The Great Basin Naturalist

VOLUME XVI, 1956

VASCO M. TANNER, *Editor*

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A PRELIMINARY LIST OF COLLEMBOLA OF IDAHO

By D. L. Wray[1] and G. F. Knowlton[2]

This list is the result of a study of the ecological range of this interesting group of insects in this general area during the years 1948 to 1956. Over 300 field samples of leaves, debris, grass, moss, soil, etc., were collected in various habitats by G. F. Knowlton and his associates. Specimens were most commonly secured by the use of a modified Berlese funnel. The systematic arrangement and identification of specimens were made by D. L. Wray.

Order COLLEMBOLA Lubbock

Family Poduridae

Achorutes armatus Nicolet. Franklin, Nov. 2, Dec. 22, April 7, from garden litter, grass, ash and boxelder leaves, and thistles, G. F. Knowlton, S.C. Ma, K. Goodarzy; Lava Hot Springs, June 29, poplar leaves and trash, B. A. Baldwin; Aberdeen, Sept. 21, from rotting weeds and moss from canal, GFK and J. V. Bruce; Cub River Canyon, Aug. 28, from moss, GFK and B. K. Collmar; Cherry Creek, Nov. 10, GFK; Fish Haven, Oct. 11, July 6, from rotten wood and wild grass hay, GFK; Montpelier, July 6, from grass and moss, GFK; Idaho Falls, Nov. 6, in lawn, GFK; Paris, July 6, in lilac leaves and soil, GFK and Ted Tibbetts; Georgetown, July 6, from strawberry field litter, GFK; Stone, Aug. 24, from sage litter and soil, GFK; St. Charles, June 29, from straw litter, TT and D. Haws; Whitney, May 19, from corral litter, GFK and E. H. Kardos.

Achorutes maturus Folsom. Cherry Creek, Nov. 10, from shade tree litter, GFK; Deer Lodge, Apr. 7, from rotten wood, GFK, EHK; Preston, Dec. 30, from maple and basswood leaves, GFK, SCM; Montpelier, July 6, GFK; Lava Hot Springs, June 29, from poplar leaves, BAB; Fish Haven, July 6, from wild grass hay, GFK; Blackfoot, Aug. 2, from leaves, GFK, TT, and D. McComb; Stone, Aug. 24, GFK, SCM; Paris, Mar. 16, from spruce litter, GFK, SCM; Twin Falls, Nov. 21, from willow leaves, GFK, SCM; St. Charles, June 29, from straw litter, TT, DH; Whitney, May 19, Feb. 20, from

1. Entomologist, Division of Entomology, Department of Agriculture, Raleigh, N. C.
2. Professor and Extension Entomologist, Utah State Agricultural College, Logan, Utah.

corral litter and moldy grass, GFK. SCM. EHK; Georgetown, July 6, from strawberry litter, GFK; Franklin, Apr. 7, from thistles, GFK, SCM.

Achorutes promatro Wray. Franklin, Nov. 2, 26, Dec. 22, from garden, grass, boxelder and ash tree litter, GFK, SCM, KG; Woodruff, Sept. 8, straw litter, GFK, DH; Lava Hot Springs, June 29, from popular leaves, BAB; Georgetown, July 6, from strawberry patch, GFK; Montpelier, July 6, GFK.

Achorutes nivicolus Fitch. Franklin, Dec. 22, from boxelder litter, GFK, KG.

Xenylla baconae Folsom. Fish Haven, Oct. 11, from maple leaves, GFK, SCM.

Xenylla welchi Folsom. Franklin, Nov. 26, from garden litter, GFK.

Frisea claviseta Axelson. Lava Hot Springs, June 29, Dec. 22, from popular leaves and trash, BAB, GFK; Franklin, Nov. 2, from ash tree litter, GFK, SCM; Fish Haven, July 6, from wild grass hay, GFK.

Frisea grandis Mills. Cherry Creek, Nov. 10, from shade tree litter, GFK.

Neanura muscorum Templeton. Deer Lodge, Apr. 7, from rotten wood, GFK, EHK; Fish Haven, July 6, from wild grass hay, GFK; Franklin, Nov. 2, from grass, GFK, SCM.

Onychiurus armatus Tullberg. Franklin, Nov. 21, 26, from garden litter and grass, GFK; Lava Hot Springs, June 29, from poplar leaves and trash, BAB; St. Charles, Nov. 19, from grass, GFK, SCM; Fish Haven, Oct. 11, July 6, from rotten wood and grass, GFK, SCM; Montpelier, July 6, GFK; Idaho Falls, Nov. 6, from lawn, GFK; Blackfoot, Aug. 2, from leaves, GFK, TT, DH; Georgetown July 6, from strawberry field, GFK.

Tullbergia grandis Mills. Cherry Creek, Nov. 16, from shade tree litter, GFK.

Tullbergia granulata Mills. Idaho Falls, Nov. 6, from lawn, GFK; Georgetown, July 6, in strawberry patch, GFK; Franklin, Nov. 2, 26, Apr. 7, in garden litter, grass, and thistles, GFK, SCM.

Tullbergia clavata Mills. Blackfoot, Aug. 2, from leaves, GFK, TT, DMc; Stone, Aug. 24, from poplar leaves, GFK, SCM.

Tullbergia knowltoni Wray. Franklin, Nov. 26, from garden litter, GFK.

Tullbergia iowensis Mills. Franklin, Nov. 26, from garden litter, GFK; Woodruff, Sept. 8, from straw litter, GFK, DH.

Tullbergia collis Bacon. Bloomington, Nov. 17, from lilac leaves, GKF, SCM; Fish Haven, July 6, from wild grass hay, GFK.

Family Isotomidae

Isotomodes tenuis Folsom. Stone, Aug. 24, from poplar leaves, GFK, SCM.

Folsomia fimetaria Linn. Lava Hot Springs, June 29, from poplar leaves and trash, BAB; Fish Haven, July 6, from birch leaves, GFK; Woodruff, Sept. 8, from leaves and soil, GFK, DH.

Folsomia diplophthalma Axelson. Franklin. Apr. 7. EHK.

Agrenia bidenticulata Tullberg. Cub River Canyon. Aug. 28, in moss, GFK, BKC.

Proisotoma minuta Tullberg. Stone. Aug. 24, from sage and willow leaves, and soil. GFK, SCM.

Proisotoma decemoculata Folsom. St. Charles, June 29, in grass, TT. DH.

Proisotoma aquae Bacon. Franklin. Nov. 26. from garden litter, GFK; Lava Hot Springs, June 29, poplar leaves and trash. BAB; Woodruff. Sept. 8. from straw litter. GFK, DH; Aberdeen, Sept. 2, from rotting weeds and moss from canal, GFK. JVB; Fish Haven, July 6, from birch leaves and rotten wood, GFK. SCM; Deer Lodge, Apr. 7, from rotten wood. GFK. EHK; Georgetown. July 6. from strawberry patch, GFK; Idaho Falls. Nov. 6, from lawn, GFK; Stone, Aug. 24. from bedding straw, GFK. SCM; Whitney, May 19, from corral litter and moldy grass, GFK. SCM. EHK; St. Charles, June 29, from straw litter. TT, DH.

Spinisotoma sp. Montpelier. July 6. GFK.

Isotomurus palustris Muller. Fish Haven, Oct. 11, in rotten wood, GFK, SCM; Bloomington, July 6, from meadow soil. GFK; Woodruff. Sept. 8, from leaves and soil. GFK, DH; St. Charles, June 29, in grass, TT, DH.

Isotoma viridis *Bourlet*. Franklin, Nov. 26. Dec. 22. in garden and boxelder litter, GFK; St. Charles, Nov. 19, from slough grass, GFK, SCM; Cub River Canyon, Aug. 28, in moss, GFK, KG.

Isotoma cinerea Nicolet. St. Charles, Nov. 19, from slough grass. GFK, SCM.

Isotoma olivacea Tullberg. Cub River Canyon. Aug. 28, in moss, GFK. KG; Fish Haven, Aug. 28. July 6, from birch leaves and wild grass, GFK; Lava Hot Springs. June 29. from poplar leaves, BAB; Whitney, May 19. from corral litter, GFK. EHK; St. Charles, June 29, in grass, TT, DH.

Isotoma minor Schäffer. Cub River Canyon. Aug. 28, in moss. GFK. BKC; Paris. July 6. from lilac leaves and soil. GFK. TT.

Isotoma trispinata MacGillivray. Cub River Canyon, Aug. 28, in moss. GFK. BKC. Woodruff. Sept. 8. in leaves and soil. GFK. DH.

Isotoma eunotabilis Folsom. Franklin. Nov. 2, 26, Apr. 7. in garden litter, grass, and thistles. GFK, SCM; St. Charles. Nov. 19, June 29. from slough grass, straw litter. GFK, SCM. TT, DH; Bloomington. Nov. 17. from lilac leaves. GFK, SCM; Woodruff. Sept. 8, from straw litter. leaves. and soil. GFK. DH; Aberdeen. Sept. 21, from rotting weeds and moss from canal. GFK. JVB; Cub River Canyon. Aug. 28. from moss. GFK. KG; Fish Haven. Oct. 11. from rotten wood and maple leaves. GFK, SCM; Georgetown, July 6. from strawberry field litter, GFK; Idaho Falls. Nov. 6. from lawn, GFK; Twin Falls, Nov. 21. from willow leaves. GFK. SCM; Blackfoot, Aug. 2, from leaves. GFK; TT. DMc; Stone, Aug. 24. from poplar leaves, GFK. SCM; Paris. July 6, from lilac leaves and soil. GFK. TT.

Family ENTOMOBRYIDAE

ENTOMOBRYA ATROCINCTA Schött. Franklin, Nov. 26, from garden litter, GFK; Cherry Creek, Nov. 10, from shade tree litter, GFK; Blackfoot, Aug. 2, from leaves, GFK, DMc; Stone, Aug. 24, from poplar and willow leaves, GFK, SCM.

ENTOMOBRYA PSEUDOPERPULCHRA Mills. Cherry Creek, Nov. 10, from shade tree litter, GFK; Blackfoot, Aug. 2, from leaves, GFK, TT, DMc.

ENTOMOBRYA NIVALIS Linn. Aberdeen, Sept. 21, from rotting weeds and grass from canal, GFK, JVB.

ENTOMOBRYA MARGINATA Tullberg. Aberdeen, Sept. 2, from rotting weeds and moss from canal, GFK, JVB; Lava Hot Springs, June 29, from poplar leaves, BAB; Inkom, Aug. 13, from moss, GFK, SCM; Idaho Falls, Nov. 16, from lawn, GFK; Georgetown, July 6, from strawberry patch, GFK; Montpelier, July 6, GFK; St. Charles, June 29, from straw litter, TT, DH; Twin Falls, Nov. 21, from willow leaves, GFK, SCM.

ENTOMOBRYA PURPURASCENS Packard. Franklin, Nov. 2, 26, from garden litter and grass, GFK, SCM; Lava Hot Springs, June 29, Aug. 24, from willow and poplar leaves and trash, BAB, GFK, SCM; Cub River Canyon, Aug. 28, from moss, GFK, KG; Fish Haven, July 6, Oct. 11, from rotten wood and wild grass, GFK, SCM; Montpelier, July 6, from grass and moss, GFK; St. Charles, June 29, from grass, TT, DH.

ENTOMOBRYA MULTIFASCIATA Tullberg. Franklin, Nov. 26, from garden litter, GFK; Cherry Creek, Nov. 10, from shade tree litter, GFK; Fish Haven, Oct. 11, from rotten wood, GFK, SCM; Idaho Falls, Nov. 6, from lawn, GFK; Blackfoot, Aug. 2, from leaves, GFK, TT, DMc; Stone, Aug. 24, from poplar leaves, GFK, SCM; Twin Falls, Nov. 24, from willow leaves, GFK, SCM; Woodruff, Sept. 8, from leaves and soil, GFK, DH.

DREPANURA KANABA Wray. Cherry Creek, Nov. 10, from shade tree litter, GFK; Franklin, Dec. 22, from boxelder litter, GFK, KG.

SIRA PLATANI Nicolet. Cherry Creek, Nov. 10, from shade tree litter, GFK.

LEPIDOCYRTUS CYANEUS Tullberg. Bloomington, Nov. 17, from lilac leaves, GFK, SCM; Aberdeen, Sept. 21, from rotting weeds and moss from canal, GFK, SCM; Deer Lodge, Apr. 7, from rotten wood, GFK, EHK; Preston, Dec. 30, from *Tilia americana* leaves, GFK; Fish Haven, July 6, Oct. 11, from wild grass hay and maple leaves, GFK, SCM; Blackfoot, Aug. 2, from leaves, GFK, TT, DMc; Twin Falls, Nov. 21, from willow leaves, GFK, SCM; St. Charles, June 29, from straw litter, TT, DH; Whitney, May 19, from corral litter, GFK, EHK; Paris, Nov. 19, from sawdust, lilac leaves and soil, GFK, SCM, TT; Franklin, Nov. 2, from *Crataegus*, GFK, SCM.

LEPIDOCYRTUS CYANEUS var. *aenescens* Guthrie. Fish Haven, Oct. 11, from rotten wood, GFK, SCM; Montpelier, July 6, GFK.

DREPANOCYRTUS KNOWLTONI Wray. Cherry Creek, Nov. 10, GFK.

Pseudosinella alba Packard. Fish Haven, July 6, from birch leaves, GFK.

Pseudosinella violenta Folsom. Fish Haven, Oct. 11, from big-toothed maple leaves, GFK, SCM; Stone, Aug. 24, from poplar leaves, GFK, SCM.

Pseudosinella sexoculata Schött. Lava Hot Springs, June 29, from poplar leaves and trash, BAB; Cherry Creek, Nov. 10, from shade tree litter, GFK; Montpelier, July 6, GFK; Fish Haven, July 6, Oct. 11, from wild grass hay and maple leaves, GFK; Blackfoot, Aug. 2, from leaves, GFK, TT, DMc; Stone, Aug. 24, from sage litter and soil, poplar leaves, GFK, SCM; Whitney, May 19, from corral litter, EHK; Franklin, Apr. 7, from thistles, GFK, SCM.

Pseudosinella octopunctata Börner. Blackfoot, Aug. 2, from leaves, GFK, TT, DMc; Stone, Aug. 24, from sage, soil, bedding straw, and poplar leaves, GFK, SCM; St. Charles, June 29, from straw litter, TT, DH; Whitney, May 19, from corral litter, GFK, EHK; Woodruff, Sept. 8, from leaves and soil, GFK, DH; Fish Haven, July 6, from waste hay, GFK; Franklin, Apr. 7, from thistles, GFK, SCM; Georgetown, July 6, from strawberry field litter, GFK.

Family Orchesellidae

Orchesella cincta Linn. Montpelier, July 6, from grass and moss, GFK; St. Charles, June 29, from grass, TT, DH.

Family Tomoceridae

Tomocerus vulgaris Tullberg. Franklin, Nov. 26, from garden litter, GFK; Blackfoot, Aug. 2, from leaves, GFK, DMc; Whitney, May 19, from corral litter, GFK, EHK.

Tomocerus flavescens var. *americanus* Schött. Cub River Canyon, Aug. 28, from moss, GFK, KG.

Family Sminthuridae

Sminthurides *(Sphaeridia)* pumilis Krausbauer. Franklin, Nov. 2, from grass, GFK, SCM; Bloomington, July 6, from meadow soil, GFK.

Sminthurides aquaticus var. *levanderi* Reuter. Cub River Canyon, Aug. 28, from moss, GFK, BKC; Bloomington, July 6, from meadow soil, GFK.

Sminthurinus elegans Fitch. Franklin, Nov. 21, 26, Apr. 7, from garden litter, thistles, and *Crataegus*, GFK, SCM; St. Charles, Nov. 19, July 6, from slough grass, GFK, SCM, TT, DH; Montpelier, July 6, GFK.

Sminthurinus elegans var. *ochropus* Reuter. St. Charles, Nov. 19, from slough grass, GFK, SCM; Georgetown, July 6, from strawberry patch, GFK; Montpelier, July 6, from grass and moss, GFK; St. Charles, June 29, from straw litter, TT, DH; Twin Falls, Nov. 21, from willow leaves, GFK, SCM.

Sminthurinus niger Lubbock. Aberdeen, Sept. 21, from rotten weeds and moss from canal, JVB, GFK; Twin Falls, Nov. 21, from willow leaves, GFK, SCM.

Deuterosminthurus repandus Agren. Fish Haven, July 23, on raspberry, GFK; Deer Lodge, Apr. 7, from rotten wood, GFK, EHK; Cub River Canyon, Aug. 28, from moss, GFK, KG; Montpelier, July 6, from grass and moss, GFK.

Sminthurus fitchi Folsom. Montpelier, July 6, from grass and moss, GFK.

Ptenothrix unicolor Harvey. Deer Lodge, Apr. 7, from rotten wood, GFK, EHK.

In this paper are listed 57 forms and 26 genera that occur in Idaho. Doubtless many more will come to light as collecting continues.

FURTHER ADDITIONS TO THE LIST OF COLLEMBOLA OF UTAH

By D. L. Wray[1] and G. F. Knowlton[2]

Since our last list appeared (in The Great Basin Naturalist, Vol XIII, pages 43-46, Sept. 1953) some additional interesting forms have been found in Utah. All field collections (unless otherwise noted) were made by G. F. Knowlton and his associates and the identification of species by D. L. Wray.

Order COLLEMBOLA Lubbock

Family *Poduridae*

Xenylla maritima Tullberg. Beaver, Utah, from juniper litter, April 5, 1955, G. F. Knowlton.

Willemia intermedia Mills. Orderville, Utah, April 7, 1955, GFK.

Tafallia insularis Bonet. This interesting form has been found in the United States at Orderville, Utah, April 7, 1955, G. F. Knowlton. ("The first record of this form in the United States was made last summer when I found some specimens sent me for identification. The data on these were San Diego, California, collected by R. M. Ireland, May 3, 1953. This form was described by Dr. F. Bonet from Baja California, Mexico, April 12, 1945, in Revista De La Sociedad Mexicana De Historia Natural, Tomo VII, Nos. 1-4, Diciembre, 1946. This genus is placed near the genus *Willemia* in classification. D. L. Wray.")

Brachystomella parvula Schaeffer. Arches National Monument, Utah, March 9, 1955, under juniper trees, G. F. Knowlton and H. F. Thornley. A large series of specimens was secured.

Pseudachorutes subcrassoides Mills. Logan Canyon, Utah, November 19, 1949, in Douglas fir litter, GFK, S. C. Ma.

Micranurida n. sp. This form has 3 eyes on each side of the head, and will be described in a separate paper. Beaver, Utah, April 5, 1955, G. F. Knowlton; Monticello and Moab, Utah, March 4, 1955, G. F. Knowlton, H. F. Thornley. All were taken under juniper trees in litter.

Onychiurus pseudofimetarius Folsom. Mt. Timpanogos, Utah, June 23, 1951, GFK, Ted Tibbetts.

Onychiurus pseudarmatus Folsom. Logan, Utah, November 2, 1949, in ash tree litter, GFK, SCM.

Onychiurus fimetarius Linn. Tooele County, Utah, April 14, 1953, W. J. Johnson. This was in a collection sent me by H. E. Cott, Dugway, Utah.

Onychiurus subtenuis Folsom. In his Monograph of the Collembola of Iowa, H. B. Mills lists this as from Utah (1934).

Family Isotomidae

Pseudanurophorus n. sp. Arches National Monument, Utah, March

1. Entomologist, Div. of Entomology, Dept. of Agriculture, Raleigh, N. C.
2. Professor of Entomology and Extension Entomologist, Utah State Agricultural College, Logan, Utah.

4, 1955, GFK, HFT, under juniper trees; Monticello, Utah, March 4, 1955, GFK, HFT, under juniper trees; Moab, Utah, March 4, 1955, GFK, HFT, under juniper trees. ("This genus has been recorded once before from New England. This new form has two eyes on each sides of the head. It will be described in a later paper. The genus *Pseudanurophorus* is a close relative of *Anurophorus* Nicolet and *Paranurophorus* Denis, 1922. Of the latter genus I have identified *Paranurophorus armatus* Stach among a collection sent me by R. F. Wilkey. These were collected at San Diego, California, April 22, 1954, from leaf mould. D. L Wray.")

Proisotoma americana Mills. Orderville, Utah, July 7, 1955, GFK.

Proisotoma *(Proisotoma)* decemoculata Folsom. Arches National Monument, Utah, March 9, 1955, under juniper trees, GFK, HFT. A large series of specimens were collected.

Proisotoma thermophila Axelson. In his Monograph of the Collembola of Iowa (1934) Mills lists this as from Utah.

Family Entomobryidae

Sinella curviseta Brook. Logan, Utah, February 10, 1951, in greenhouse soil on bench, GFK, E. H. Kardos.

Drepanura rolfsi Mills. Tooele County, Utah, April 14, 1953, W. J. Johnson. In a collection sent me by H. E. Cott, of Dugway, Utah.

Lepidocyrtus pusillus Linn. Tooele County, Utah, August 11, 1953, W. J. Johnson. In a collection sent me by H. E. Cott, Dugway, Utah.

Family Sminthuridae

Sminthurides malmgreni var. palustris Folsom and Mills. Folsom and Mills in their paper on this group (Bull. Museum Comparative Zoology, vol. LXXXII, No. 4, 1938) lists this form from Utah. Eighteen forms are added to the Utah list bringing the total up to 110.

NOTES ON LOUSE-HOST ASSOCIATIONS OF THE GREAT SALT LAKE DESERT WITH KEYS TO THE LICE

Carlo M. Igonoffo[1]

INTRODUCTION

This study is concerned with the sucking lice of mammals, exclusive of bats, found in the southern arm of the Great Salt Lake Desert in northwestern Utah. The region includes the western parts of Box Elder, Tooele and Juab Counties. Contained in the keys are nineteen species of lice representing eight genera, which include those collected in this area as well as those known to occur on the same hosts in adjacent areas. These lice occur on twenty-two of the thirty-four species of mammals found in the study area. There are twenty-four genera of mammals of which the rodents account for approximately two-thirds of the total species. The numerical associations of lice and mammals are listed in Table I.

TABLE I
Numerical associations of the lice and mammals.

Host Order	Number of Mammal Species	Number of Louse Species
Lagomorpha	3	1
Rodentia	22	16
Carnivora	7	1
Artiodactyla	2	1

Table I indicates that the majority of the lice in this area have been found on the rodents. Of seven species of carnivores only one is known to carry lice.

The lice associated with the rodents are restricted to the families Cricetidae, Sciuridae, Muridae, and Heteromyidae. In these families the greatest number of louse associations per species of host represented occurred in the family Muridae (1 host, 3 lice). The Sciuridae, Cricetidae, and Heteromyidae follow in the order listed. These numerical associations are presented in Table II.

TABLE II
Louse associations of the families of rodents of the Great Salt Lake Desert.

Rodent			Rodent-louse
Family	Species	Louse Species	Associations
Muridae	1	3	3
Sciuridae	5	6	10
Cricetidae	8	8	11
Heteromyidae	6	3	6

1. University of Utah Ecological Research, Dugway, Utah.

The following sources were utilized in preparing the key and louse-host list: Ferris (1916, 1919-1935, 1951); Kellogg and Ferris (1915); Hopkins (1942); Durrant (1952).

The figures of each plate are arranged so that the top or left of each plate points cephalad. In some cases a small arrow designates the particular characteristics under consideration. A notation such as "II-1" in the key refers to figure one as depicted on plate II. In the keys and louse-host list, the presence of one asterisk after the louse species indicates an association which is known from other areas, but has not yet been found to occur in the Great Salt Lake Desert. Two asterisks denotes the recovery of the species from the host in the southern part of the Great Salt Lake Desert.

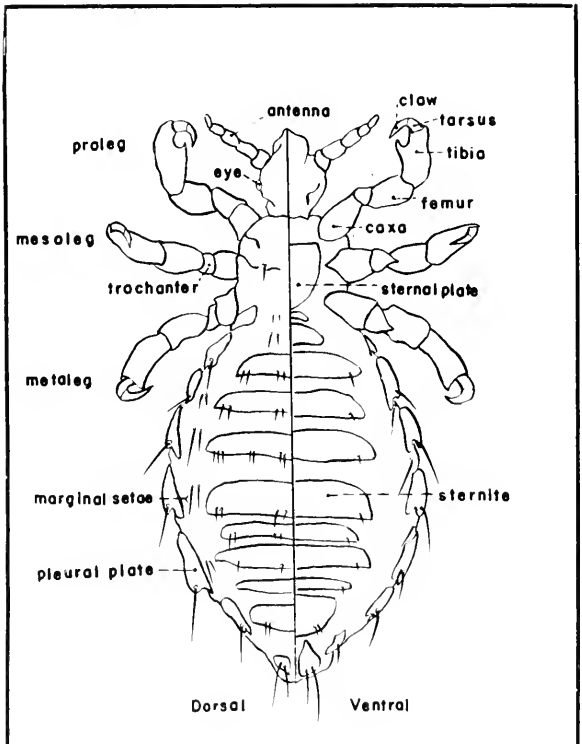

PLATE I

The study was conducted at Ecological Research, University of Utah, Dugway, Utah. Acknowledgements are made to the many workers of this group who aided in trapping and brushing the mammals as well as in the preliminary preparation of the specimens.

ILLUSTRATED KEY TO THE SUCKING LICE KNOWN OR SUSPECTED TO OCCUR IN THE GREAT SALT LAKE DESERT

1. Pleural plates of second to seventh abdominal segments absent or reduced; abdomen membranous except in the genital region. (Fig. II-1) 2

   Pleural plates of second to seventh abdominal segments present and well developed (Fig. II-2), except in *Neohaematopinus laeviusculus* where they are modified as hook-shaped sclerites (Fig. III-17); abdomen not membranous 6

2. Abdominal segments with more than one row of setae per segment (Fig. II-3); occiput produced into thorax (Fig. II-4); occurring on coyotes, Genus LINOGNATHUS: one species ..... setosus*

   Abdominal segments with one row of setae per segment (Fig. II-6); occiput not produced into thorax (Fig. II-5); not occurring on coyotes 3

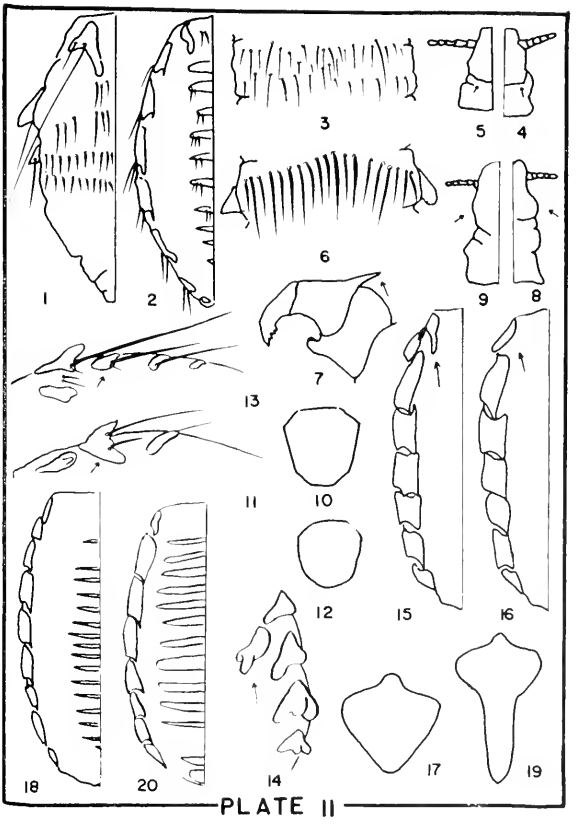

PLATE II

3. Pleural plates distinctly present on the second to fourth abdominal segments (Fig. II-1); meso- and metatarsi

projected into point at outer basal angle (Fig. II-7); occurs on rodents, Genus FAHRENHOLZIA 5
Pleural plates absent or when present reduced to minute plates; tarsi not as described above; occurs on the Lagomorpha and Artiodactyla 4

4. Head with distinct, rounded, posterior antennal angle (Fig. II-8); occurs on the black-tailed jackrabbit and the Audubon cottontail, Genus HAEMODIPSUS: one species ..... setoni**
Head without distinct, rounded, posterior antennal angle (Fig. II-9); occurs on the mule deer, Genus SOLENOPTES: one species ..... ferrisi*

5. Sternal plate octagon-shaped (Fig. II-10); with definite sides, pleural plate of the third segment of the largest single abdominal sclerite (Fig. II-11); the shortest seta

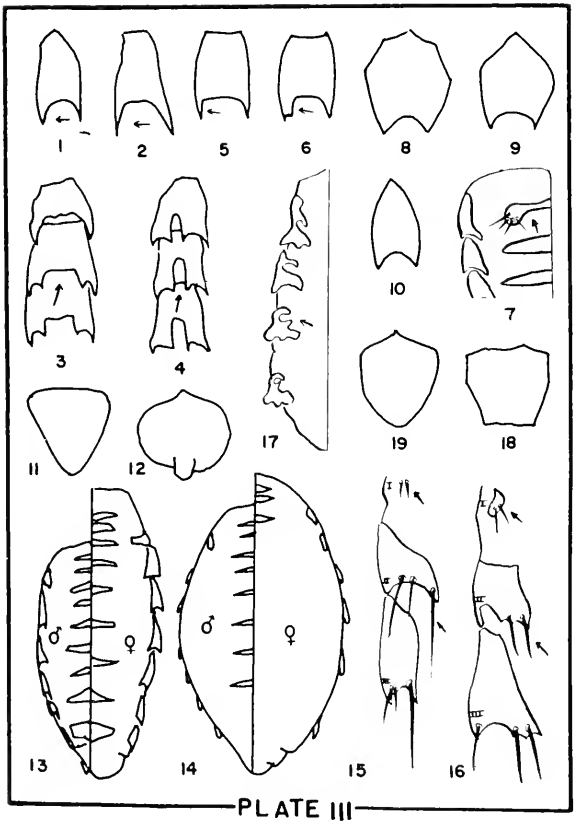

PLATE III

of the paired setae on this plate one-fourth of the length of the long seta; occurs on the little pocket mouse, Great Basin pocket mouse and the Ord kangaroo rat ..... pinnata**
Sternal plate oval-shaped without definite sides (Fig. II-12); pleural plate of the third segment not the largest

single sclerite (Fig. II-13); the shortest seta of the paired setae of this plate less than one-sixth the length of the long seta; occurs on the Great Basin pocket mouse and the long-tailed pocket mouse ..... reducta**

6. Second abdominal sternite with a posterior-projecting process (Fig. II-14); ventral abdominal segments with one row of setae per segment (Fig. II-6); head without a deeply indented post-antennal angle (Fig. II-9); occurring primarily on ground squirrels, Genus ENDERLEINELLUS 7

Second abdominal sternite without a posterior-projecting process; ventral abdominal segments with one or more rows of setae per segment (Fig. II-3); head with a definite indented post-antennal angle (Fig. II-8) 8

7. Two to four setae on the second abdominal tergite; setae short and stout, generally few in number; fourth abdominal tergite on males with two to six long setae in the median group; occurs on the rock squirrel ..... osborni*

Nine to eighteen setae on the second abdominal tergite; setae long and slender; males without long setae in the median group; occurs on the Townsend and antelope ground squirrels ..... suturalis**

8. First pair of abdominal pleurites located on the dorsum (Fig. II-15); Genus HOPLOPLEURA 9

First pair of abdominal pleurites located laterally (Fig. II-16) 12

9. Sternal plate shieldlike (Fig. II-17); length of posterior point less than one-half the greatest width of the plate; tergites and pleurites separated by more than three times the width of the widest tergite (Fig. II-18) 10

Sternal plate arrow-head shape (Fig. II-19); posterior point more than one-half the greatest width of the plate; tergites and pleurites separated by less than three times the width of the tergite (Fig. II-20) 11

10. Lobes of the pleural plates of the fourth abdominal segment at least one-third the length of the plate on which they are borne (Fig. III-2); occurs on the least chipmunk and the northern grasshopper mouse ..... arboricola**

Lobes of the pleural plates of the fourth abdominal segment less than one-third the length of the plate on which they are borne (Fig. III-1); occurs on the Townsend ground squirrel and the cliff chipmunk ..... erratica**

11. Dorsal marginal setae present (Fig. I); notch of the third pleural plate less than twice as long as wide (Fig. III-3); occurs on the long-tailed meadow mouse and the house mouse ..... acanthopus*

Dorsal marginal setae absent; notch of the third pleural plate at least twice as long as wide (Fig. III-4); occurs on the long-tailed pocket mouse, white-footed deer mouse, northern grasshopper mouse, pinyon mouse, canyon mouse, house mouse, and the western harvest mouse *hesperomydis-reithrodontomydis* complex 11a

11a. The males of *hesperomydis* and *reithrodontomydis* appear to be identical. The females may be separated as follows:

Dorsal lobe of pleurite seven definitely acute apically (Fig. III-5) ..... hesperomdydis**

Dorsal lobe of pleurite seven broad and apically truncate (Fig. III-6); occurs on western harvest mouse ..... reithrodontomydis**

12. Ventral abdominal segments with at least eight setae per row; second abdominal tergite posteriorly emarginate in

the males (Fig. III-7); sternal plate emarginate posteriorly (Figs. III-8, 9, 10); or with a posterior projecting process (Fig. III-2); or triangle-shaped; occurs on ground squirrels and wood rats, Genus NEOHAEMATOPINUS 13

Ventral abdominal segments with five to seven setae per row; second abdominal tergite not posteriorly emarginate in the males; sternal plate not emarginate posteriorly or with a posterior projecting process (Figs. II-11, 18, 19); occurs on mice, Genus POLYPLAX 17

13. Sternal plate posteriorly emarginate (Fig. III-8, 9, 10) 14

Sternal plate rounded or pointed posteriorly, never emarginate (Fig. III-12) 16

14. Abdominal tergites present in males and females, often reduced in the females (Fig. III-13); occurs on ground squirrels 15

Abdominal tergites reduced or absent in females and reduced in the males (Fig. III-14); occurs on the bushy-tailed wood rat ..... inornatus*

15. Pleural plate one absent, represented by a setal group (Fig. III-15); second pleural plate triangle-shaped with three setae evenly spaced along the edge of the pleurite; at least one seta of this group longer than the greatest length of the plate; occurs on the antelope ground squirrel ..... citellinus**

Pleural plate one small, but definitely present (Fig. III-16); second pleural plate rectangle-shaped with paired setae located on the inner third of pleurites; setae no longer than the greatest length of the plate; occurs on the Townsend ground squirrel ..... pacificus*

16. Sternal plate hexagonal in shape with posterior projection (Fig. III-12); pleural plates modified as hook-shaped sclerites (Fig. III-17); occurs on the rock squirrel ..... laeviusculus

Sternal plate triangular in shape with the angles rounded; posterior margin truncate, projection absent; pleurites not reduced to hook-shaped sclerites; occurs on the desert wood rat ..... probably new species**

17. Sternal plate pear-shaped with the anterior corners rounded; occurs on the house mouse ..... serrata*

Sternal plate not pear-shaped 18

18. Sternal plate concave anteriorly, posterior edge truncate (Fig. III-18); occurs on the white-footed deer mouse ..... auricularis**

Sternal plate not concave anteriorly; posterior edge not truncate (Fig. III-19); occurs on the long-tailed meadow mouse ..... abscisa*

HOST KEY TO THE SUCKING LICE KNOWN OR SUSPECTED TO OCCUR ON MAMMALS, EXCLUSIVE OF BATS, OF THE GREAT SALT LAKE DESERT

Occurs on:

1. Rodents 4

Other mammals 2

2. Rabbits: Audubon cottontail (Sylvilagus audubonii) and the black-tailed jackrabbit (Lepus californicus) ..... Haemodipsus setoni Ewing**

Other mammals 3

3. Mule deer (Odocoileus hemionus) .....
Solenoptes ferrisi Fahrenholzia*
Coyote (Canis latrans) .....
Linognathus setosus Olfers*
4. Squirrels and chipmunks (family Sciuridae) 5
Mice and rats (families Heteromyidae, Muridae and Cricetidae) .. 8
5. Chipmunks: cliff chipmunk (Eutamias dorsalis) and the least chipmunk (Eutamias minimus) .....
Hoplopleura arboricola Kellogg and Ferris**
Rock and ground squirrels 6
6. Rock squirrel (Citellus variegatus) .....
Neohaematopinus laeviusculus Grube*
Enderleinellus osborni Kellogg and Ferris*
Ground squirrels 7
7. Antelope ground squirrel (Citellus leucurus) .....
Neohaematopinus citellinus Ferris**
Enderleinellus suturalis Osborn**
Townsend ground squirrel (Citellus townsendii) .....
Neohaematopinus pacificus Kellogg and Ferris*
Neohaematopinus laeviusculus Grube**
Hoplopleura arboricola Kellogg and Ferris*
Enderleinellus suturalis Osborn*
8. Heteromyidae (pocket mice and kangaroo rats) 9
Muridae and Cricetidae 11
9. Pocket mice (Perognathus spp.) 10
Ord kangaroo rat (Dipodomys ordii) .....
Fahrenholzia pinnata Kellogg and Ferris**
10. Great Basin pocket mouse (Perognathus parvus) .....
Fahrenholzia pinnata Kellogg andFerris**
Fahrenholzia reducta Ferris**
Little pocket mouse (Perognathus longimembris) .....
Fahrenholzia pinnata Kellogg and Ferris**
Long-tailed pocket mouse (Perognathus formosus) .....
Fahrenholzia reducta Kellogg and Ferris**
11. House mouse (Mus musculus) .....
Hoplopleura hesperomydis Osborn*
Hoplopleura acanthopus Burmeister*
Polyplax serrata Burmeister*
Other rats and mice 12
12. Wood rats (Neotoma spp.) 13
Other rodents 14
13. Desert wood rat (Neotoma lepida) .....
Neohaematopinus sp.**
Bushy-tailed wood rat (Neotoma cinerea) .....
Neohaematopinus inornatus Kellogg and Ferris*
14. White-footed mice (Peromyscus spp.) 15
Other mice (grasshopper, harvest and meadow mice) 16
15. Canyon mouse (Peromyscus crinitus) .....
Hoplopleura hesperomydis Osborn**
Deer mouse (Peromyscus maniculatus) .....
Hoplopleura hesperomydis Osborn**
Polyplax auricularis Kellogg and Ferris**
Pinyon mouse (Peromyscus truei) .....
Hoplopleura hesperomydis Osborn**
16. Long-tailed meadow mouse (Microtus longicaudus) .....
Hoplopleura acanthopus Burmeister*
Polyplax abscisa Fahrenholzia*
Northern grasshopper mouse (Onychomys leucogaster) .....
Hoplopleura hesperomydis Osborn**
Hoplopleura arboricola Kellogg and Ferris**
Western harvest mouse (Reithrodontomys megalotis) .....
Hoplopleura reithrodontomydis Ferris**

HOST-LICE ASSOCIATIONS OF MAMMALS,[2] EXCLUSIVE OF BATS, OF THE GREAT SALT LAKE DESERT

Canis latrans (coyote)
- Linognathus setosus Olfers*

Citellus leucurus (antelope ground squirrel)
- Neohaematopinus citellinus Ferris**
- Enderleinellus suturalis Osborn**

Citellus townsendii (Townsend ground squirrel)
- Neohaematopinus pacificus Kellogg and Ferris*
- Neohaematopinus laeviusculus Grube**
- Hoplopleura arboricola Kellogg and Ferris*
- Enderleinellus suturalis Osborn*

Citellus variegatus (rock squirrel)
- Neohaematopinus laeviusculus Grube*
- Enderleinellus osborni Kellogg and Ferris*

Dipodomys ordii (Ord kangaroo rat)
- Fahrenholzia pinnata Kellogg and Ferris**

Eutamias dorsalis (cliff chipmunk)
- Hoplopleura arboricola Kellogg and Ferris**

Eutamias minimus (least chipmunk)
- Hoplopleura arboricola Kellogg and Ferris**

Lepus californicus (black-tailed jackrabbit)
- Haemodipsus setoni Ewing**

Microtus longicaudus (long-tailed meadow mouse)
- Hoplopleura acanthopus Burmeister*
- Polyplax abscisa Fahrenholzia*

Mus musculus (house mouse)
- Hoplopleura hesperomydis Osborn*
- Hoplopleura acanthopus Burmeister*
- Polyplax serrata Burmeister*

Neotoma lepida (desert wood rat)
- Neohaematopinus sp.**

Neotoma cinerea (bushy-tailed wood rat)
- Neohaematopinus inornatus Kellogg and Ferris*

Odocoileus hemionus (mule deer)
- Solenoptes ferrisi Fahrenholzia*

Onychomys leucogaster (northern grasshopper mouse)
- Hoplopleura hesperomydis Osborn**
- Hoplopleura arboricola Kellogg and Ferris**

Perognathus formosus (long-tailed pocket mouse)
- Hoplopleura hesperomydis Osborn**
- Fahrenholzia reducta Ferris**

Perognathus longimembris (little pocket mouse)
- Fahrenholzia pinnata Kellogg and Ferris**

Perognathus parvus (Great Basin pocket mouse)
- Fahrenholzia pinnata Kelogg and Ferris**
- Fahrenholzia reducta Ferris**

Peromyscus crinitus (canyon mouse)
- Hoplopleura hesperomydis Osborn**

Peromyscus maniculatus (deer mouse)
- Hoplopleura hesperomydis Osborn**
- Polyplax auricularis Kellogg and Ferris**

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2. Arranged alphabetically according to genus

Peromyscus truei (pinyon mouse)
Hoplopleura hesperomydis Osborn**
Reithrodontomys megalotis (western harvest mouse)
Hoplopleura reithrodontomydis Ferris**
Sylvilagus audubonii (Audubon cottontail)
Haemodipsus setoni Ewing**

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NEW AFRICAN AND ASIAN TINGIDAE (HEMIPTERA)

Carl J. Drake[1]

The present paper contains the descriptions of five new lace-bugs of the subfamily Tinginae from Asia and Africa. The types have been deposited as stated under the description of each species. In the structural measurements, 80 units equal one millimeter.

CYSTEOCHILA **INCOLANA** Drake n. sp.

Small, brownish testaceous to dark brown, without color markings. Head black, armed with five moderately large testaceous spines, with median spine and hind pair appressed and front pair turned downward; eyes moderately large, blackish fuscous; bucculae contiguous in front. Rostrum brownish, extending to middle of mesosternum; laminae testaceous, uniseriate, narrowly separated on mesosternum, more widely separated and cordate on metasternum. Antennae testaceous with first two segments brownish and fourth mostly black, indistinctly pubescent, measurements — I, 8; II, 6; III, 45; IV, 16.

Pronotum moderately convex, coarsely punctate, tricarinate; median carina composed of one row of small areolae; lateral carinae concealed on disc by reflexed paranota but exposed on hind part of disc and the posterior projection, slightly divergent anteriorly, the areolae a little smaller than in media carina; hood very small, inflated; paranota moderately wide, reflexed, barely concealing lateral carinae in widest part (on disc), feebly raised above pronotal surface at humeri, sharply rounded behind.

Elytra not wider than widest part of pronotum, feebly slowly narrowed posteriorly on apical half; costal area wanting, represented only by the vein forming outer edge of subcostal area; subcostal area nearly vertical, largely biseriate; discoidal area large, extending beyond middle of elytra, with outer boundary straight, acutely angulate at both base and apex, four or five areolae deep at widest part (middle); with areolae same size as in subcostal area; sutural area with cells larger apically. Body beneath black-fuscous.

TYPE (male), Lion's Head, Capetown, South Africa, June, 1920; ALLOTYPE (female), Ceres, Cape Province, elevation 1,500 feet, Jan., 1921, both in British Museum. PARATYPES: 2 specimens with types and 1 from Port St. John, Pondoland, Sept., 1912.

Very similar in general aspects to *C. cremeri* Drake, but easily separated from it and other South African *Cysteochila* by the scarcely inflated paranota at humeral angles, lack of costal areas and distinctly narrowed apical half of elytra.

CYSTEOCHILA **VADOSA** Drake n. sp.

Small, robust, dark brown with paranota across humeri, crest of small hood, transverse band near middle of costal and subcostal

1. Ames, Iowa.

areas and numerous veinlets in discoidal and sutural areas blackish. Head dark fuscous, the spines represented by small tubercles; eyes moderately large, blackish fuscous; bucculae closed in front. Antennae dark brown with last segment black, indistinctly pubescent, measurements — I, 8; II, 8; III, 68; IV, 20. Rostrum brownish, extending to end of sulcus; laminae thick, areolate, open behind.

Pronotum wide, strongly convex, coarsely punctate, strongly narrowed anteriorly, largely concealed from dorsal aspects by reflexed paranota; hood very small, almost circular in outline, placed just back of front row of cells of collar; median carina distinctly raised but without areolae; lateral carinae covered on disc by reflexed paranota but visible on posterior process, there convergent anteriorly; paranota very large, reflexed, somewhat like an inverted bowl in shape, with outer margin resting on pronotal surface and in contact with median carina, the discal part of bowl elevated a little above pronotal surface. Orifice present. Legs rather short, dark brown, sparsely beset with setalike, golden pubescence. Body beneath dark, brown, with mesosternum blackish, sparsely provided with short, somewhat golden pubescence.

Elytra equal in width (widest part just behind posterior apex of pronotum) to pronotum across humeri, with sutural areas overlapping and apices jointly rounded; costal area uniseriate, the areolae moderately large, subquadrate, clear or whitish; subcostal area biseriate, the areolae smaller than in costal area; discoidal area large, reaching beyond middle of elytra, with outer boundary a little convex within, acutely angulate at base and at apex, widest at middle, there six areolae deep.

Length, 2.75 mm.; width, 1:15 mm.

Type (male), Umkomaas, Natal, South Africa, Feb. 16, 1953, A. L. Capener, in Drake Collection.

Separated from its South African congeners by the broader form and darker color; the paranota distinctly elevated across humeral angles.

CYSTEOCHILA **MALAYANA** Drake n. sp.

Moderately large, parallel-sided, tastaceous, with fuscous markings as stated in structures. Head very short, reddish to blackish fuscous; eyes large, dark fuscous; bucculae broad, brownish testaceous, with ends convergent in front. Rostrum testaceous, extending to middle of metasternum; laminae testaceous, uniseriate, not widely separated, meeting behind. Antennae testaceous with terminal segment blackish, indistinctly pubescent, measurements — I, 12; II, 10; III, 108; IV, 34.

Pronotum moderately convex coarsely punctate, fuscous to dark fuscous, with collar, hood, anterior part of paranota and posterior pronotal projection testaceous; hood very small, a little longer than high; median carina uniseriate, slightly more elevated anteriorly, the areolae small; lateral carinae not quite as high as median, the areolae scarcely visible; paranota moderately wide, completely re-

flexed, resting flatly on pronotal surface, with outer margin not attaining median carina and distinctly concave in front of pronotal disc. Legs testaceous, indistinctly pubescent.

Elytra testaceous, with a narrow median band (veinlets only) and a subapical band fuscous or dark fuscous (apical band with a large triangular projection extending anteriorly into sutural area); costal area uniseriate, the areolae small and hyaline; subcostal area wider, biseriate; discoidal area extending beyond middle of elytra, acutely angulate at both base and apex, the areolae moderately large and four deep at middle. Body beneath brownish.

Length, 3.50 mm.; width, 1.10 mm.

TYPE (male) and ALLOTYPE (female), Selangor, Malaya (Ulu Klang Jungle), March 22, 1827, in British Museum. PARATYPES, 2 specimens same date as type.

Distinguished at once from other Oriental members of the genus by the concave outer margin of the paranota in front of the center of pronotal disc.

TINGIS **BENGALANA** Drake n. sp.

Head blackish ferrugineous, armed with five whitish spines, the hind longest and appressed, the other three turned downward; eyes quite large, black; pubescence whitish, a little frosted; bucculae brownish with inferior margin testaceous, convergent in front. Antennae moderately stout, brownish ferrugineous, provided with short golden pubescence, measurements — I, 18; II, 15; III, 100; IV, 35. Rostrum dark fuscous, nearly reaching to end of channel; laminae testaceous, coated with whitish exudate.

Pronotum very wide, moderately convex, coarsely punctate, tricarinate, clothed with very fine, recumbent, yellowish pubescence, also lightly coated with a whitish exudate; hood moderately large, inflated, testaceous, pyriform, projected posteriorly, terminating posteriorly a little in front of center of disc, not elevated and truncate in front, not as high as long, the width and height subequal; carinae elevated, uniseriate, the median a little more elevated than lateral; lateral carinae parallel, terminating anteriorly a short distance behind hood; paranota testaceous, long, rather narrow, turned upright, uniseriate. Ostiolar canal upright. Legs brownish ferrugineous.

Elytra pale testaceous, with premedian band in costal area, numerous veinlets in subcostal and discoidal areas and most of veinlets in sutural area dark fuscous; entire surface very lightly coated with whitish exudate; costal area moderately wide, mostly biseriate, irregularly triseriate in a few places, the areolae (save in band) clear; subcostal area mostly biseriate, triseriate opposite apex of discoidal area, extending a little beyond middle of elytra, acutely angulate at base and at apex, five areolae deep a little behind middle. Body beneath dark ferrugineous. Legs rather slender, dark ferrugineous, shortly pubescent, lightly coated with whitish exudate.

Length, 3.95 mm., width, 2.10 mm.

TYPE (male), Tipahar, Rajmahal, Bengal, India, July 7, 1909, Annandale, British Museum. PARATYPES: 1 example (broken), same data as type.

Separated from other members of genus *Tingis* (subg. *Tingis*) by color, position and shape of hood, broader form, and erect and narrow poranota.

DICTYOTINGIS MONTICULA Drake n. sp.

Head grayish testaceous, long, broad, with apex attaining apices of second antennal segments, considerably produced in front of eyes and in front of base of antennae, armed with five spines; median spine (situated between eyes) and frontal pair (slightly behind bases of antennae) short, pale, tubercle-like and erect; posterior pair (behind eyes), slender, appressed, pale, scarcely attaining front margins of eyes; eyes rather small, black, widely separated; bucculae very long, parallel, narrow, mostly uniseriate, biseriate behind, with apices not quite attaining apex of head. Rostrum extremely long, brownish testaceous with darkened tip, almost reaching to penultimate segment of venter; laminae rather low, whitish, areolate, entirely open behind. Antennae grayish stramineous, with segment largely blackish fuscous, sparsely indistinctly pubescent, first segment not strongly swollen, measurements — I, 16; II, 10; III, 112; IV, 40.

Pronotum wide, moderately convex, coarsely punctate, dark brown with veinlets of paranota partly stramineous or testaceous and areolae clouded with dark fuscous, almost entirely concealed from dorsal aspect by reflexed, thimble-like paranota (collar, small hood, median carina and narrow strip on each side of it, and posterior projection are visible from dorsal view); median carina raised, thick, uniseriate; lateral carinae exposed on posterior process, there low and nearly parallel; paranota very large, thimble-shaped, inflated, with circular margins resting on pronotal surface near median carina, slightly tilted outward, longer than high (82:64), not quite as wide as long, with lower row of cells within subquadrate and arranged in regular row, other cells nearly equal in size but five- or six-sided.

Elytra slowly rounded widened at base, widest a little in front of middle, there wider than pronotum across paranota, roundly narrowed posteriorly, slightly constricted on sides opposite apex of discoidal area, with apices jointly rounded; costal area moderately wide, mostly triseriate, biseriate at base and in apical part, the areolae whitish or clear and not regularly arranged in rows; discoidal with outer boundary vein straight and running slightly obliquely inward to middle, then deeply concavely extended into subcostal area to apex, with an adventitious vein running obliquely across area near middle, five or six cells deep in widest part; sutural area large, with areolae brownish. Wings smoky, nearly as long as elytra.

Length, 5.00 mm., width, 2.40 mm

TYPE (female), Naga Hills, Assam, elevation 5,000 ft., 1940, in Drake collection.

Easily distinguished from the genotype *D. gibberis* Drake by its much smaller hood, shorter antennae, thimble-shaped paranota, concavely expanded apical half of discoidal area into subcostal area. In *gibberis* the paranota are strongly transversely constricted just in front of the middle, which makes them longer, narrower and leaves more of the median part of pronotum uncovered; the first antennal segment is also strongly enlarged apically. Although both species belong to the subfamily Tinginae, the head is long, strongly produce anteriorly in front of eyes; the bucculae are also long, parallel and open in front.

MITES FOUND ON MICE OF THE GENUS PEROMYSCUS IN UTAH. I. GENERAL INFESTATION[1]

Dorald M. Allred[2]

INTRODUCTION

The part that many of the Acarina, particularly the ticks, play as vectors and intermediate hosts of diseases of man and animals is well known. Most of the mites, however, are little known with regards to their host relationships and disease transmission potentials. Parasitic mites have been implicated in the transmission of scrub typhus, rickettsialpox, neurotropic viruses, tularemia, plague, filariasis, hepatozoan and haemosporozoan parasites, and are suspected vectors of endemic typhus. Other mites are known to be intermediate hosts of tapeworms. It may be assumed that any mite that sucks blood or tissue fluids is a potential vector of the diseases of the hosts upon which it feeds.

Rodents of many species on which the Acarina feed serve as reservoirs of such diseases as trypanosomiasis, typhus, rickettsialpox, plague, tularemia and Rocky Mountain spotted fever, all of which affect man. El-Gindy (1951), Chandler and Melvin (1951), Packchanian (1938), Harkema (1936) and others have contributed to our knowledge concerning mice of the genus *Peromyscus* as hosts for protozoan and other diseases that affect man and other mammals. Units of the United States Public Health Service have found sylvatic plague in native mice of the species *P. boylii*, *P. leucopus*, *P. maniculatus* and *P. truei* throughout western United States (Allred, 1952). These few examples demonstrate the importance of these mice as reservoirs of pathogenic organisms.

The study of acarine ectoparasites received impetus with the advent of World War II. The stationing of troops in areas where scrub typhus, plague and other diseases occurred required that much attention be given to the reservoirs and vectors of these diseases in those areas. Early studies of mite-host relationships in North America were at most limited to incidental collections until the outbreak of plague in San Francisco in 1900 when the study of rodents, their endemic diseases and their ectoparasite vectors was accelerated. Subsequently, investigations by plague suppressive units, members of federal and state health services and others have contributed greatly to our knowledge of these host-ectoparasite relationships.

When mice of the species *P. maniculatus* were implicated with sylvatic plague near Salt Lake City in September of 1948, a study of host-parasite relationships was made by the Utah State Health Commission and the United States Public Health Service, principally in Salt Lake County. Many of the ectoparasites that were collected

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1. Part 1 of an abstract from a thesis for the Ph.D. degree, University of Utah, June, 1954.
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were identified at the United States Public Health Laboratory at Atlanta, Georgia, but the results of that study with reference to the mites collected were never published. A few records obtained during that plague survey are included in this paper.

The objectives of the study reported herein were to determine (1) the frequency of infestation of native mice of the genus *Peromyscus* by mites, (2) the kinds of mites that occur on these mice, (3) the host specificity, (4) the geographic distribution, and (5) other biological and ecological aspects of the mites.

According to Durrant (1952), six species of white-footed mice of the genus *Peromyscus* occur in Utah. The deer mouse, *P. maniculatus*, is statewide in distribution. The canyon mouse, *P. crinitus*, occurs throughout the western, eastern and southern portions of Utah, but is absent in the Wasatch and Uinta mountains and High Plateau Provinces of the Middle Rocky Mountain Area. These high mountains and plateaus are located in a strip from north to south through the central part of the state (see Durrant, 1952:480). The piñon mouse, *P. truei*, occurs in the same general geographic area as does the canyon mouse. The brush mouse, *P. boylii*, occurs only in the southern and eastern portions of Utah. The cactus mouse, *P. eremicus*, occurs only in the southwestern corner of Utah, principally in Washington County, and the long-nosed deer mouse, *P. nasutus*, occurs in San Juan County, south of the San Juan River.

I am indebted to the following individuals and institutions for their cooperation and assistance in the collection, determination and compilation of the data contained in this and following papers of this series. My many thanks are extended Dr. D Elden Beck, Brigham Young University, Provo, Utah for his courtesy and whole-hearted cooperation in furnishing field records and mites taken from mice collected during his investigations on plague and Rocky Mountain spotted fever. These investigations were supported (in part) by research grants from the Microbiological Institute of the National Institutes of Health, United States Public Health Service. I am indebted to Fred C Harrison SA Sanitarian, and to Roy J. Myklebust, Wildlife Research Biologist, of the United States Public Health Service, and to Lynn M. Thatcher, Sanitary Engineer, Utah State Board of Health, for field notes on surveys of plague in Utah during 1948 and 1949. I am grateful to Drs. Don M. Rees, Albert W. Grundmann, Walter P. Cottam, Stephan D. Durrant, Robert L. Gering and Stanley Mulaik, University of Utah, for their constructive criticisms and helpful suggestions during the preparation of the original manuscript. To my other associates who have collected specimens and helped in any way, I express my appreciation. I am grateful to my wife, Berna, for her endurance and patience in spending many long evenings alone, and for her support and assistance which helped greatly in these studies.

METHODS

A total of 3296 mice was examined for ectoparasites. This num-

ber included 2907 *P. maniculatus*, 201 *P. eremicus*, 67 *P. crinitus*, 59 *P. truei*, 37 *P. boylii*, and 25 specimens not identified past the genus. No *P. nasutus* were collected. The study was in progress for five years, from September, 1948 to August, 1953, inclusive. Relatively few collections of mice were made during 1950. Animals were collected all months of the year throughout the entire state with the exception of the period from September, 1948 to August, 1949 when collections were restricted to Davis, Salt Lake and Utah counties.

Mice were trapped with Museum Special snap traps and other types designed to capture animals alive. Each host found dead in the trap was placed into a tightly sealed paper bag until it was examined for ectoparasites. Each live-trapped mouse was placed into a gallon-size, wide-mouth glass jar and killed with chloroform. Ectoparasites were collected by brushing the mice in a large, white enamel-ware pan. Each host was processed separately in order to maintain specific data, except in a few cases when several carcasses of the animals of both sexes of the same species were placed in the same collection bag. Mice and their containers were examined under a directing microscope when possible.

Although mites were not found on every mouse, a total of 3695 mites was collected.

RESULTS

TABLE I
Number of Infested Mice (*Peromyscus maniculatus*)
Collected Over a Five-year Period, 1948-1953

Month	No. Mice Collected			Mice Infested					
				Male		Female		Total	
	Male	Female	Total	No.	%	No.	%	No.	%
Jan.	12	11	23	2	17	2	18	4	17
Feb.	20	16	36	3	15	6	38	9	26
Mar.	44	36	80	18	41	20	56	38	48
Apr.	67	59	126	25	37	13	22	38	29
May	83	61	144	41	49	19	31	60	40
June	178	138	316	54	30	38	28	92	29
July	109	64	173	16	15	11	17	27	16
Aug.	221	175	396	47	21	42	24	89	22
Sept.	29	20	49	7	24	4	20	11	22
Oct.	66	52	118	8	12	9	17	17	14
Nov.	32	24	56	4	13	7	29	11	21
Dec.	12	12	24	4	33	3	25	7	29
Total	873	668	1541	229	26	174	26	403	26

Table 1 shows the comparative numbers of male and female *P. maniculatus* found infested during the five-year period. The numbers given in the table opposite each month are the total mice examined during that specific month for the five-year period. The differences between the numbers of male and female mice that were infested during certain months may be indicative of the trends in popu-

lations of mites or the variable activities of the hosts. Over a five-year period, equal numbers of male and female *P. maniculatus* were found infested. Considerably more females than males of this species were infested by mites during February, March and November, while more males than females were infested during April and May.

Table 2 shows the numbers of male and female mice of five species found infested during the five-year study. These data indicate that mice of certain species had a relatively higher infestation of

TABLE II
Number and Species of Infested Mice, 1948-1953

Species of *Peromyscus*	Total Mice Collected			Mice Infested					
	Male	Female	Total	Male		Female		Total	
				No.	%	No.	%	No.	%
truei	26	14	40	9	34	6	43	15	38
crinitus	28	24	52	6	21	12	50	18	35
boylii	12	15	27	9	75	14	93	23	84
eremicus	50	50	100	20	40	15	30	35	35
maniculatus	873	668	1541	227	26	175	26	402	26
Total	989	771	1760	271	27	222	28	493	28

mites than did others. In Utah, fewer *P. maniculatus* and more *P. boylii* were infested than were any other species of *Peromyscus*. Considerably more female than male *P. crinitus*, *P. boylii* and *P. truei*, and more male than female *P. eremicus* were infested by mites.

Table 3 shows that more young than adult mice were infested. This is expected because the young spend more time in the nests than the adults. Frequent association with the nest normally allows a greater chance of infestation by nest-dwelling mites. More young mice were infested during May and June than during other months of the year.

TABLE III
Comparative Numbers of Young and Adult Infested Mice
(All Species), 1948-1953

Age	No. Mice Examined			Mice Infested					
	Male	Female	Total	Male		Female		Total	
				No.	%	No.	%	No.	%
Young	95	70	165	37	39	30	43	67	41
Adult	205	150	355	57	28	47	31	104	29
Total	300	220	520	94	31	77	35	171	33

Table 4 deals with the comparative numbers of infested *P. maniculatus* taken from specific localities. During comparative months, more mice were infested in some geographic areas than in others.

TABLE IV
Comparative Numbers and Localities
of Infested Mice *(P. maniculatus)*

Date		Locality	No. Mice Examined	Mice Infested	
				No.	%
Mar.	1949	Salt Lake City	28	18	64
	1953	Chimney Rock Pass	35	8	23
Apr.	1949	Salt Lake City	45	14	31
	1953	Chimney Rock Pass	32	7	22
May		Lucin, 10 miles north of	29	5	17
		Chimney Rock Pass	29	22	72
June	1951	Price	24	11	46
		Palmyra Forest Camp	32	28	88
	1952	Lucin, 10 miles north of	44	9	20
	1953	Chimney Rock Pass	22	2	9
July	1952	Aspen Grove	24	4	17
		Bear Valley Junction	26	9	35
Aug.	1951	Pleasant Creek Picnic Area	24	10	42
		Roosevelt, 7 miles west of	51	6	12
		Duchesne, 22 miles west of	25	7	28
		Dinosaur National Monument	38	6	16
		Sheep Creek	32	5	16
		Aspen Grove	26	2	8
	1952	Fish Lake	42	6	14
		Torrey	47	16	34
		Paradise Valley	41	15	37
		Elkhorn Ranger Station	40	2	5
		Laketown	23	4	17
Oct.	1948	Salt Lake City	45	9	20
	1952	Lucin, 10 miles north of	40	5	13

There also were variations in the degree of infestation in the same areas during different months. Although the numbers of mice collected in some areas were not large, the differences between the numbers of mice that were infested are indicative that the degree of infestation varies between mice from different localities, and between mice of the same locality during different seasons.

TABLE V
Comparative Yearly Numbers of Infested
Male and Female Mice *(P. maniculatus)*

	No. Mice Examined			Mice Infested					
	Male	Female	Total	Male		Female		Total	
				No.	%	No.	%	No.	%
1948	75	57	132	14	19	13	23	27	21
1949	89	62	151	46	52	31	50	77	51
1951	247	196	443	87	35	69	35	156	35
1952	303	215	518	66	22	46	21	112	21
1953	158	139	297	16	10	19	13	35	11

Table 5 shows the numbers of male and female *P. maniculatus* infested during comparative years. Collections for 1950 were not in-

cluded because an insufficient number of individual records were kept. This table shows that the degree of infestation of mice varied during successive years. Considerably more *P. maniculatus* were infested in 1949 and 1951 than in 1948, 1952 and 1953. During 1953, the numbers of mites on rodents were considerably reduced when compared with those of previous years.

DISCUSSION

The variations in the numbers of mice infested by mites probably are due to the nesting, reproductive and food acquiring habits of

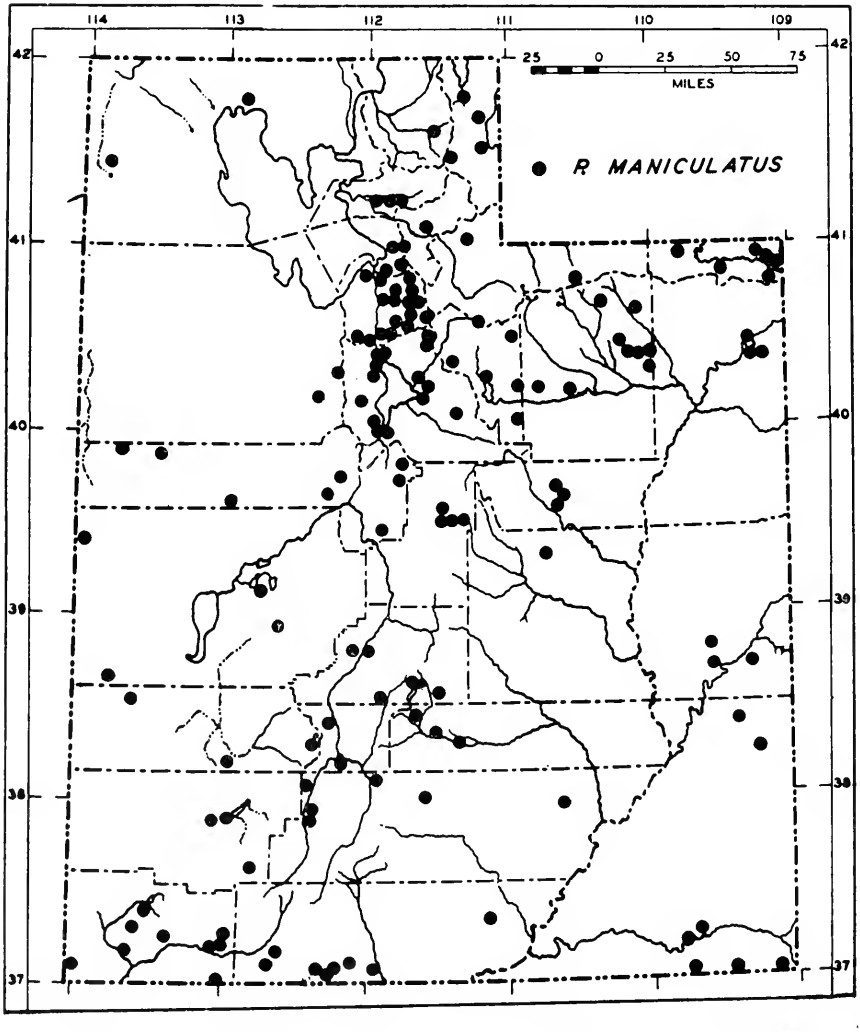

Figure 1. Collection localities of mice of the genus *Peromyscus*.

the hosts, and the reproductive cycles of the acarine consortes. These variations may be closely correlated with the host's association with its nest which is believed to be a major center of reproduction of parasitic mites and a major source of infestation of the mice.

Mice of certain species were infested by mites more frequently than others. Those mice that live at higher elevations, where moist habitats are abundant outside of the nest for long periods, are apt to be infested by mites from areas other than the nest. Mites may be more abundant in specific areas where mice gather food, and may crawl onto the body of a passing mouse. At lower elevations and in

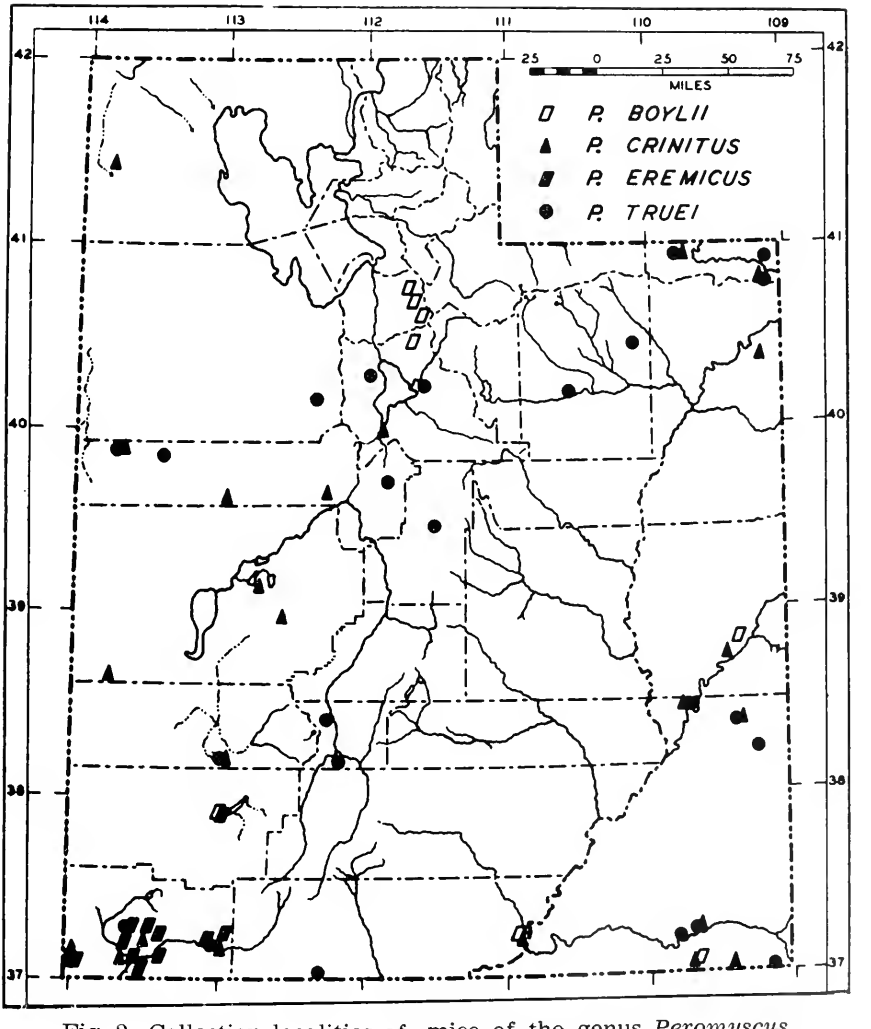

Fig. 2. Collection localities of mice of the genus *Peromyscus*.

other habitats where moisture conditions outside the nest are not favorable, the mice become infested almost solely by mites that are restricted to the environs of the nest *Peromyscus boylii* was infested more frequently by mites than were other species of *Peromyscus*. *Peromyscus truei* was second in the degree of mite infestation, while *P. crinitus*, *P. eremicus* and *P. maniculatus* followed in order in the degree of infestation. Although little evidence is available to explain this phenomenon, it may be correlated with the distribution and habits of the mice. *Peromyscus maniculatus* is widely distributed and occurs in most types of habitats, whereas the other species of *Peromyscus* in Utah generally are restricted in their distribution to certain communities or plant types. The Upper Sonoran and Transition life zones in Utah provide areas which apparently most closely approach optimum conditions of temperature and moisture for the survival and reproduction of parasitic mites, for mice that occur in these areas are most frequently infested by mites.

Those mice that are associated with nests most frequently may be infested with more mites than mice that seldom visit the nest. Mice that utilize the same nest for long periods of time may be infested more frequently than those mice that construct new nests at frequent intervals. During certain months of the year, more female than male mice were infested by mites. These differences probably are related to the frequency that the mice are associated with the nest, for the female spends more time in the nest during the time that the young are nursing.

More young than adult mice were infested by mites. This probably results from the longer time that the young mice spend in the nest. The relatively short period that elapses between the time the young leave the nest and are trapped allows little opportunity for the mice to rid themselves of mites, either intentionally or accidentally.

The low percentage of rodents that were infested in 1953 may be indicative of population cycles of mites similar to those which are known to occur among other invertebrates and vertebrates. The population cycles of mites may be closely correlated with the population cycles of their rodent hosts.

This report, one of several which deals with mite-host relationships in Utah, is concerned with all the mites found on the animal hosts, whether the association was accidental or of a regular occurrence. Although 3296 mice were examined for mites during the five-year study, the data are not sufficient, in all instances, to be conclusive. They show certain trends and relationships which in certain instances seemingly are quite variable. There are many conditions which may affect the degree of infestation. The results may be affected by such conditions as the interval between the time the host leaves its nest and is captured, and the time between its capture and its examination. Infestation by free-living mites, or by mites from scavenger or other insects coming into contact with the body of the mouse also may influence the results. Different conditions of trapping and collection affect the results, even though standardized meth-

ods are used. The habits and life histories of the mite consortes and their hosts may also influence the results. In order for a study of this type to be more significant, standard techniques must be followed, variable conditions must be known and accounted for, and a large number of animals need to be examined from each locality at similar seasons over a period of many years. Nevertheless, the data as presented are certainly indicative and are of value for comparative purposes in further studies of this type.

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BIRDS OF THE PIÑON ASSOCIATION OF THE KAWICH MOUNTAINS, NEVADA

Ned K. Johnson[1]

The Kawich Mountains of the central Great Basin, Nye County, Nevada have received attention from only four ornithologists as listed by Linsdale (Pac. Coast Avif. No. 23, 1935:17). Since none of these workers were there during the summer months, the breeding avifauna of the range remained unstudied until 1953, when a party from the University of Nevada collected there from June 10 to 18. In view of the fact that the area is contained within the vast Las Vegas-Tonopah Air Force Bombing Range and is therefore generally inaccessible for further study due to military restrictions, the information gathered during the June 1953 visit on the birds resident in the piñon *(Pinus monophylla)* zone is presented here. Species collected are marked by an asterisk. These specimens are preserved in the University of Nevada Museum of Biology. The reader is referred to a paper by Miller (Ecology, 27(1), 1946:54-60) discussing the birds of the piñon association of the Grapevine Mountains, also in Nye County, 80 miles south-southwest of the Kawich region.

Kawich Peak at 9500 feet elevation is the highest point in central Nye County for 55 miles in any direction. Between 6000 and 7000 feet the sagebrush growth of the alluvial fans surrounding the mountains is replaced by piñon and sparse juniper cover. On the best soils, especially at east-facing slopes near Breen Canyon on the west side of the range, the piñon woodland becomes quite dense. There the trees grow to thirty feet in height and to two feet in diameter at the ground. In such places the branches interlock to form an overhead canopy, allowing sparse undergrowth. In the vicinity of Eden Canyon, on the more moist east side of the mountains, the same situation as regards plant belts exists except that the piñon tracts are generally more dense, especially on the south-facing slopes. Above 8000 feet mountain mahogany *(Cercocarpus ledifolius)* forms groves which continue to the crest of the range.

The *Scrub Jay *(Aphelocoma coerulescens nevadae)*, Piñon Jay *(Cyanocephalus cyanocephalus)*, *Bush-tit *(Psaltriparus minimus)*, Blue-gray Gnatcatcher *(Polioptila caerulea)*, *Black-headed Grosbeak *(Pheucticus melanocephalus)*, *Gray Flycatcher *(Empidonax griseus)*, and *Black-throated Gray Warbler *(Dendroica nigrescens)*, all species expected to be resident in the piñon zone, were subsequently found there. In addition several other species present deserve special comment. Small numbers of the Hairy Woodpecker *(Dendrocopos villosus)* and the *White-breasted Nuthatch *(Sitta carolinensis)* inhabited the best stand of climax piñon in Eden Canyon. Two juvenile nuthatches with soft bills were obtained. Apparently these species were attracted by the unusual dominance of the piñon, a situation parralleling that found by Miller in the Grapevine

1. University of Nevada Museum of Biology, Reno, Nevada.

area (*op. cit. p.* 56). At least two pairs of *Solitary Vireos (*Vireo solitarius plumbeus*) were established for breeding in the dense piñon at 8000 feet in Eden Canyon where a singing male with enlarged testes was collected. This station marks a significant extension of known breeding range for this race of Solitary Vireo in Nevada. Previous summer records of *V. s. plumbeus* in Nevada are from the Ruby and East Humboldt Mountains in the northeastern part of the state. Mountain Bluebirds (*Sialia currucoides*), although most often seen at sagebrush-covered flats near 7000 feet, were met with sparingly in the piñon belt. One pair in particular had a nest in a woodpecker-excavated cavity in a dead piñon at 8000 feet. Piñon and juniper (*Juniperus* sp.) grew commonly at this station, although not in heavy groves, with the mountain mahogany sparsely represented. Mountain Chickadees (*Parus gambeli*) and Western Tanagers (*Piranga ludoviciana*) were noted at several of the well developed piñon stands, these species never being found where the piñon was scattered and mixed with sagebrush. Singing males of the latter species gave evidence of breeding activity. Two species, the Cassin Finch (*Carpodacus cassinii*) and the *Gray-headed Junco (*Junco caniceps*), lived at the ecotone of the piñon and the mahogany near 8000 feet. Several Clark Nutcrackers (*Nucifraga columbiana*) visited the piñon zone occasionally but were probably resident at higher altitudes in the mahogany. At Sumner Spring, in the southern part of the range, several *Scott Orioles (*Icterus parisorum*) occupied mixed piñon and juniper at 6700 feet on a large alluvial fan. Males of this species sang from tops of piñons, giving evidence of territorial establishment. This locality is near the northern breeding limits for the species in Nevada. Although not definitely proven to be nesting, the *Plain Titmouse (*Parus inornatus ridgwayi*) was present near Breen Ranch at 7500 feet, where a female was taken on June 12, and at Sumner Spring. Small groups were seen at each locality. On June 11, a vagrant *Eastern Kingbird (*Tyrannus tyrannus*) with testis ten millimeters in length was collected at Breen Ranch, 7000 feet, providing the first specimen of this flycatcher from south-central Nevada.

Several species recorded from the piñon zone in the Grapevine region were probably overlooked in the Kawich Range. In this category would be the Bewick Wren (*Thryomanes bewickii*), Screech Owl (*Otus asio*), and possibly the Mountain Quail (*Oreortyx picta*). However, the Booming Nighthawk (*Chordeiles minor*), Sage Thrasher, (*Oreoscoptes montanus*), and Lark Sparrow (*Chondestes grammacus*), all found in the Kawich Mountains associated with sagebrush and at least scattered piñon, were not recorded from the Grapevine area.

Dr. Ira La Rivers and Mr. Ernest A. Carl, the other members of the 1953 field party, also contributed ornithological information, although they were primarily collecting invertebrates and reptiles. Dr. Alden H. Miller of the Museum of Vertebrate Zoology, Berkeley, has kindly identified several of the specimens secured on the trip.
January 7, 1956.

INDEX TO VOLUME XVI

The new genera and species described in this volume appear in bold type in this index.

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