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A STUDY OF THE FAMILIES OF UTAH HEMIPTERA

A Thesis

Presented to the

Department of Zoology and Entomology

Brigham Young University

In Partial Fulfillment

of the Requirements for the Degree of

Master of Arts

by

GERALD L. NIELSEN

June 1955

This thesis by Gerald L. Nielsen is accepted in its present form
by the Special Thesis Committee as satisfying the thesis requirements for
the degree of Master of Arts.

Signed:

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INTRODUCTION

The purpose of this thesis is to (1) determine which families of Hemiptera occur in Utah, (2) provide an illustrated taxonomic key for their classification, (3) give the distinguishing characteristics of each family, (4) give the general distribution of each family, and (5) name the most prevalent genera and species of each family occurring in Utah.

Whether the general public be working in the garden, looking over their crops, or walking in the hills or marshlands, they will see organisms crawling on the vegetation or ground. The first thing they will say or think is "What kind of a bug is this?" To most people a bug is almost anything that is small and capable of movement, but in reality the "true bugs" represent only a small portion of this great group of organisms. The true bugs belong to the phylum Arthropoda, the class Insecta, and the order Hemiptera.

Authorities are not yet agreed as to the exact limits of the order Hemiptera. Linnaeus (1735) established the order Hemiptera, which consisted of representatives of four of the present-day orders and such genera as Cimex, Notonecta, Gryllus, Lampyrus, and Formica. In 1758 he restricted the order Hemiptera to include Thysanoptera and most of the insects generally thought to belong to this group. Latreille (1810) divided the order Hemiptera into the suborders Heteroptera and Homoptera (Essig 1942). Uhler placed Hemiptera as the principal order with three suborders, Homoptera, Heteroptera, and Parasita. Packard included in the order Hemiptera five suborders, Heteroptera, Homoptera, Parasita, Mallophaga, and Thysanoptera. Osborn (1885) considers another group which he calls the

Hemiptera genuina, consisting of the two suborders, Heteroptera and Homoptera, along with the suborders, Parasita, Mallophaga, and Thysanoptera. Other authorities are of the opinion that Parasita, Mallophaga, and Thysanoptera should not be considered as suborders of the order Hemiptera but that there are morphological differences sufficient to consider the Homoptera and Heteroptera as separate and distinct orders. Ashmead (1888) placed the Mallophaga and Thysanoptera with the Orthoptera because of their mandibulate mouthparts and placed the Pediculidae as a family of the Heteroptera. More recent authorities do not consider the Pediculidae as a family of the Heteroptera or Hemiptera, but classify them as a family under the order Anoplura. Use of the term Hemiptera in place of Heteroptera, which is done by Comstock (1924), Brues and Melander (1932), and Borror and Delong (1954), is the basis upon which this thesis is worked out.

The Homoptera and Hemiptera are similar in many respects. Most species have four wings which are held flat over the abdomen when at rest. Their mouthparts are of the piercing-sucking type, and their beaks are slender and segmented. Their metamorphosis is paurometabolous. The newly hatched young resemble the adults in every respect, except in size and lack of wings. It is not until the last molt that the wings become expanded.

The Homoptera and Hemiptera are separated into two separate orders, principally on the basis of differences in the structure of the wings and in the location of the beak. The Homoptera (Homo-uniform, ptera, wings) have fore-wings with uniform texture throughout, either membranous or leathery. The beak arises from the posterior part of the head, often appearing superficially to come from the base of the front legs. In the Hemiptera (Hemi-half, ptera-wings) the basal half of the fore-wing is usually thickened and the terminal half membranous and transparent. The

beak of the Hemiptera arises from the front part of the head.

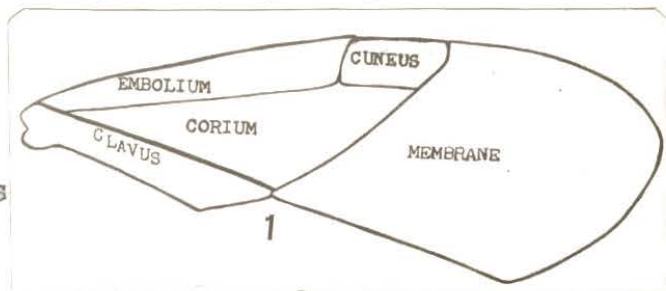
The front legs of most predaceous Hemiptera are modified for grasping their prey and are called raptorial. The femora is usually enlarged and armed with spines. The antennae may be four or five-segmented and may be either short and concealed or long and not concealed in grooves. The beak is usually three or four-segmented and may be either short or long. In some families it fits into a groove in the prosternum. The tarsi are usually three or four-segmented and bear claws, either apically or antepically.

KEY TO THE FAMILIES OF UTAH HEMIPTERA

The following key is of necessity similar to the keys made by other authors, for many of the same distinguishing characters have been used. In using a key it is essential that one understands the meaning of the descriptions and characters used; therefore the key is illustrated as an additional aid in classification. The function of this key is to identify the bugs to the family only. The key is dichotomous, giving two alternatives at each point. The indented type key is used to allow the reader to see both alternatives together.

The characters used and the statements made, both in the key and in the descriptions, apply mostly to Utah species which the writer has collected and studied. The sketches found in the key are drawn to scale, representing a distinguishing character of the family. The sketches are made of distinctive characters seen in the antennae, front tarsi, or wings and depict the shape of the antennae, the shape of the front tibia and tarsi, or the pattern of the veins in the membrane of the hemelytra. The hemelytra are very useful in classification and are divided into a thickened basal part consisting of the clavus, corium, and an apical part called the membrane.

In some families a cuneus is formed by a suture from the apical part of the corium. In other families a suture sets off a narrow strip



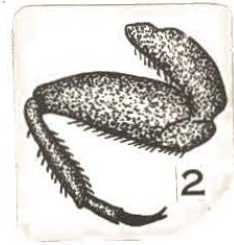
along the costal margin of the corium and is called the embolium (Figure 1).

Because the number and arrangement of veins in the membrane vary, they provide an effective way to differentiate most families.

- A. Antennae shorter than head, often concealed in cavities beneath eyes.
 -- Suborder CRYPTOGERATA --

B. Membrane of hemelytra without distinct veins.

- C. Ocelli present; front legs raptorial (Fig. 2);
 large projecting eyes; toad-like appearance.
 GELASTOCORIDÆ p. 10



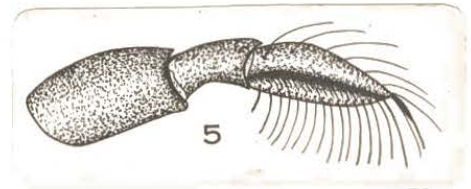
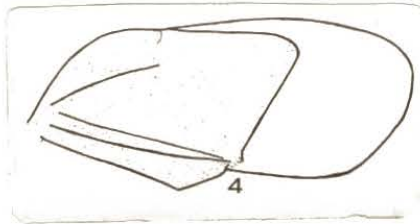
CC. Ocelli absent.

- D. Front legs raptorial (Fig. 3); membrane of hemelytra without veins
 (Fig. 4). NAUCORIDÆ p. 11

DD. Front legs not raptorial.

- E. Fore tarsi flattened and shovel-shaped, without claws (Fig. 5);
 body flattened above. CORIXIDÆ p. 12

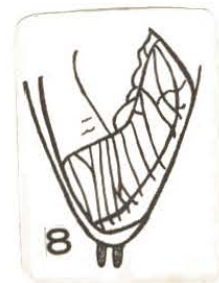
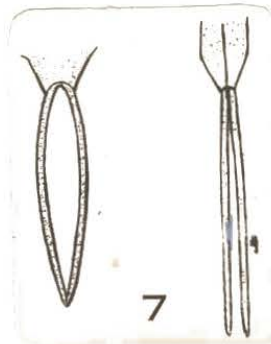
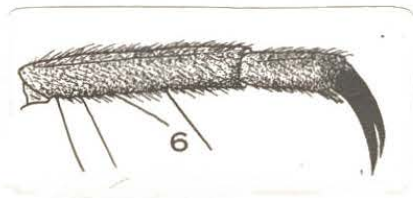
- EE. Fore tarsi not flattened and shovel-shaped, with two claws
 (Fig. 6); body convex above. NOTONECTIDÆ p. 14



BB. Membrane of hemelytra with distinct veins.

- C. Apical appendages of abdomen long and slender, not retractile
 (Fig. 7); tarsi 1-segmented. NEPIDÆ p. 15

- CC. Apical appendages of abdomen short, flat and retractile (Fig. 8);
 tarsi 2-segmented. BELOSTOMIDÆ p. 16

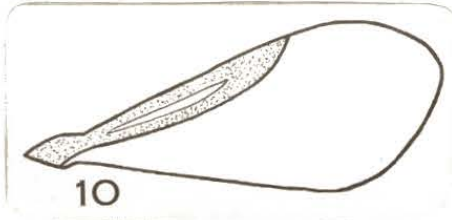
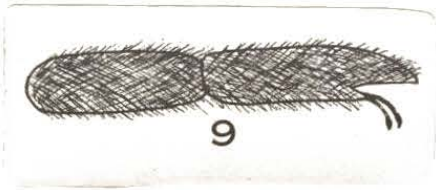


- AA. Antennae at least as long as head, not concealed in cavities beneath
 eyes. -- Suborder GYMNOGERATA --

B. Last segment of tarsi more or less split; claws of at least front tarsi distinctly anteapical (Fig. 9).

C. Hind femora does not extend much beyond apex of abdomen; middle legs usually arise midway between front and hind legs (except *Rhagovelia*); beak 3-segmented. VELLIIDAE p. 18

CC. Hind femora extends much beyond apex of abdomen; middle legs arise closer to hind legs than to front legs; beak 4-segmented. GERRIDAE p. 19



BB. Last segment of tarsi not split; claws all apical.

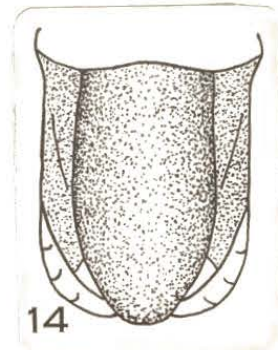
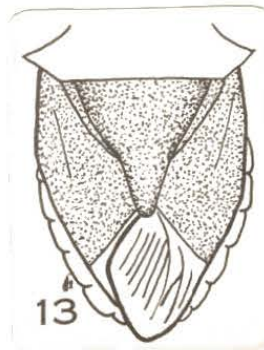
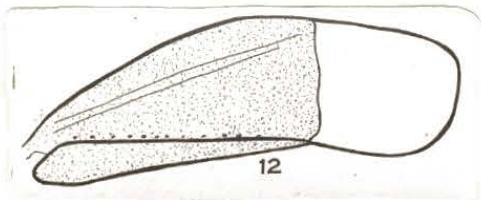
C. Antennae 5-segmented.

D. Clavus of hemelytra similar in texture to membrane (Fig. 10); membrane without veins; first and second segments of antennae thicker than others; minute in size. HEBRIDAE p. 20

DD. Clavus of hemelytra much thicker than membrane.

E. Tibia armed with strong spines (Fig. 11); corium narrow acute or rounded apically (Fig. 12); front legs fossorial.

CYDNIDAE p. 21



EE. Tibia with small spines or smooth; front legs not fossorial.

F. Scutellum moderate in size and narrowed apically, rarely covering most of abdomen (Fig. 13). PENTATOMIDAE p. 22

FF. Scutellum not narrowed apically, generally very convex, large, covering most of the abdomen (Fig. 14).

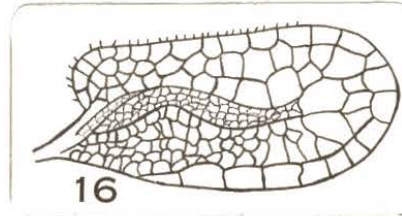
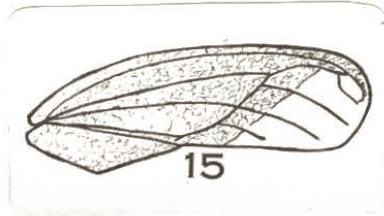
SCUTELLERIDAE p. 23

CC. Antennae 4-segmented.

D. Hemelytra lace-like; body and wings with reticulate sculpturing; beak 4-segmented; tarsi 1 or 2-segmented; small flat insects.

E. Ocelli present; Hemelytra with non-reticulate membrane (Fig. 15); pronotum does not extend over scutellum. PIESMIDAE p. 24

EE. Ocelli absent; hemelytra of similar texture throughout, densely reticulate (Fig. 16); pronotum with triangular process which extends over scutellum. TINGIDIDAE p. 25



DD. Hemelytra not lace-like, body and wings without reticulate sculpturing; beak 3 or 4-segmented.

E. Hemelytra with an embolium when well developed.

F. Hemelytra vestigial.

G. Ocelli absent; parasitic, feed on man, birds, and bats. CIMICIDAE p. 26

GG. Ocelli present, predaceous. MESOVELIIDAE p. 27

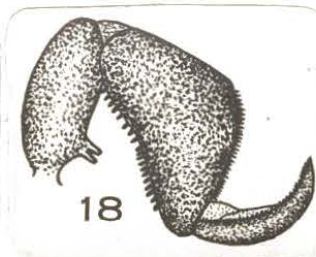
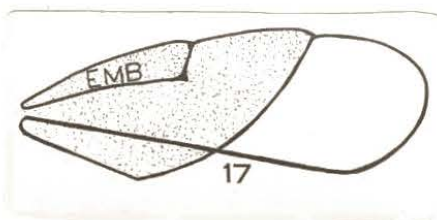
FF. Hemelytra generally well developed (Fig. 17); ocelli present, not parasitic. ANTHOCORIDAE p. 28

E. Hemelytra without an embolium when well developed.

F. Beak 3-segmented.

G. Front legs usually enlarged, raptorial, beak short.

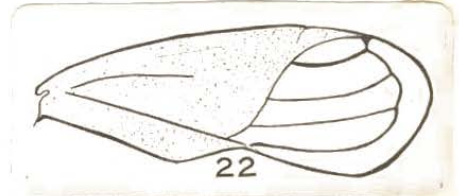
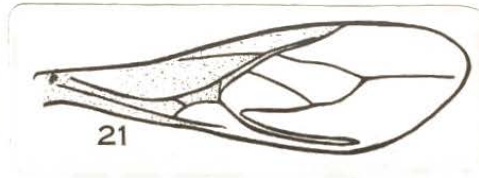
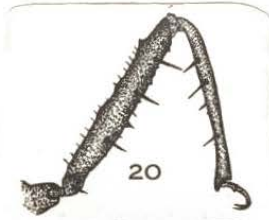
H. Front femora greatly enlarged (Fig. 18); terminal segment of antennae thickened; hemelytra with many veins (Fig. 19). PHYMATIDAE p. 29



HH. Front femora not greatly enlarged (Fig. 20); terminal segment of antennae filiform; hemelytra with few veins (Fig. 21).
REDUVIIDAE p. 30

GG. Front legs not raptorial; beak long.

H. Membrane of hemelytra with four or five closed cells (Fig. 22).
SALDIDAE p. 31



HH. Membrane of hemelytra without veins, hemelytra largely membranous.
MESOVELIIDAE p. 27

FF. Beak 4-segmented.

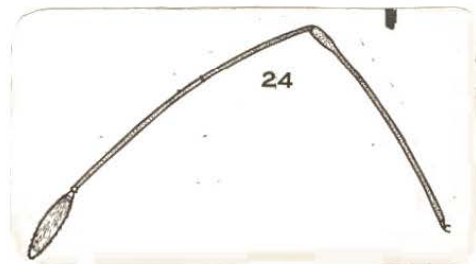
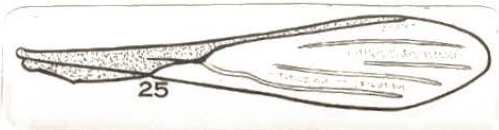
G. Front legs enlarged, raptorial, fitted for grasping.

H. Hemelytra entirely membranous, with few distinct longitudinal and cross veins; pronotum divided into three lobes.
ENICOCEPHALIDAE p. 33

HH. Hemelytra not entirely membranous; membrane usually with four long veins bounding three discal cells from which many veins diverge forming several marginal cells (Fig. 23); pronotum not divided into three lobes.
NABIDAE p. 33

GG. Front legs not enlarged, not raptorial, fitted for walking.

H. Body and appendages linear, extremely slender; head with transverse incision in front of ocelli; first segment of antennae long and clubbed, last segment spindle-shaped (Fig. 24); hemelytra long and narrow (Fig. 25).
NEIDIDAE p. 35



H. Body and appendages not extremely slender; head without transverse incision in front of ocelli; antennae varied in shape, hemelytra not long and narrow.

- I. Hemelytra with a cuneus; membrane of hemelytra with one or two closed cells (Fig. 26); ocelli absent.

MIRIDAE p. 36

- II. Hemelytra without a cuneus, membrane with few or many veins.

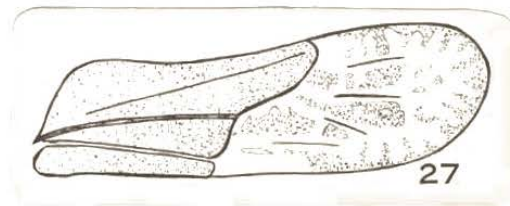
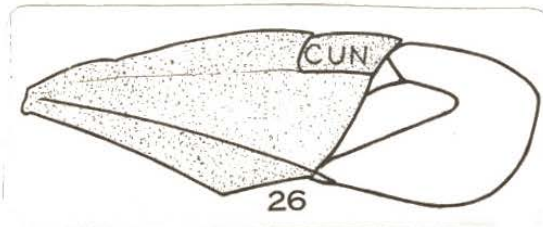
- J. Ocelli absent.

- K. Hemelytra with few veins, covers only disk of abdomen (Fig. 27); very flat bugs.

ARADIDAE p. 38

- KK. Hemelytra with many veins, covered abdomen in mature bugs (Fig. 28); marked with contrasting colors; stout and heavily built insects.

PYRRHOCORIDAE p. 39

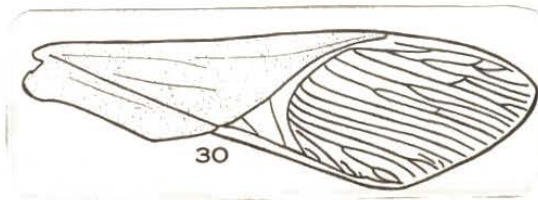
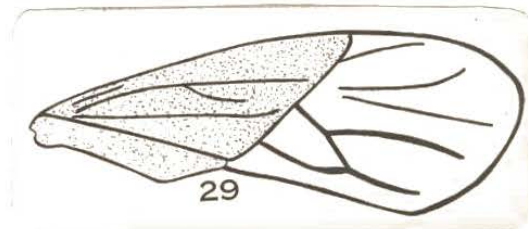
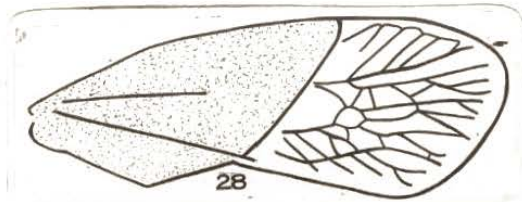


- JJ. Ocelli present.

- K. Membrane with four or five simple veins arising from base of membrane (Fig. 29); antennae inserted low on side of head. LYGAEIDAE p. 39

- KK. Membrane with numerous anastomosing veins. (Fig. 30); antennae inserted high on side of head.

COREIDAE p. 41



FAMILIES OF UTAH HEMIPTERA

The function of this section is to give additional information to that found in the key. It is to be used in conjunction with the key to make certain that the bug has been run to the right family. Twenty-eight families of Utah Hemiptera are herein discussed. Under each family is given such pertinent information as (1) the family characteristics, (2) the family habitat, (3) the occurrence of each family in Utah, (4) the important genera and species known from the state, and (5) recent literature which discusses the species of each family as they are known to occur in Utah.

GELASTOCORIDAE (Kirkaldy 1897) -- Toad Bugs

In 1802 Latreille placed the Toad Bugs with the Notonectariae, after describing the first genus, Galgulus, in 1801. In 1820 Billberg used the name Galgulidae. This family name was used until Kirkaldy in 1897 discovered that Galgulus Latr. (1801) was used in 1760 by Brisson in Aves. Kirkaldy then introduced the family name Gelastocoridae with the genus Gelastocoris as the type genus.

FAMILY CHARACTERISTICS: Ocelli present; antennae shorter than head, nearly concealed beneath eyes; body broad and short; have large widely separated, projecting eyes; front legs stout and raptorial, fitted for grasping; beak short, stout, and four-segmented.

HABITAT: The Toad Bugs resemble a toad in both their warty appearance and their movement. They are found along the moist edges of

streams and ponds or on sandy beaches. They feed upon other insects, which they capture by leaping at them and grasping them with their raptorial front legs. They usually lay their eggs in the sand. The Toad Bugs furnish a notable example of protective coloration by the way in which they blend into their surroundings.

OCCURRENCE IN UTAH: Gelastocoris variegatus (Guer.) and G. oculatus Fabr. are the only species of this family reported from Utah. The Toad Bugs are most common in the southern part of the state in the vicinity of St. George and Zion National Park, but Knowlton (1955) reports that G. oculatus Fabr. has also been collected at Logan and Thistle.

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- Knowlton, G. F. 1955. Hemiptera of Utah -- Records. Utah Agric. Exp. Sta. Mimeogr. Ser. 140.
- Tanner, V. M. 1940. A Biotic Study of the Kaiparowits Region of Utah, Great Basin Naturalist. 1(3&4):118-120.
- Woodbury, B. G. 1950. The Taxonomy of Aquatic and Semi-aquatic Hemiptera of Utah. Thesis. University of Utah

NAUCORIDAE (Fallén 1814) -- Creeping Water Bugs

In 1814 Fallén gave the Creeping Water Bugs the name Naucoridea. In 1815 Leach placed them in the family Naucorida under the tribe Nepides. In 1817 Samouelle placed them in Nepadae. It was not until 1851 that the family name Naucoridae was proposed by Fieber (Essig 1942).

FAMILY CHARACTERISTICS: Front legs raptorial, front femora greatly enlarged; middle and hind legs fitted for crawling; ocelli absent; antennae very short and concealed beneath the eyes; body flattened; membrane of hemelytra without veins, but with distinct embolium; beak three-segmented.

HABITAT: The Creeping Water Bugs are a small family. They swim or creep through the submerged vegetation in quiet water among rushes and grasses and are predaceous on small aquatic animals. They obtain the air which they carry beneath their wings by pushing the tip of their abdomen above the surface of the water.

OCCURRENCE IN UTAH: There are about two hundred described species of Naucoridae, but only two species, Ambrysus mormon Montd. and A. woodburyi Usinger, are known to occur in Utah. They were collected in San Juan and Washington counties.

LITERATURE:

Knowlton, G. F. 1936. The Insect Fauna of Utah (From the Standpoint of an Economic Entomologist). Utah Acad. of Sci., Arts and Letters. 13:249-262.

_____ 1955. Hemiptera of Utah - Records. Utah Agric. Exp. Sta. Mimeog. ser. 140.

Woodbury, B. G. 1950. The Taxonomy of Aquatic and Semi-aquatic Hemiptera of Utah. Thesis. University of Utah.

CORIXIDAE (Leach 1815) -- Water Boatmen

Leach in 1885 separated the Water Boatmen from the family Notonectidae and gave them the name Corixida. In 1859 Dohrn gave this group the true family name, Corixidae (Essig 1942).

FAMILY CHARACTERISTICS: Antennae shorter than head, concealed in a cavity beneath eyes; hind legs elongate and oar-like; fore tarsi one-segmented, flattened or shovel-shaped, without claws, has fringe of bristles; middle legs long and slender, ending in two claws; head overlaps prothorax dorsally; ocelli absent; beak very short, one or two-segmented; body oval, somewhat flattened; membrane of hemelytra without veins.

HABITAT: The Water Boatmen are very common and occur in large numbers in most of the pools and marshes of the state. They swim on their ventral surface in quick darting movements, getting air at the surface of the water and often carrying a bubble of air under water, either under their wings or on the surface of their body. They cling to submerged vegetation for long periods of time. Most species are herbivorous, scooping up algae and other minute aquatic organisms with their spatulate front tarsi, while other species are predaceous, feeding on midge larvae and other small aquatic animals. The Corixids are important economically, for they serve as food for many of our game fish. Because they are able to fly from pond to pond, they are found in many temporary ponds and intermittent streams.

OCCURENCE IN UTAH: The family Corixidae is the largest family of semi-aquatic Hemiptera in number of species and individuals found in Utah, being widely distributed throughout the state in ponds, marshes, and slow streams. The family is represented by the following genera:

Arctocorixa, Callicorixa, Cenocorixa, Corisella, Graptocorixa, Hesperocorixa, Sigara, and Trichocorixa. Hesperocorixa laevigata (Uhl.) is the most common species found in the ponds and streams at lower elevations. The members of the genus Callicorixa are also relatively abundant in the valleys. Species such as Arctocorixa subtilis Hung. are found only at higher elevations. A. subtilis has been recorded only at Alta at an elevation over 10,000 feet.

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- Hungerford, H. B. 1948. The Corixidae of the Western Hemisphere (Hemiptera) The University of Kansas Science Bulletin. 32:164, 260, 267, 275, 279, and 354.
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- Woodbury, B. G. 1950. The Taxonomy of Aquatic and Semi-aquatic Hemiptera of Utah. Thesis. University of Utah.

NOTONECTIDAE (Leach 1815) — Back-swimmers

Leach in 1815 gave the Back-swimmers the name Notonectides, which was later changed by Samouelle in 1819 to Notonectidae (Essig 1942).

FAMILY CHARACTERISTICS: Eyes large; beak three or four-segmented; antennae shorter than head; arolia absent; front tarsi with two claws; head inserted in prothorax, not overlapping pronotum; ocelli absent; front legs not raptorial; hind tarsi usually without claws, three-segmented; dorsal side of body usually lightly colored and convex.

HABITAT: The Back-swimmers are common in most ponds and slow streams. They receive their name because they swim on their backs, a characteristic which readily distinguishes them from the other aquatic bugs. They use their long hind legs like oars and are able to swim very rapidly. They are predaceous, feeding on other insects, crustaceans, and at times on tadpoles and small fish. They are often a serious menace to young fry in hatchery pools. If handled carelessly, they are capable of inflicting a very painful bite. They may be seen flying about the ponds during the hours of darkness.

OCCURRENCE IN UTAH: The family Notonectidae is represented in the state by two genera, Buenoa and Notonecta. Only one specimen of the genus

Buenoa has been collected in Utah, in Salt Lake City (Woodbury, B. G. 1950). But the members of the genus Notonecta are widely distributed throughout Utah. Notonecta indica (L.), N. insulata, and N. spinosa Hung. are three of the common species found in Utah.

LITERATURE:

- Hungerford, H. B. 1930. Two New Waterbugs from Western U. S. A. (Nepidae and Notonectidae). *The Canadian Entomologist*. 62:217.
- _____ 1933. The Genus Notonecta of the World (Notonectidae-Hemiptera). *The University of Kansas Science Bulletin*. 21:89, 110, 113, 122, 202.
- Knowlton, G. F. 1951. A Flight of Water Boatmen. *Bul. of Brooklyn Ent. Soc.* 46:22.
- _____ 1955. Hemiptera of Utah - Records. *Utah Agric. Exp. Sta. Ser.* 440.
- Moore, R. C. and Hungerford, H. B. 1922. Water Insects from a Portion of the Southern Utah Desert. *Kansas University Science Bulletin*. 14(17):416, 417.
- Tanner, V. M. 1940. A Biotic Study of the Kaiparowits Region of Utah. *Great Basin Naturalist*. 1(3&4):118-120.
- Woodbury, B. G. 1950. The Taxonomy of Aquatic and Semi-aquatic Hemiptera of Utah. Thesis. University of Utah.

NEPIDAE (Latreille 1802) — Water Scorpions

The Water Scorpions were given the name *Nepariae* by Latreille in 1802. In 1815 Leach proposed the name *Nepida*, tribe *Nepides*. In 1819 Samouelle used the name *Nepadae*, which was changed in 1829 by Fallen and Stephens to *Nepidae* (Essig 1942).

FAMILY CHARACTERISTICS: Body broad and flat or rounded and linear; tarsi one-segmented; hind tarsi with distinct claws; ocelli absent; membrane of hemelytra with veins; antennae shorter than head; apical abdominal appendages form a long, slender, nonretractile tube; hind legs

cylindrical; second and third pairs of legs fitted for walking; first pair of legs raptorial, coxa very long; beak three-segmented, very short; usually from 18-45 mm. in length.

HABITAT: The Water Scorpions live mostly in shallow, stagnant water on weeds and other plants in or at the bottoms of the shallow pools. They are very sluggish and seemingly awkward in their movements, both when swimming and when walking on submerged vegetation. They prey upon various small aquatic animals which they ambush and grasp with their raptorial front legs.

OCCURRENCE IN UTAH: Of some 200 species distributed throughout the world and seven species in the United States, the family Nepidae is represented in Utah by two species, Ranatra quadridentata Stal. and R. americana Montd. R. americana was collected in Salt Lake and Utah counties. R. quadridentata Stal. was collected at Salem Pond.

LITERATURE:

- Tanner, V. M. 1946. Ranatra quadridentata Stal. (Nepidae) Found in Utah. Great Basin Naturalist. 7(1-4):29.
- Woodbury, B. G. 1950. The Taxonomy of Aquatic and Semi-aquatic Hemiptera of Utah. Thesis. University of Utah.

BELOSTOMIDAE (Leach 1815) — Giant Water Bugs

Leach in 1815 proposed for the Giant Water Bugs the name Belostomida. Later this name was changed to Belostomidae by Dohrn in 1859 (Essig 1942).

FAMILY CHARACTERISTICS: Fore legs raptorial; middle and hind legs fitted for swimming; membrane of hemelytra with veins; tarsi two-segmented; apical abdominal appendages short, flat, and retractile; hind legs flattened

and fringed; ocelli absent; antennae shorter than head; hind tarsi with distinct claws; beak stout or slender, bent under head.

HABITAT: The family Belostomidae contains the largest bugs in the order Hemiptera. Some of the common names given these bugs are Giant Water Bugs, Toe Biters, Electric Light Bugs, and Fish Killers. The Belostomids are large, flat, brown bugs which often attain the length of three to four inches. The larger species are found in the genus Lethocerus. The Belostomids are predaceous on other insects and their larvae, snails, and small fish. If these insects are handled carelessly, they are capable of inflicting a very painful bite with their stout beaks. During the summer months they may be seen flying around the large neon lights or other powerful lights. In the genera Belostoma and Abedus the female lays her eggs on the back of the male, where they usually remain until they hatch.

OCCURRENCE IN UTAH: Of the approximately 150 species of Belostomids described, four genera and eight species are represented in Utah. Members of the genera Benacus, Lethocerus, Abedus, and Belostoma are found in Utah. The species Lethocoris americanus Leidy is the most common species. This bug is found in most parts of the state, but usually in relatively small numbers. Haldemann (1852) mentions the species Belostoma bifoveata Hald. and B. reticulata Hald. as occurring in Utah.

LITERATURE:

- Haldemann, S. S. 1852. Appendix C - Insects. In Stanbury's Exploration and Survey of the Great Salt Lake of Utah. Zoology 370. Washington.
- Knowlton, G. F. 1955. Hemiptera of Utah - Records. Utah Agric. Exp. Sta. Mimeogr. Ser. 140.
- Woodbury, B. G. 1950. The Taxonomy of Aquatic and Semi-aquatic Hemiptera. Thesis. University of Utah.

VELIIDAE (Amyot and Serville 1843) — Broad-shouldered Water Striders

Amyot and Serville in 1842 proposed for the Broad-shouldered Water Striders the name Velidae. In 1865 Douglas and Scott established the present family name, Veliidae (Van Duzee 1917).

FAMILY CHARACTERISTICS: Ocelli generally absent; antennae four-segmented, at least as long as head; tarsal claws anteapical; tip of last tarsal segment more or less cleft; body stout, oval, and broadest across prothorax; beak three-segmented; hind femora do not extend much beyond end of abdomen; legs fitted for walking or running over water and not for rowing as in the family Gerridae; middle legs arise about midway between front and hind legs.

HABITAT: The family Veliidae is much less common in Utah than the family Gerridae. They are found on the banks and on the surface of streams and ponds, upon which they are capable of running very rapidly. These insects are predaceous, feeding on other insects found in the same environment.

OCCURRENCE IN UTAH: Microvelia and Rhagovelia are the two genera of this family found in Utah. The genus Microvelia is represented by a single species, M. americana Uhl., and genus Rhagovelia is represented by three species, R. distincta Champ., R. excellentis D & H, and R. obesa Uhl. They were collected in Washington, Kane, Garfield, Iron, Salt Lake, and Utah counties.

LITERATURE:

Drake, C. J. 1951. New Neotropical Water-Striders (Hemiptera - Veliidae). Great Basin Naturalist. 11 (1-2):37.

- Moore, R. C. and Hungerford, H. B. 1922. Water Insects from a Portion of the Southern Utah Desert. Kansas University Science Bulletin. 14(17):416, 417.
- Tanner, V. M. 1940. A Biotic Study of the Kaiparowits Region of Utah Great Basin Naturalist. 1(3&4):118-120.
- Woodbury, B. G. 1950. The Taxonomy of Aquatic and Semi-aquatic Hemiptera of Utah. Thesis. University of Utah.

GERRIDAE (Leach 1815) -- Water Striders

Leach in 1815 proposed for the Water Striders the name Gerrida. In 1843 Amyot and Serville gave this group the name Gerrides. The family name Gerridae was used by Dohrn in 1859 (Essig 1942).

FAMILY CHARACTERISTICS: Body and legs long and slender, fitted for rowing; hind femora extends much beyond apex of abdomen; middle legs arise closer to hind legs than to front legs; terminal segment of tarsi is more or less bifid; claws are antepical; beak four-segmented; front legs short and raptorial; beak short and stout; ocelli present.

HABITAT: The Water Striders are semiaquatic and are found mostly in quiet water, streams, and ponds, where they row leisurely or rapidly over the surface of the water using their middle legs as oars and their front and hind legs to guide themselves. From this type of movement they have received the common names Water Striders, Skaters, and Skippers. The fine hair on their tarsi allows them to remain afloat. They are predaceous, feeding on aquatic and other insects which they are able to catch. The mature Water Striders often hibernate under old logs or debris along the edges of ponds and streams during the winter.

OCCURRENCE IN UTAH: The family Gerridae is represented in Utah by four genera: Gerris, Limnopus, Metrobates, and Trepobates. The genus

Gerris is the most prevalent genus and the species Gerris remigis (Say), G. gillettei Leth. & Serv. and G. notabilis D. & H. are the common Water Striders found in the streams and ponds of Utah.

LITERATURE:

- Beck, D. E. 1936. Report on Collection of Water Striders in Brigham Young University Entomological Collection. Proc. Utah Acad. Sci., Arts and Letters. 45:203-206.
- Drake, C. J. and Harris, H. M. 1934. The Gerrinae of The Western Hemisphere (Hemiptera). Annals of The Carnegie Museum. 23:179-240.
- Knowlton, G. F. 1936. The Insect Fauna of Utah (From the Standpoint of an Economic Entomologist). Utah Acad. of Sci., Arts and Letters. 13:249-262.
- _____ 1955. Hemiptera of Utah - Records. Utah Agric. Exp. Sta. Mimeogr. Ser. 140.
- Knowlton, G. F. and Taylor E. J. 1948. Some Predaceous Hemiptera, largely from Utah. Utah Acad. of Sci., Arts and Letters. 26:135.
- Tanner, V. M. 1940. A Biotic Study of the Kaiparowits Region of Utah. Great Basin Naturalist. 1 (3&4):118-120.
- Woodbury, B. G. 1950. The Taxonomy of Aquatic and Semi-aquatic Hemiptera of Utah. Thesis. University of Utah.

HEBRIDAE (Amyot & Serville 1843) -- Velvet Water Bugs

In 1843 Amyot and Serville gave the Velvet Water Bugs the name Hebrides, and in 1859 Dohrn presented the family name Hebridae (Van Duzee 1917).

FAMILY CHARACTERISTICS: Antennae four or five-segmented; beak three-segmented; tarsi two-segmented; ocelli present; clavus of hemelytra similar in texture to membrane; first and second segments of antennae thicker than others.

HABITAT: The Hebrids are very small, stout insects. Their entire body is covered with velvety hair, which prevents them from becoming wet

and from sinking. They are found in small pools where there is an abundance of aquatic vegetation.

OCCURRENCE IN UTAH: Only one species, Merrgata hebroides White, collected at St. George, Utah, has been reported from Utah.

LITERATURE: The only reference to this family found by the writer was in Van Duzee's "Catalogue of the Hemiptera of America North of Mexico," in which the family is listed as being present in Utah.

CYDNIDAE (Billberg 1820) -- Burrower Bugs

In 1820 Billberg proposed for the Burrower Bugs the name Cydnides and 1861 Fieber proposed the family name Cydnidae (Essig 1942).

FAMILY CHARACTERISTICS: Tibia armed with strong spines; antennae five-segmented; oval and mostly black in color; scutellum large; corium of varied form apically.

HABITAT: The Burrower Bugs are small to medium in size and are usually found burrowing beneath stones or boards, in sand, or among roots of grass. It is from this habit that the name Burrower Bugs is derived. They are phytophagous, feeding on plant juices. The members of the genus Thyreocoris or Negro Bugs have the appearance of small beetles in form and color.

OCCURRENCE IN UTAH: Representatives of the following genera have been reported from Utah: Aethus, Amnestus, Galgupha, Macroporus, Pangaeus, and Thyreocoris. Thyreocoris extensus (Uhl.), the most common species, is widespread throughout the state.

LITERATURE:

Knowlton, G. F. and Harmston. 1950. Utah Insects - Hemiptera. Utah Agric. Exp. Sta. Mimeogr. Ser. 200, Pt. 6:10pp.

Knowlton, G. F. 1955. Hemiptera of Utah - Records. Utah Agric. Exp. Sta. Mimeogr. Ser. 140.

Pack and Knowlton. 1930. Notes on Utah Hemiptera. Canadian Entomologist. 7:124-125.

PENTATOMIDAE (Leach 1815) -- Stink Bugs

Latreille in 1804 gave the Stink Bugs the name Corisiae and in 1815 Leach formulated the name Pentatomides. The family name Pentatomidae was established by Samouelle in 1819 and Stephens in 1829 (Essig 1942).

FAMILY CHARACTERISTICS: Ocelli present; tibia smooth or with very short spines; antennae five-segmented; head and prothorax form a triangle; scutellum narrowed behind and in form of a triangle; beak four-segmented.

HABITAT: The Stink Bugs are medium to large in size and common to most localities of the state. They vary greatly in their food habits; some are predaceous, others are phytophagous, and still others are both predaceous and phytophagous. These insects produce a very disagreeable odor, from which they derive their name, "Stink Bugs."

OCCURRENCE IN UTAH: Twenty-eight genera have been reported from Utah. The three most representative genera are Brochymena, Chlorochroa, and Euschistus. Among the Pentatomids, which are economically important because of the damage they do to crops, are Chlorochroa sayi Stal and C. uhleri Stal. These insects, if very numerous, do considerable damage to young grain and developing alfalfa, as well as certain garden crops. Among those species which are predaceous on harmful insects are Apateticus crocatus (Uhl.), Perillus bioculatus (Fabr.), and Euschistus variolarius (P. & B.). Apateticus crocatus (Uhl.) was found to feed on tent caterpillars and Perillus bioculatus (Fabr.) was found to feed on larvae of the Colorado

potato beetle, Leptinotarsa decimlineata Say, and the sunflower leaf beetle larvae (Knowlton and Taylor 1949). In the spring of 1954 the writer found Euschistus variolarius (P. & B.) feeding on the larvae and oversized female beetles, ⁴Gastroidea cyanea Melsh (Tanner and Nielsen 1954).

LITERATURE:

- Hayward, C. L. 1945. Biotic Communities of the Southern Wasatch and Uinta Mountains, Utah. Great Basin Naturalist. 6(1-4):1-124.
- Knowlton, G. F. 1931. Notes on Utah Heteroptera and Homoptera. Entomological News. 42:40-43; 68-72.
- _____ 1953. Say's Stink Bug in Utah. Utah Agric. Exp. Sta. Mimeogr. Ser. 408.
- _____ 1955. Hemiptera of Utah - Records. Utah Agric. Exp. Sta. Mimeogr. Ser. 140.
- Pack and Knowlton. 1930. Notes on Utah Hemiptera. The Canadian Entomologist. 62:248-250.
- Sorenson and Anthon. 1936. Preliminary Studies of Acosternum hilaris in Utah Orchards. Utah Acad. of Sci., Arts and Letters. 13:229-232.
- Tanner, V. M. and Nielsen, G. L. 1954. Gastroidea cyanea Melsh (Coleoptera) Preyed Upon by an Hemipteran Predator. The Great Basin Naturalist. 14(1-2):27-29.
- Woodbury, L. A. 1931. A List of the Pentatomidae of Zion National Park, Utah. Pan-pacific Entomologist. 7:124-125.
- Uhler, P. R. 1892. Summary of the Collection of Hemiptera Secured by Mr. E. A. Schwarz in Utah. Proc. Ent. Soc. Wash. 2:266-385.

SCUTELLERIDAE (Leach 1815) -- Shield-backed Bugs

Leach in 1815 gave the Shield-backed Bugs the name Scutellerida and in 1863 Uhler proposed the name Pachycoridae. The family name Scutelleridae was used by Lethierry and Severin in 1893 (Essig 1942).

FAMILY CHARACTERISTICS: Scutellum very large and U-shaped, covering nearly all of abdomen; two ocelli present; wings are visible only

at edges of scutellum; tibia are smooth or have small spines; antennae five-segmented; beak four-segmented; bodies short, broad, and convex.

HABITAT: The Shield-backed Bugs were previously grouped with the family Pentatomidae, but are now considered a separate and distinct family. They are common on grasses, grain, alfalfa, and weeds of pastures, orchards, and fields. They are phytophagous, feeding on plant juices. The general habits of this group much resemble those of the Pentatomidae.

OCCURRENCE IN UTAH: Representatives of six genera Diocles, Euptychodera, Eurygaster, Homaemus, Phimodera, and Tetyra are found in Utah. The two most common genera are Eurygaster and Homaemus. Eurygaster alternatus (Say) and Homaemus bijugis Uhl. are the most common species found throughout Utah.

LITERATURE:

- Knowlton, G. F. 1955. Hemiptera of Utah - Records. Utah Agric. Sta. Mimeogr. Ser. 140.
- Pack and Knowlton. 1930. Notes on Utah Hemiptera. Canadian Entomologist. 62:248-250.

PIESMIDAE Amyot and Serville 1843 -- Ash-gray Leaf Bugs

Amyot and Serville in 1843 separated the Ash-gray Leaf Bugs from the family Tingididae and placed them in the family Piesmidae (Essig 1942).

FAMILY CHARACTERISTICS: Ocelli present; front wings with membrane not reticulate or not net-veined; corium and rest of dorsal part of hemelytra pitted; head is wider than it is long; beak four-segmented; tarsi two-segmented; antennae shorter than head.

HABITAT: The Ash-gray Leaf Bugs are small, oblong, oval insects which are common on weeds, sagebrush, and shadscale, as well as on such

garden vegetables as beets and potatoes. They are phytophagous in habit. Unless these insects are found in large numbers on the foliage, they are not considered economically important. These insects are similar to the Lace Bugs, but are more slender and have less lace-like sculpturing on the dorsal part of their body.

OCCURRENCE IN UTAH: Piesma is the only genus of this family found in Utah. Piesma cinerea Say is the most common species found in the state.

LITERATURE:

Knowlton, G. F. 1932. Notes on Utah Hemiptera. The Canadian Entomologist. 64:166-167.

_____ 1936. The Insect Fauna of Utah (From the Standpoint of an Economic Entomologist). Utah Acad. of Sci., Arts and Letters. 13:249-262.

TINGIDIDAE (Laporte 1832) — Lace Bugs

Laporte in 1832 and Spinola in 1837 proposed for the Lace Bugs the name Tingidites. The name Tingidae was used by Westwood in 1840. In 1850 Spinola used the name Tingiditae. The name Tingididae was first used in 1860 by Fieber.

FAMILY CHARACTERISTICS: Ocelli absent; beak four-segmented; antennae four-segmented, the third segment the longest; tarsi two-segmented; head, thorax, and hemelytra usually have pattern of membranous oval pits; front wings entirely reticulate; veins prominent.

HABITAT: The Lace Bugs are easily recognized because of their lace-like appearance. They are very small insects, about five to seven mm. in length, and are found chiefly on leaves of native shrubs and trees, such as oak and willows, but may be found on ornamental shrubs, trees, and cultivated plants, where they feed on the plant juices. They seldom cause

harmful effects on the food plants.

OCCURRENCE IN UTAH: The Lace Bugs are represented in the state by six genera: Corythaica, Corythucha, Gargaphia, Melanorhopala, Physatocheila, and Teleonemia, of which the genus Corythucha is the most common.

Corythucha distincta O. & D. is a common species found on such garden vegetables as corn, lettuce, and squash, as well as on many weeds. Other species, such as Corythucha padi (Drake) are found mostly in the foothills or higher elevations on oak and willows.

LITERATURE:

Knowlton, G. F. 1936. The Insect Fauna of Utah (From the Standpoint of an Economic Entomologist). Utah Acad. of Sci., Arts and Letters. 13:249-262.

Knowlton and Harmston. 1950. Utah Insects - Hemiptera. Utah Agric. Exp. Sta. Minneogr. Ser. 200, Pt. 6:10pp.

CIMICIDAE (Latreille 1804) — Bedbugs

Latreille in 1804 gave the Bedbugs the name Cimicides and Leach in 1815 the name Cimicida. Stephens (1829) and Westwood (1840) used the family name Cimicidae to include the same genera used today (Essig 1942).

FAMILY CHARACTERISTICS: Ocelli absent; antennae four-segmented; beak three-segmented; tarsi three segmented; hemelytra vestigial, showing as small scales under pronotum, without a membrane; flat and oval bugs.

HABITAT: The Bedbugs are ectoparasites of birds and mammals, including man. The common bedbug, Cimex lectularius Linn., is mostly nocturnal. During the day it hides in cracks in furniture and walls, under the wallpaper or in the springs of beds and comes out during the night to feed. It causes considerable irritation when it bites, but is unimportant as a disease vector.

OCCURRENCE IN UTAH: Cimex lectularius Linn. and Oeciacus vicarius Horv. are the only species recorded from Utah. Cimex lectularius Linn., widespread throughout the state, is found wherever mammals and man live and where there is a satisfactory habitat available. D. E. Beck (1953b) reports Cimex lectularius Linn. as one of the consortes found in the nests of Neotoma cinerea. D. E. Beck (1953a) also reports that Oeciacus vicarius Horvath, the Swallow Bug, is found in the nests of the Northern Cliff Swallow, Petrochelidon albifrons albifrons (Rafinesque).

LITERATURE:

- Beck, D. E., Barnum, A. H., and Moore, L. 1953a. Arthropod Consortes Found in the Nests of Neotoma cinerea acraia (Ord) and Neotoma lepida lepida Thomas. Utah Acad. of Sci., Arts and Letters. 30:43-52.
- Beck, D. E. 1953b. A Study of Some Consortes Found at a Nesting Site of the Northern Cliff Swallow, Petrochelidon albifrons albifrons (Rafinesque). Utah Acad. of Sci., Arts and Letters. 30:39-42.
- Knowlton, G. F. 1931. Notes on Utah Heteroptera and Homoptera. Ent. News. 42:40-43; 68-72.
- _____ 1935. Bedbugs and Cockroaches. Utah Agric. Exp. Sta. Leaflet No. 68.
- Knowlton and Harmston. 1950. Utah Insects - Hemiptera. Utah Agric. Exp. Sta. Mineogr. Ser. 200, Pt. 6:10pp.

MESOVELIIDAE (Douglas and Scott 1867) — Water Treaders

Reuter in 1910 separated the Water Treaders from the families Veliidae and Hydrometridae and proposed the name Mesoveliidae (Essig 1942).

FAMILY CHARACTERISTICS: Antennae four-segmented; beak three-segmented; tarsi three-segmented; eyes prominent; adults with or without wings; membrane of hemelytra without veins.

HABITAT: The Water Treaders are small, semiaquatic, predaceous

insects. They live on the surface of quiet pools and on vegetation protruding from the water.

OCCURRENCE IN UTAH: The only record of this family found by the writer is of four specimens of Microvelia sp. collected by Beck and Chandler on the Escalante River near its junction with the Colorado River (Tanner 1940).

LITERATURE:

Tanner, V. M. 1940. A Biotic Study of the Kaiparowits Region of Utah. Great Basin Naturalist. 1(3&4):120.

ANTHOCORIDAE (Amyot and Serville 1843) — Flower Bugs

The name Anthocorides was given the Flower Bugs by Amyot and Serville 1843 and was changed to the present family name, Anthocoridae, by Dallas in 1852 (Essig 1942).

FAMILY CHARACTERISTICS: Ocelli present; beak three-segmented; antennae four-segmented; hemelytra with well-developed embolium; cuneus usually not well defined; membrane without closed cells, veins few or absent; width across eyes shorter than length of head.

HABITAT: The Flower Bugs are very small and are usually black and white. They are found mostly upon flowers and trees, but are also found under loose bark or in decaying matter, such as leaf litter. The Flower Bugs are considered beneficial, for they are predators on small soft-bodied insects, such as aphids, mites, thrips, scale insects, and insect eggs.

OCCURRENCE IN UTAH: The Anthocorids are represented in Utah by five genera, Anthocoris, Lyctocoris, Triphleps, Tetraphleps, and Xylocoris, which are the most important genera of the family. Anthocoris antevolens

White, one of the most common species found in the state, is called the "aphis killer" because it feeds so ferociously on aphids. Triphleps tristicolor White is another common Anthocorid which is beneficial. They are predaceous on Mites, Thrips, Aphids, Leafhoppers, and other small harmful insects.

LITERATURE:

- Hayward, C. L. 1945. Biotic Communities of the Southern Wasatch and Uinta Mountains, Utah. Great Basin Naturalist. 6(1-4):1-124.
- Knowlton, G. F. and Taylor, E. J. 1948. Some Predaceous Hemiptera, Largely from Utah. Utah Acad. of Sci., Arts and Letters. 26:135.
- Knowlton, G. F. 1955. Celery and Potato Field Insects of Utah. Part III. Utah Agric. Exp. Sta. Mimeogr. Ser. 416.

PHYMATIDAE (Laporte 1833) — Ambush Bugs

The name Phymatites was given the Ambush Bugs used by Laporte in 1833 and the name Phymatini by Costa in 1838. In 1852 Costa proposed the name Phymatidae (Essig 1942).

FAMILY CHARACTERISTICS: Front legs fitted for seizing prey, coxae elongated, femora greatly thickened; tibia sickle-shaped and fits closely on the femora; femora and tibia armed with teeth; tarsi bent back into groove in tibia; antennae four-segmented, terminal segment enlarged forming a knob; hemelytra narrower than abdomen; ocelli present; usually black and green or yellow.

HABITAT: The Ambush Bugs are well concealed by their color patterns as they await their prey on flowers, usually compositae. They capture Bees, Flies, Wasps, fair-sized Bumblebees, and other nectar-seeking insects, grasping their prey with their raptorial front legs and inserting their beaks into the bodies of the prey to suck out the juices.

OCCURRENCE IN UTAH: The Ambush Bugs are represented in Utah by the genus Phymata. Phymata pennsylvanica coloradensis Mel., P. borica Evans and P. erosa (Linn.) are three of the common species found in Utah. These insects are most common on Stanleya, but are also found on sunflowers, goldenrod, and certain mustards, where they await nectar-seeking insects.

LITERATURE:

- Knowlton, G. F. and Taylor, E. J. 1948. Some Predaceous Hemiptera, largely from Utah. Utah Acad. of Sci., Arts and Letters. 26:135.
- Knowlton, G. F. 1955. Hemiptera of Utah - Records. Utah Agric. Exp. Sta. Mimeogr. Ser. 140.

REDUVIIDAE (Latreille 1807) — Assassin Bugs

Latreille in 1807 proposed for the Assassin Bugs the name Reduvini, but it was not until 1829 that the present family name, Reduviidae, was established by Stephens (Essig 1942).

FAMILY CHARACTERISTICS: Beak short, three-segmented; prosternum grooved where tip of beak fits when at rest; antennae four-segmented; ocelli present; head narrow and elongate; part behind head neck-like; margins of abdominal segments usually exposed; apical segment of antennae filiform.

HABITAT: For the most part the species found in the state are beneficial, living on the foliage of herbs and shrubs, where they stalk or ambush small plant-feeding insects. They grasp their prey in their front legs and suck out the body juices. The Assassin Bugs may inflict very painful bites if handled carelessly.

OCCURRENCE IN UTAH: The Assassin Bugs are represented in Utah by eleven genera. Many of the species are economically important, for they

feed on harmful insects. Four of the most common genera are Apiomerus, Reduvius, Sinea, and Zelus. Apiomerus crassipes (Fabr.) is a species which is common on flowers, where it captures Bees and other visiting insects. Zelus socius Uhl. is an economically important insect, for it feeds on Beet Leafhoppers and other soft-bodied adults and larvae. Sinea diadema (Fabr.) feeds on Caterpillars, Grubs, and larvae of many harmful insects (Essig 1926). Beck (1953) reports Reduvius personatus Linn. from the nests of Neotoma lepida lepida Thomas and N. cinerea acraia (Ord). Ryckman (1954) reports Reduvius senilus Van D. from the lodges of Neotoma in San Juan County. Triatoma protracta (Uhl.) was also taken from Neotoma nests in Kane and Washington counties by D. E. Beck.

LITERATURE:

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- Jorgensen, C. D. 1955. The Insect Fauna of Sagebrush. Unpublished.
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SALDIDAE (Amyot and Serville 1843) — Shore Bugs

Leach in 1815 established for the Shore Bugs the name Acanthides and Stephens in 1829 the name Acanthidae. Amyot and Serville in 1843 used the name Saldides, but the family name Saldidae was not established until 1852 by Costa (Essig 1942).

FAMILY CHARACTERISTICS: Antennae exposed, four-segmented; head distinct from thorax; two ocelli; beak three-segmented, long, reaches to or beyond middle coxae; membrane of hemelytra with four or five long closed cells; hemelytra without a cuneus.

HABITAT: The Shore Bugs are common along banks of streams, ponds, and lakes, especially near marshes. Some species dig burrows and live part of their lives underground. When frightened they usually fly short distances and then run quickly under debris, rocks, or vegetation, where they are very difficult to see because of their protective coloration, which is similar to their surroundings. They are predaceous on aquatic and semiaquatic insects. They also feed on Midges, Gnats, and Mosquitoes.

OCCURRENCE IN UTAH: The Shore Bugs are represented in Utah by five genera Ioscytus, Micracanthia, Pentacora, Salda, and Saldula. The two most common genera are Salda and Saldula. The species which are the most common are Salda littoralis (Linn.), Saldula explanata (Uhl.), and Saldula interstitialis Say. These species, although not numerous, are found in most areas of the state.

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ENICOCEPHALIDAE Stal. 1860 — Unique-headed Bugs

The Unique-headed Bugs was formerly considered as belonging to the family Reduviidae. In 1837 Westwood established the type genus, Enicocephalus, and the family name is now considered to be Enicocephalidae (Essig 1942).

FAMILY CHARACTERISTICS: Hemelytra entirely membranous; head elongate and divided into two parts by a constriction behind the eyes; ocelli present; antennae four-segmented, small ring joints present after first, second, and third segments; beak four-segmented; front tarsi one-segmented; middle and hind tarsi two-segmented; front legs raptorial, fore tarsi capable of closing upon end of tibia.

HABITAT: These small, delicate insects are found under bark, in debris on damp ground, and on some plants.

OCCURRENCE IN UTAH: These insects are very rare in Utah. Systemelloderus biceps (Say) is the only species recorded from the state. Collected by Mr. E. A. Schwarz about 1892 at Utah Lake, Utah, it was considered a new species at that time and was given the name Enicocephalus culicis Uhl.

LITERATURE:

Ashmead, W. H. 1892. Notes on the genus Enicocephalus Westwood, and description of a new species from Utah. Proc. Ent. Soc. Wash. 2:328-330.

NABIDAE (Costa 1852) — Nabids or Damsel Bugs

Dohrn in 1859 established for the Damsel Bugs the family Nabidae

as it is known today (Essig 1942).

FAMILY CHARACTERISTICS: Beak long, slender, four-segmented; antennae four-segmented; front legs enlarged, raptorial; fore tibia armed with spines and may be closed tightly upon femora; ocelli present; hemelytra with many marginal veins.

HABITAT: The Nabids are found mostly on grasses, sedges, and small weeds in fields and orchards, where they wander about slowly in search of prey. They are predaceous on many insects, such as aphids, leafhoppers, small caterpillars, and other soft-bodied insects. They grasp their prey between the apposed surfaces of the fore femora and the tibia while they insert their beaks into the body of the prey.

OCCURRENCE IN UTAH: Two genera, Nabis and Pagasa, have been collected in Utah. The most common species are Nabis alternatus Parsh., N. roseipennis Reut., and N. ferus (Linn.). They are considered as some of the most beneficial insects of the order Hemiptera, being economically important because they are predators on Beet Leafhoppers, Aphids, and other small harmful insects. The genus Pagasa has not been collected extensively in the state. No specimens of this genus are found in the collections examined by the writer. The only reference to this genus comes from the literature. Harris (1928) and Van Duzee (1917) say that Pagasa pallipes Stal is found in Utah.

LITERATURE:

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NEIDIDAE Kirkaldy 1902 — Stilt Bugs

FAMILY CHARACTERISTICS: Body long and narrow; antennae and legs long and very slender; antennae four-segmented, elbowed at base of second segment, segment at tip enlarged; ocelli present; beak four-segmented; membrane of hemelytra furnished with very few veins; head has transverse incision in front of ocelli; eyes distant from base of head; femora apically enlarged.

HABITAT: The Stilt Bugs consist of a very few species. They are rather sluggish, brown insects found on weeds and plants in meadows, orchards, and pastures. They are both predaceous and phytophagous.

OCCURRENCE IN UTAH: Four genera: Acanthophysa, Jalysus, Neides, and Pronotocantha have been reported from Utah, of which the genera Jalysus and Neides are the most common. These two genera are found widespread throughout the state. Neides muticus (Say) is a predaceous Stilt Bug which feeds on Beet Leafhoppers and other small insects. Jalysus spinosus (Say) is a plant feeder and causes damage to such plants as potatoes and tomatoes.

LITERATURE:

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MIRIDAE Hahn 1831 — Leaf Bugs

Leach in 1815, Samouelle in 1819, and Stephens in 1829 grouped the Leaf Bugs with the family Coreidae. In 1835 Burmeister introduced the name Capsini, in 1837 Spinola introduced the name Capsoides, and in 1837 Kirby used the name Capsidae. The family Miridae was established by Hahn in 1831 (Essig 1942).

FAMILY CHARACTERISTICS: Hemelytra complete with clavus, corium, cuneus, and membrane; membrane has only one or two closed cells at base; ocelli wanting; antennae and beak four-segmented; tarsi three-segmented; front legs fitted for walking; tarsi with arolia.

HABITAT: The family Miridae is the largest family of the order Hemiptera. They are found in vegetation almost everywhere and are therefore by far the most common insects in number of species and individuals. The Mirids are mostly phytophagous, but many species are definitely predaceous and a few are both phytophagous and predaceous. Many of the phytophagous Mirids aid in the transmission of plant diseases.

OCCURRENCE IN UTAH: Sixty-seven genera of the family Miridae have been reported from Utah. The two most common genera are Lygus and Deraeocoris. It is in this family that are found many of the insects that are economically important because of the harm they do to cultivated plants. The Tarnished Plant Bugs, Lygus pratensis (Linn.), attack all kinds of fruits, grains, and flowers, piercing the plant tissue and extracting the juices. When they become numerous, they often injure the seed of alfalfa, causing the leaves to curl and the buds to drop off. Lygus elisus Van D. causes considerable damage to beets, alfalfa, potatoes, and various types

of berries. Knowlton (1951) mentions that Thyrillus pacificus (Uhl.) causes serious damage to giant rye grasses, timothy, blue grass, brome, and other grasses. There are also other species, such as those of the genus Deraeocoris, which are beneficial, for they are predaceous on Leafhoppers, Aphids, and other small insects.

A. B. Call made an excellent study of the Utah Miridae, in which he listed existing and new records of eighty-one species and subspecies. He was aided in his taxonomic work by Dr. H. H. Knight. He also discusses the habits of the species.

C. J. Sorensen (1946) gave a lecture in which he stated the harmful effects of the Lygus Bugs on alfalfa seed. He gives their characteristic features and their host plants. He explains the nature of the injury to the plants and the amount of harm they have done. Also he mentions the population densities and methods of controlling the Lygus Bug.

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ARADIDAE (Spinola 1837) -- Flat Bugs

The Flat Bugs were formerly grouped with the Bedbugs, Cimicidae. Spinola in 1837 used the name Aridides and Costa in 1852 established the family name Aradidae (Essig 1942).

FAMILY CHARACTERISTICS: Very flat; hemelytra usually well developed, with distinct membrane, corium, and clavus; hemelytra covers only disk of abdomen; antennae and beak four-segmented; tarsi two-segmented; ocelli absent; eyes very prominent.

HABITAT: The Flat Bugs are usually a dull brown or black in color and live in cracks and beneath bark of decaying trees. They are sometimes mistaken for bedbugs because of their flat appearance. They are well adapted for living under cramped conditions. Most species feed on moisture in bark and decaying wood or sap of fungi, but a few species feed on living plants.

OCCURRENCE IN UTAH: The Flat Bugs are represented in Utah by two genera, Aneurus and Aradus. The two most common species are Aradus lugubris Fall. and A. vadosus Van D. These species of the flat bugs have been collected mostly at high altitudes, such as Alta, Aspen Grove, Uinta Mountains, and Logan Canyon, but they have also been collected at Logan and Ogden.

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PYRRHOCORIDAE Fieber 1861 -- Red Bugs

The Red Bugs were grouped in both the families Coreidae and Lygaeidae until Fieber established the family Pyrrhocoridae in 1861 (Essig 1942).

FAMILY CHARACTERISTICS: Antennae four-segmented; beak four-segmented; ocelli absent; hemelytra lack cuneus; base of membrane with two or three large cells from which arise branching veins.

HABITAT: The Red Bugs are both phytophagous and gregarious in habit, living in colonies on foliage. They are stout and heavily built and are usually marked with red and black. Some members of this family are often confused with members of the families Coreidae and Lygaeidae, for at first glance they look very much alike. The greatest difference between the family Pyrrhocoridae and the families Coreidae and Lygaeidae are in wing venation and the absence of ocelli in the family Pyrrhocoridae.

OCCURRENCE IN UTAH: Euryopthalmus convivus (Stal) and E. succinctus (Linn.) are the only representatives of this family reported from Utah. E. convivus (Stal) has been found at Indianola and St. George. E. succinctus (Linn.) has been found at St. George and Pine Valley.

LYGAEIDAE (Schiller 1829) -- Lygaeid Bugs

The Lygaeids were formerly grouped with the family Coreidae. The name Lygaeides was introduced by Schiller in 1829 and the name Lygaeodes by Burmeister in 1835. The family name Lygaeidae was first established by Herrich-Schaeffer in 1835. The name Geocoridae was also given to this group by Kirkaldy in 1902 (Essig 1942).

FAMILY CHARACTERISTICS: Membrane with four or five simple longitudinal veins; ocelli present; beak four-segmented; antennae four-segmented, slender, longer than head.

HABITAT: The Lygaeids are the second to the largest family in the order Hemiptera. They are medium-sized bugs, most species being marked with spots or bands of white, black, and red. The species of this family are both phytophagous and predaceous. They live on plants and are often seen on areas between plants or hidden under debris at the foot of the plants.

OCCURRENCE IN UTAH: Twenty genera of the family Lygaeidae have been reported from Utah. Four of the principal genera found in the state are Crophius, Geocoris, Lygaeus, and Nysius. The False Chinch Bugs, Nysius ericae (Schill.), cause considerable damage to sugar beets, alfalfa, grasses, and most garden vegetables. They are also pests to the berry growers, for they also feed on raspberries, strawberries, and dewberries. Among the predaceous Lygaeids found in the state are the members of the genus Geocoris. Geocoris decoratus Uhl. is a well-known species which feeds on the nymphal forms of Nysius ericae (Schill.), Lygus elisus Van D., Alfalfa Weevil Larvae, and Aphids.

LITERATURE:

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COREIDAE (Leach 1815) — Leaf-footed Bugs

The Leaf-footed Bugs were given the name Coreides by Leach in 1815. The family name Coreidae was established by Samouelle in 1819 (Essig 1942).

FAMILY CHARACTERISTICS: Ocelli present; beak four-segmented; antennae four-segmented; tarsi three-segmented; hemelytra usually complete and composed of clavus, corium, and membrane; membrane has many veins, which arise from a transverse basal vein; scutellum is small or medium in size; head narrower and shorter than pronotum.

HABITAT: These insects are commonly found on most plants or under debris on the ground. They are mostly phytophagous, but some members of the family are predaceous and are therefore, considered to be beneficial insects because of their control of certain harmful species.

OCCURRENCE IN UTAH: Several common bugs of the family Coreidae are found in Utah. The Boxelder Bugs, Leptocoris trivittatus (Say), are very often given the name "Firebug," and are common around the boxelder trees. They cause economic losses by sucking juices from ripening fruits. The Squash Bugs, Anasa tristis (De Geer), causes considerable damage to squash, pumpkins, and related plants by sucking juices from the leaves and stems. They may kill young plants outright or just some of the leaves and runners on older plants. During the summer and fall of 1954 the Leaf-footed Bugs, Leptoglossus clypealis Heid., did considerable damage to fruit. They damaged the cherries and apricots to a great extent by piercing the

fruit with their beaks and sucking out the juices. They also ruined the market value of such fruits as the apples, pears, and plums in many sections of the state.

LITERATURE:

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SUMMARY AND CONCLUSIONS

During the summer of 1954 and the school year 1954-55, a study was undertaken of Utah Hemiptera, as represented by the collections of Brigham Young University, Utah State Agricultural College, and the University of Utah, as well as by published records. The purpose of the study was (1) to determine which families occur in Utah, (2) to furnish a taxonomic key for their classification, (3) to give the distinguishing characteristics of each family, (4) to name the most prevalent genera and species of each family occurring in Utah, and (5) to report some of the most important literature which discusses the species of the families as they are known to occur in Utah. The writer during this period collected Hemiptera from several localities in the state and classified them to their respective families.

As a result of this study twenty-eight families are reported from Utah. Members of the families Mesoveliidae and Enicocephalidae were not examined because of the absence of specimens in the collections of the state. The only reference to these families comes from the literature.

More extensive collecting will probably prove that many of the bugs mentioned in this study have a much wider distribution than present-day records indicate. It is very probable that other families of Hemiptera will also be found which have not as yet been reported from Utah. There is yet much work to be done before we can truly say we know what families, genera, and species of Hemiptera are found in our state.

It is hoped that this study will benefit future workers of Utah Hemiptera and add to the knowledge of the families of Utah Hemiptera as well as be an aid to the trained and untrained entomologist in classifying

the specimens of Hemiptera they collect to their respective families. This study is general in nature but will serve as a basis for more specific work to be done by future workers in Utah Hemiptera.

APPENDIX I. GLOSSARY

- ANTEAPICAL -- just before the apex.
- APEX -- the end, tip or outermost part.
- APICAL -- at the end, tip or outermost part.
- DORSAL -- top, back or upper side.
- FILIFORM -- hair or thread-like.
- FOSSORIAL -- fitted for or habit of burrowing and digging.
- GREGARIOUS -- large number of individuals grouped together.
- HEMELYTRA -- front wing of Hemiptera.
- OCELLUS -- simple eyes (pl. ocelli).
- PHYTOPHAGOUS -- feeds on plants.
- PREDACEOUS -- attacks and feeds on other animals
- RAPTORIAL -- fitted for grasping prey.
- RETICULATE -- similar to network.
- SCUTELLUM -- a thoracic sclerite, triangular or oblong in shape, between the hemelytra.
- SPATULATE -- spoon or shovel-shaped.
- THORAX -- body region behind the head which bears wings and legs.
- VEIN -- thickened supporting lines in wings.
- VENTRAL -- underneath, underside of body.
- VESTIGIAL -- small, degenerate, or poorly developed.

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A STUDY OF THE FAMILIES OF UTAH HEMIPTERA

Abstract of

A Thesis Presented to the
Department of Zoology and Entomology
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of the Requirements for the Degree of
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by

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ABSTRACT

This study determines the number of families of Hemiptera found in the state and has a key for their classification. The characteristics and general distributions of each family are given, along with specific examples of the most common and economically important bugs. Important references are given for each family of work done to date.

It was found that there have been twenty-eight families of Hemiptera collected in Utah, some of which are well represented in numbers of genera, species, and individuals, while others are represented by a single species and collected in only one or two places in the state.