Arphia pseudonietana Thos-----	.95	.98	--	--	--	
Aulocara ellioti Thos-----	.32	3.18	--	4.25	--	
Boopodon nudilum Say-----	--	1.22	--	--	--	
Bruneria brunnea Thos-----	--	3.67	--	--	3.22	
Camnula pellucida Scudd-----	32.90	8.56:61.11	--	--	25.81	
Cordillacris crenulata Brun-----	1.90	.24	--	--	--	
Dissosteira carolina L.-----	--	.24	--	--	--	
Drepanopterna femoratum Scudd-----	5.70	3.91	--	--	--	
Encoptolophus costalis Scudd-----	--	.73	--	--	8.06	
Hesperotettix viridis Thos-----	.32	--	--	6.38	--	
Melanoplus angustipennis Dodge-----	--	.73	--	--	--	
Melanoplus bivittatus Say-----	2.33	3.67	2.78	--	--	
Melanoplus dawsoni Scudd-----	2.22	1.22	--	--	12.90	
Melanoplus femur-rubrum Deg-----	--	4.40	--	--	--	
Melanoplus gladstoni Scudd-----	--	.49	--	--	3.22	
Melanoplus infantilis Scudd-----	.95	.98	2.78	8.51	14.52	
Melanoplus keeleri luridus Dodge-----	--	.49	--	--	--	
Melanoplus mexicanus Sauss-----	4.43	43.28	8.33	27.66	20.97	
Melanoplus packardii Scudd-----	--	2.69:22.22	--	--	--	
Mestobregma kiowa Thos-----	8.23	2.44	--	--	--	
Metator pardalinus Sauss-----	--	.49	--	--	--	
Opeia obscura Thos-----	--	.98	--	--	--	
Orphulella pelidna Burm-----	.32	--	--	--	--	
Orphulella speciosa Scudd-----	--	.24	--	--	--	
Phlibostroma quadrimaculatum Thos---	9.18	.49	--	--	1.61	
Phoetaliotes nebrascensis Thos-----	2.21	3.31	--	2.13	--	
Spharagemon collare Scudd-----	.63	1.95	--	--	--	
Spharagemon equale Say-----	--	1.95	--	2.13	1.61	

Table 10.--Distribution of Grasshopper species in pasture grassland (983 specimens)

Species	North Dakota		South Dakota				Wyoming	
	3-SW	1-NE	2-SE	3-C	4-W		1-E	
Ageneotettix deorum Scudd-----	7.59	:23.83	:39.31	:21.05	--	:	26.87	
Amphitorus bicolor Thos-----	1.26	:1.07	:1.73	:7.89	--	:	1.49	
Arphia pseudonietana Thos-----	1.26	:1.42	--	--	--	:	1.49	
Bruneria brunnea Thos-----	--	:.36	:3.89	--	--	:	--	
Camnula pellucida Scudd-----	8.86	:2.13	--	--	--	:	--	
Dissosteira carolina L-----	3.80	--	--	--	--	:	--	
Drepanopterna femoratum Scudd-----	--	:1.07	:1.73	--	--	:	14.92	
Encoptolophus costalis Scudd-----	5.07	--	--	:1.31	--	:	--	
Hadrotettix trifasciatus Say-----	--	--	:.65	--	--	:	--	
Hesperotettix viridis Thos-----	1.26	--	--	--	--	:	--	
Hippiscus rugosus Scudd-----	--	--	:.21	--	--	:	--	
Hypochlora alba Dodge-----	1.26	--	--	--	--	:	--	
Melanoplus angustipennis Dodge-----	6.33	:.72	--	--	--	:	--	
Melanoplus bivittatus Say-----	1.26	--	--	--	--	:	7.46	
Melanoplus differentialis Thos-----	1.26	--	--	--	--	:	--	
Melanoplus femur-rubrum DeG-----	12.66	--	--	--	--	:	23.88	
Melanoplus gladstoni Scudd-----	6.33	--	--	--	--	:	--	
Melanoplus infantilis Scudd-----	1.26	--	--	--	--	:	--	
Melanoplus mexicanus Sauss-----	22.79	:2.13	:1.73	:15.79	--	:	7.46	
Merimira maculipennis mclungi Rehn--	--	--	--	:1.31	--	:	--	
Mestobregma kiowa Thos-----	1.26	:58.01	:41.68	:46.05	--	:	2.98	
Melanoplus packardii Scudd-----	5.07	--	--	--	--	:	13.43	
Metator pardalinus Sauss-----	--	:.72	--	--	--	:	--	
Opeia obscura Thos-----	2.53	:1.78	:1.94	--	--	:	--	
Orphulella speciosa Scudd-----	--	:3.91	--	:1.31	--	:	--	
Phliostrota quadrimaculatum Thos-----	--	:2.13	:7.13	:5.26	--	:	--	
Phoetaliotes nebrascensis Thos-----	8.86	--	--	--	--	:	--	
Spharagemon collarare Scudd-----	--	:.72	--	--	--	:	--	

DOMINANT SPECIES BY STATES

Only a few of the most important species, selected because of their greater abundance and economic importance, will be discussed.

North Dakota

The dominant and most important grasshoppers in this State were Melanoplus mexicanus Sauss. and Camnula pellucida Scudd. The former was abundant in the western part of the State, reaching its peak in the northwestern district (district 2) where it composed 64.8 percent of the total number of grasshoppers collected in small grain. It was also a major species in flax (27 to 41 percent), abundant in corn (14 to 26 percent), and numerous in grasslands (14 to 25 percent). Camnula pellucida was most abundant in eastern and northeastern North Dakota (district 1), where it formed over half the grasshopper population along roadsides (77.6 percent) and in small grain (54 percent). Although abundant in the middle and western portions of the State, it constituted less than 10 percent of the total number of grasshoppers collected. Melanoplus femur-rubrum De G. was next in abundance in cropped fields. In alfalfa it composed from 15 to 36 percent of the total number of grasshoppers, in flax 20 to 25 percent, and was numerous in corn and small grain. M. packardii Scudd. and Ageneotettix deorum Scudd. were also fairly abundant throughout the entire State.

Two species of grasshoppers of major importance in past outbreaks have now greatly decreased in numbers. These are Melanoplus bivittatus Say and M. differentialis Thos. M. bivittatus was most abundant in the eastern part of the State. M. differentialis, formerly numerous in the southern and southwestern portions, has almost disappeared. This change is probably due to recent extreme heat and drought. Eggs of M. differentialis have been known to dry out under such circumstances, possibly because they are laid in the crowns of grass clumps close to the soil surface. Both of these species have a distinct preference for succulent food and cannot live through extreme drought.

In the grasslands Ageneotettix deorum Scudd., Mestobregma kiowa Thos., Opeia obscura Thos., Phlibostroma quadrimaculatum Thos., Melanoplus infantilis Scudd., and Encoptolophus costalis Scudd. were abundant. Together with M. mexicanus and Camnula pellucida they were the species of economic importance in the range and pasture lands.

South Dakota

Most of the crops in South Dakota were destroyed by drought and were replaced by Russian-thistle. In the small grain that was left Melanoplus mexicanus was the dominant species, ranging from 24 percent of the total population in the northeastern part (district 1) to 60 percent in the central part (district 3). No other species was nearly so abundant. In alfalfa in the central part (district 3) and the western part (district 4), it constituted 79 percent of the total number. Melanoplus bivittatus and M. differentialis, which were responsible in 1931 for the destruction of crops in a 30,000-square mile area ran only from 2 to 8 percent in all but the southeastern part

(district 2). The great hordes of these grasshoppers have disappeared over the greater part of the State. Melanoplus differentialis was abundant, however, in the southeastern district (district 2) in corn and weedy pastures and along roadsides. It comprised from 29 to 49 percent of the total number of grasshoppers collected in these habitats. Over most of the State Ageneotettix deorum was much more abundant than either M. differentialis or M. bivittatus, ranking next to M. mexicanus. Melanoplus packardii was fairly numerous and generally distributed. Camnula pellucida occurred in the northeastern district (district 1) and at the first of the season was abundant and dominant in the western (district 4) or mountain areas. Vigorous control measures reduced its numbers by 80 percent in most of the western area. Melanoplus femur-rubrum did not occur abundantly and was found mostly in alfalfa.

In the grasslands, Ageneotettix deorum, Mestobregma kiowa, Phlibostroma quadrimaculatum, and Drepanopterna femoratum Scudd. were most abundant. Melanoplus mexicanus was numerous in the central portion and Camnula pellucida was dominant in the low-mountain grassland. Mestobregma kiowa was dominant in the native sod pastures, making up from 41 to 58 percent of the total population. In pastures suffering from severe drought, where the grass was burned up and overgrazed, this species was fairly abundant (8 per square yard) even though the foliage seemed insufficient to support the most meager population. M. kiowa has been called the pasture grasshopper and is rightly named.

In the thousands of acres of Russian-thistle M. mexicanus was by far the most abundant species, constituting from 43 to 67 percent of the total grasshopper population. The next in abundance here was Ageneotettix deorum making up from 4 to 10 percent.

Wyoming

In small grains Melanoplus mexicanus was dominant at 18 percent; followed closely by Ageneotettix deorum, at 15 percent; M. bivittatus, 13 percent; M. femur-rubrum, 11 percent; and Aulocara ellioti Thos., 11 percent. Earlier in the season, Camnula pellucida was abundant, especially in the northeastern part. There was a terrific slaughter of this particular species, together with M. mexicanus and M. bivittatus, in the poisoned-bait campaigns. Observers recorded, time and again, the finding of countless numbers of dead grasshoppers on the ground. This disturbed the normal balance for the different species here, as well as in all other districts where intensive control measures had been in force.

Alfalfa is an important forage crop in Wyoming. Melanoplus mexicanus was the species most numerous in this crop at 31 percent in the eastern district (district 1), and M. femur-rubrum at 37 percent was dominant in the western district (district 2). Ageneotettix deorum ranked next, at 13 percent in the eastern part, and M. packardii at 22 percent in the western part. Camnula pellucida formed about 2 percent of the population in the eastern part and jumped to 13 percent in the western district.

Wyoming is an important stock-raising State, and large grazing areas

have been seriously damaged by grasshoppers. A great deal of interest has been aroused regarding the control of grasshoppers and the kinds found in grazing lands. From collections made here, it seems that Ageneotettix deorum was most abundant, running from 28 to 44 percent of the total population in the open range of the plains and 27 percent in the pastures. Melanoplus mexicanus was the most abundant in the low-mountain grasslands at 43 percent. Other important species of the grasslands were Camnula pellucida, M. packardii, M. infantilis, and Drepanopterna femoratum. Of course, there were numerous other kinds of lesser importance, but all contributed their part to the havoc wrought on the grazing land.

Montana

It was in this State, the old home of Melanoplus spretus Thos., that M. mexicanus reached its greatest abundance and its highest rank over other species. In the great wheat areas it constituted from 47 to 70 percent of the total grasshopper population in small grains. The species next in rank were M. femur-rubrum and M. packardii, both at 4 to 9 percent. M. infantilis was next, ranging from 2 to 5 percent. M. mexicanus was also the most abundant species in alfalfa and sweetclover, ranging from 30 percent in the counties bordering the mountains to 72 percent in the eastern counties south of the Missouri River. In these crops M. femur-rubrum ran from 12 percent of the total population in the eastern district (district 3) to 39 percent in the western district (district 1).

In the severe 1923 outbreak Melanoplus bivittatus was abundant in alfalfa and sweetclover all along the Yellowstone Valley. This year it composed only 0.5 percent of the populations in these crops. In the irrigated valleys of the mountain district it increased to 3.8 percent.

Montana, like Wyoming, has large grazing tracts, which have been severely damaged by grasshoppers. On these grazing lands, Melanoplus mexicanus was most numerous, ranging from 7 percent in the mountain counties to 45 percent of the total population in the eastern districts. Melanoplus infantilis was next in importance, its abundance ranging from 4 percent in the eastern part to 26 percent in the mountain district. Other abundant grasshoppers were Ageneotettix deorum, at 5 to 9 percent; Drepanopterna femoratum, 2 to 12 percent; Mestobregma kiowa, 4 to 13 percent; and Philibostroma quadrimaculatum, 1 to 17 percent. The last was most abundant on the grazing lands in the northern wheat district. Other species found were Opeia obscura, Phoetaliotes nebrascensis Thos., Melanoplus packardii, and Encoptolophus costalis Scudd. Camnula pellucida was very abundant in the mountain districts, making up from 12 to 26 percent of the total number.

In Southeastern Montana Melanoplus confusus Scudd. was dominant on the range land early in the season. It had reached its maturity early in May and by the middle of July had practically disappeared. It must, however, be considered as an important range species.

SUMMARY OF THE DISTRIBUTION OF GRASSHOPPERS FOUND IN TYPICAL ENVIRONMENTS

In table 11 is given the distribution of species by percentages of the total numbers collected in each of the 10 typical environments. This table summarizes the distribution of the species through all of the habitats. This facilitates the making of direct comparisons between these environments for any one species.

Table 11.--Distribution of 44,700 specimens collected in Montana, North Dakota, South Dakota, and Wyoming by species, expressed in percentage of total number collected in each habitat

Species	Small grains	Legumes	Corn	Flax	Road- side	Weedy patches	Russian- thistle	Plains grass	Low-moun- tain grass	Pasture grass
<i>Aerolophytus hirtipes</i> Say	---	---	---	---	---	---	---	.04	---	---
<i>Aeoloplus turnbullii</i> Thos	.01	.03	---	---	---	.05	.64	.05	---	---
<i>Aeroboreutes carlinianus</i> Thos	---	---	---	---	---	---	---	.01	---	---
<i>Aeneoetelix deorum</i> Scudd	3.47	4.57	9.63	2.26	7.57	10.26	5.38	23.16	15.56	29.40
<i>Amphitornus orcolor</i> Thos	.29	.09	.12	---	.41	.15	.04	.96	.69	1.93
<i>Arpia pseudonietana</i> Thos	.22	.11	.59	---	.42	.25	.07	.46	.80	.61
<i>Aulocara ellipti</i> Thos	.18	.61	---	---	.02	.15	.21	.72	1.84	---
<i>Brachystola magna</i> Gir	---	---	---	---	---	---	.02	---	---	---
<i>Bruneria prunee</i> Thos	.06	.29	.12	.19	.79	.30	.17	1.30	1.95	1.93
<i>Byopodon nubilum</i> Say	---	.05	---	---	---	---	---	---	.57	---
<i>Camnula pellicida</i> Scudd	17.29	5.36	4.35	20.57	18.07	2.60	1.63	2.18	20.34	1.63
<i>Chloealtis conspersa</i> Harr	---	.02	---	---	---	---	---	---	---	---
<i>Chorthippus curtipennis</i> Harr	.17	.05	.23	---	---	.10	---	.41	---	---
<i>Cordillacris crenulata</i> Brun	.01	.02	---	---	---	---	---	.21	.80	---
<i>Dissosteira carolina</i> L	2.68	1.85	1.53	2.64	3.98	1.88	1.61	.40	.11	.30
<i>Drepanopterna femoratum</i> Scudd	.57	1.02	.12	---	.98	.49	.17	7.68	3.91	2.14
<i>Derotmena haydeni</i> Thos	.01	---	---	---	---	.07	.02	---	---	---
<i>Encyrtolophus costalis</i> Scudd	1.36	1.08	5.40	2.64	.85	1.96	.79	2.96	.92	.51
<i>Gomphocerus clavatus</i> Thom	.11	.02	.12	---	---	---	---	.04	---	---
<i>Haeroteletix trifasciatus</i> Say	.03	.02	---	---	---	.10	.19	.09	---	.30
<i>Hesperoteletix viridis pretensis</i> Scudd	---	.02	---	---	---	---	---	.04	---	---
<i>Hesperoteletix viridis</i> Thos	.16	.16	.12	---	.38	.10	.43	.47	.46	.10
<i>Hippiscus rugosus</i> Scudd	---	---	---	---	.30	.07	.02	.01	---	.10
<i>Hypocilora alba</i> Dodge	.10	---	.35	---	---	.27	.02	.02	---	.10
<i>Melanoplus alvitudinum</i> Scudd	---	---	---	---	.04	.02	.28	.08	---	---
<i>Melanoplus angustipennis</i> Dodge	.97	3.03	4.23	.38	3.04	4.19	3.63	.78	.57	.71
<i>Melanoplus divistatus</i> Say	3.45	4.68	2.23	4.53	4.57	1.61	1.83	.27	2.76	.81
<i>Melanoplus bowditchi</i> Scudd	.04	.03	---	---	---	.05	---	.53	---	---
<i>Melanoplus conlusus</i> Scudd	---	---	---	---	---	---	.02	.04	---	---
<i>Melanoplus dawsoni</i> Scudd	.53	.54	3.05	---	.13	.92	.49	.86	2.30	---
<i>Melanoplus differentialis</i> Thos	1.29	.61	6.46	---	6.74	3.49	2.92	.28	---	.10

Table 11.--continued

Species	Small:	Grain:	Legumes:	Corn:	Flax:	side:	Weedy:	Russian:	Plains:	Low moun-:	Pasture:
Melanoplus femur-rubrum DeG	9.46:	24.72:	11.40:	23.96:	4.53:	6.10:	6.24:	1.32:	2.07:	3.15:	
Melanoplus fluviatilis Burm	--:	--:	--:	--:	--:	--:	--:	.07:	--:	--:	
Melanoplus gladstoni Scudd	1.24:	1.45:	7.28:	3.21:	.30:	1.46:	1.20:	.10:	.46:	.51	
Melanoplus infantilis Scudd	1.31:	1.54:	.59:	--:	1.27:	1.11:	.41:	4.45:	2.41:	.10	
Melanoplus keeleri luridus Dodge	--:	--:	--:	.38:	--:	.10:	--:	--:	.23:	--	
Melanoplus kennicottii Scudd	--:	--:	--:	--:	--:	--:	--:	.01:	--:	--	
Melanoplus lakinus Scudd	.02:	--:	--:	--:	--:	.02:	.97:	--:	--:	--	
Melanoplus mexicanus Sauss	43.00:	37.24:	26.79:	31.12:	31.62:	38.64:	59.93:	13.65:	25.28:	5.59	
Melanoplus occidentalis Thos	--:	.05:	--:	--:	--:	--:	--:	.09:	--:	--	
Melanoplus packardii Scudd	4.01:	6.67:	1.88:	3.96:	6.46:	2.43:	4.59:	1.14:	2.18:	1.42	
Melanoplus punctulatus Scudd	--:	--:	--:	--:	--:	--:	--:	.01:	--:	--	
Merimira maculipennis macclunji Rehn	.01:	--:	--:	--:	--:	--:	--:	.11:	--:	.10	
Merimira kiowa Thos	1.25:	.52:	4.46:	.19:	3.19:	1.96:	1.01:	13.42:	4.14:	40.08	
Merimira neomexicana Thos	--:	--:	--:	--:	--:	--:	--:	.01:	--:	--	
Metator parcalinus Sauss	.67:	.20:	.47:	.19:	.79:	.47:	.17:	1.01:	.23:	.20	
Opeia obscura Thos	1.10:	.14:	1.29:	.38:	.40:	3.51:	.35:	7.49:	.46:	1.63	
Orphulella pelidna Burm	--:	--:	.12:	--:	.02:	--:	--:	.07:	.11:	--	
Orphulella speciosa Scudd	.29:	--:	.70:	.38:	.19:	.25:	.15:	.49:	.11:	1.22	
Pardalophora haldemani Scudd	--:	.02:	--:	--:	--:	.02:	.02:	--:	--:	--	
Paropomala wyomingensis Thos	--:	--:	--:	--:	--:	--:	--:	.01:	--:	--	
Phliostrota quadrimaculata Thos	1.26:	.16:	1.06:	--:	.79:	9.00:	.19:	9.00:	3.68:	4.37	
Phoetaliotes nebrascensis Thos	2.21:	1.15:	4.70:	2.64:	.57:	4.58:	3.03:	2.08:	2.76:	.71	
Pseudopomala brachyptera Scudd	--:	--:	--:	--:	--:	--:	--:	.01:	--:	--	
Spharagemon collare Scudd	.69:	.52:	.59:	.38:	1.02:	.87:	.73:	.33:	1.15:	.20	
Spharagemon equale Say	.35:	.90:	--:	--:	.47:	.32:	.43:	.40:	1.15:	--	
Trimerotropis pistrinaria Sauss	--:	.02:	--:	--:	--:	.05:	--:	.02:	--:	--	
Trimerotropis campestris McNeill	.02:	--:	--:	--:	--:	--:	--:	--:	--:	--	
Trimerotropis gracilis Thos	--:	--:	--:	--:	--:	--:	--:	.01:	--:	--	
Trimerotropis pallidipennis Burm	.01:	.23:	--:	--:	.02:	--:	--:	--:	--:	--	
Trimerotropis sparsa Thos	--:	--:	--:	--:	--:	--:	--:	.01:	--:	--	

In order to shorten the discussion of the grasshoppers found in each of the environments selected in Montana, North Dakota, South Dakota, and Wyoming, the most abundant species have been listed, together with their percentages of the total number of specimens collected in each environment. The percentages are expressed in round numbers.

Small grain

Legumes

	Percent
1. <u>Melanoplus mexicanus</u> -----	43
2. <u>Camnula pellucida</u> -----	17
3. <u>Melanoplus femur-rubrum</u> ----	9
4. <u>Melanoplus packardii</u> -----	4
5. <u>Melanoplus bivittatus</u> -----	3
6. All others-----	24

	Percent
1. <u>Melanoplus mexicanus</u> -----	37
2. <u>Melanoplus femur-rubrum</u> -----	25
3. <u>Melanoplus packardii</u> -----	7
4. <u>Camnula pellucida</u> -----	5
5. <u>Ageneotettix deorum</u> -----	5
6. All others-----	21

Corn

Flax

1. <u>Melanoplus mexicanus</u> -----	27
2. <u>Melanoplus femur-rubrum</u> ----	11
3. <u>Ageneotettix deorum</u> -----	10
4. <u>Melanoplus gladstoni</u> -----	7
5. <u>Melanoplus differentialis</u> ---	6
6. All others-----	39

1. <u>Melanoplus mexicanus</u> -----	31
2. <u>Melanoplus femur-rubrum</u> -----	24
3. <u>Camnula pellucida</u> -----	21
4. <u>Melanoplus bivittatus</u> -----	5
5. <u>Melanoplus packardii</u> -----	4
6. All others-----	15

Roadside

Weedy patches

1. <u>Melanoplus mexicanus</u> -----	32
2. <u>Camnula pellucida</u> -----	18
3. <u>Ageneotettix deorum</u> -----	8
4. <u>Melanoplus differentialis</u> ---	7
5. <u>Melanoplus packardii</u> -----	6
6. All others-----	29

1. <u>Melanoplus mexicanus</u> -----	39
2. <u>Ageneotettix deorum</u> -----	10
3. <u>Phlibostroma quadrimaculatum</u>	9
4. <u>Melanoplus femur-rubrum</u> ----	6
5. <u>Phoetaliotes nebrascensis</u> ---	5
6. All others-----	31

Russian-thistle

Plains grassland

1. <u>Melanoplus mexicanus</u> -----	60
2. <u>Melanoplus femur-rubrum</u> ----	6
3. <u>Ageneotettix deorum</u> -----	5
4. <u>Melanoplus packardii</u> -----	5
5. <u>Melanoplus angustipennis</u> ---	4
6. All others-----	20

1. <u>Ageneotettix deorum</u> -----	23
2. <u>Melanoplus mexicanus</u> -----	14
3. <u>Mestobregma kiowa</u> -----	13
4. <u>Phlibostroma quadrimaculatum</u>	9
5. <u>Drepanopterna femoratum</u> ----	8
6. <u>Opeia obscura</u> -----	7
7. All others-----	26

Low-mountain grassland

Pasture grassland

1. <u>Melanoplus mexicanus</u> -----	25
2. <u>Camnula pellucida</u> -----	20
3. <u>Ageneotettix deorum</u> -----	16
4. <u>Mestobregma kiowa</u> -----	4
5. <u>Drepanopterna femoratum</u> ----	4
6. <u>Phlibostroma quadrimaculatum</u>	4
7. All others-----	27

1. <u>Mestobregma kiowa</u> -----	40
2. <u>Ageneotettix deorum</u> -----	29
3. <u>Melanoplus mexicanus</u> -----	6
4. <u>Phlibostroma quadrimaculatum</u>	4
5. <u>Melanoplus femur-rubrum</u> ----	3
6. All others-----	18

THE MAJOR SPECIES OF GRASSHOPPERS IN OTHER STATES

For all States other than Montana, North Dakota, South Dakota, and Wyoming, the information is based on reports in which only dominant and major species were recorded either at each point of observation or for the State as a whole.

Michigan

The report for this State was furnished by the State leader and was divided into two parts, one for the Upper Peninsula and the other for the Lower Peninsula counties. In these reports the one dominant species was recorded at each place surveyed. These dominant species are listed in order with the number of times they each were recorded as being the most abundant.

Upper Peninsula counties

1. <u>Camnula pellucida</u> -----	90
2. <u>Melanoplus mexicanus</u> -----	42

Lower Peninsula counties

1. <u>Melanoplus mexicanus</u> -----	115
2. <u>Melanoplus femur-rubrum</u> -----	20
3. <u>Camnula pellucida</u> -----	14
4. <u>Arphia tenebrosa</u> -----	4
5. <u>Arphia salphurea</u> -----	1
6. <u>Spharagemon sp.</u> -----	1

In the Upper Peninsula Camnula pellucida is dominant, whereas Melanoplus mexicanus is most abundant in the Lower Peninsula, with C. pellucida ranking third and M. femur-rubrum second. The Upper Peninsula is rugged mountainous "old land" not completely worn down by erosion, and the Lower Peninsula is a portion of the old coastal plain with the soil varying from a light sandy loam in the north-central part to a dark clay loam in the southwest and southeast. This may explain the difference between the dominant species found in the Upper and the Lower Peninsulas.

Wisconsin

In Wisconsin the State leader recorded the three major species in the order of their abundance at each point surveyed. These are listed below according to the number of times they ranked first, second, and third.

First in abundance

1. <u>Camnula pellucida</u> -----	295
2. <u>Melanoplus mexicanus</u> -----	74
3. <u>Dissosteira carolina</u> -----	6
4. <u>Melanoplus bivittatus</u> -----	2

Second in abundance

1. <u>Melanoplus mexicanus</u> -----	196
2. <u>Camnula pellucida</u> -----	24
3. <u>Dissosteira carolina</u> -----	9
4. <u>Melanoplus femur-rubrum</u> -----	6
5. <u>Melanoplus bivittatus</u> -----	5

Third in abundance

1. <u>Melanoplus bivittatus</u> -----	19
2. <u>Dissosteira carolina</u> -----	9
3. <u>Melanoplus mexicanus</u> -----	4
4. <u>Camnula pellucida</u> -----	1

Camnula pellucida was by far the dominant grasshopper in this State.

California

The following information was obtained from a report made by C. C. Wilson, of the Bureau of Entomology and Plant Quarantine, Sacramento, Calif. In California Camnula pellucida was the dominant species on grazing lands, with Oedaleonotus enigma ranking second. Melanoplus femur-rubrum was most abundant in alfalfa and irrigated crops, with M. mexicanus next. In some sections M. differentialis and M. marginatus were numerous.

The important species for the States not previously mentioned are listed in the order of their abundance. These data are based on a report by B. M. Gaddis, of the Bureau of Entomology and Plant Quarantine, of the results of a questionnaire sent to each State:

Minnesota

1. Camnula pellucida
2. Melanoplus bivittatus
3. Melanoplus mexicanus
4. Melanoplus packardii
5. Dissosteira carolina
6. Melanoplus femur-rubrum

Nebraska

1. Melanoplus bivittatus
2. Melanoplus differentialis
3. Melanoplus mexicanus
4. Aulocara ellioti

Idaho

1. Melanoplus mexicanus
2. Melanoplus bivittatus
3. Camnula pellucida

Colorado

1. Melanoplus differentialis
2. Melanoplus mexicanus
3. Melanoplus femur-rubrum

Kansas

1. Melanoplus differentialis
2. Melanoplus bivittatus
3. Melanoplus mexicanus

Nevada

1. Melanoplus mexicanus
2. Camnula pellucida
3. Melanoplus bivittatus

Utah

1. Camnula pellucida
2. Melanoplus mexicanus
3. Melanoplus femur-rubrum
4. Melanoplus packardii
5. Melanoplus bivittatus
6. Aulocara ellioti

Oregon

1. Camnula pellucida
2. Melanoplus femur-rubrum
3. Melanoplus bivittatus
4. Melanoplus mexicanus

DISCUSSION

The survey indicates that Melanoplus mexicanus was the most widespread and destructive to crops of all the grasshopper species concerned in the outbreak. Camnula pellucida came next. Even on the grazing lands, both these species were of great importance. C. pellucida occurred in greatest abundance at higher elevations or in more northern latitudes. Two other species, Melanoplus bivittatus and M. differentialis, very important in past outbreaks, have all but disappeared in the areas of heavy drought. These two species began building up in 1928 in the States of North and South Dakota, and reached their peak of abundance and widespread destruction in the outbreaks of 1931 and 1932. During these years weather conditions, although somewhat hot and

dry, permitted an abundance of food in the form of succulent crops. As drought increased in 1933 and 1934 and crops were ruined, these two species decreased almost to the vanishing point. Native grasses in this drought-stricken area were better able to withstand dry conditions than cultivated crops. M. mexicanus and C. pellucida withstood the drought because they are better adapted to feeding on dry native grass than are either M. bivittatus or M. differentialis, which are more adapted to cultivated crops and build up in abundance in cultivated areas. These changes greatly affect the method and extent of control measures. Melanoplus mexicanus lays its eggs over a much wider area than does either Camnula pellucida, M. bivittatus, or M. differentialis. This means that larger areas have to be poisoned, involving more material and machine scattering to cover the ground. On the other hand, Camnula pellucida, Melanoplus bivittatus, and M. differentialis localize their eggs along headlands, ditch banks, roadsides, and pastures and for this reason can be more easily controlled.

Surveys to determine the species and distribution of grasshoppers are of great importance. Knowing the economic species and their preferred habitats, egg surveys can be concentrated where eggs are most likely to be found and, as a result, more accurate estimates can be made in regard to control measures that will be needed the following year.

