

## BIONOMICS OF THE AQUATIC AND SEMI-AQUATIC HEMIPTERA OF DALLAS COUNTY, TEXAS\*

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Although (as Professor S. W. Geiser has shown in his publications on scientific study and exploration in Early Texas) a number of naturalists and entomological collectors have worked in Texas, and some of them (like Jacob Boll, Gideon Lincecum, J. D. Mitchell, A. C. V. Schott, G. W. Belfrage, E. A. Schwarz and F. A. Schaupp) have made notable contributions toward our first knowledge of the insect fauna of Texas, either by collection of specimens sent to monographers and specialists, or by publication, still, on several groups our information is meager. Among these groups are the aquatic and semi-aquatic Hemiptera.

Dr. E. P. Van Duzee in his "Catalogue of the Hemiptera of America North of Mexico" (1917) reported forty-three species of aquatic Hemiptera for Texas. Prof. H. B. Hungerford (1919), in a paper listing a number of Texas species, reported only one (sub) species not previously listed by Van Duzee. Since then, the literature gives only scattered records of aquatic and semi-aquatic Hemiptera for Texas.

Perhaps one of the main reasons for this neglect lies in the fact that these insects are, aside from fish culture, of little economic importance. The increasing attention given to the lakes and streams of Texas by state and institutional organizations will, I believe, see increasing emphasis placed on the general biology of aquatic insects.

In September, 1938, I began a careful systematic and

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ecological study, with laboratory experiments, of aquatic and semi-aquatic Hemiptera for the vicinity of Dallas. Other regions of the state were also visited during the course of my study. Since the period of investigation has been short this report is not exhaustive, although most of the more widely distributed species have probably been collected. Those species that may have been overlooked are scattered ones whose habitats made them difficult to find during the seasons of the year that the study was under way.

I believe this is the first attempt to study carefully the aquatic Hemiptera for any given locality in Texas, with comparisons of previous records from the state. This paper lists 33 genera and 71 species from Texas. Data on temperature, weather conditions, habitat, and relative number, were kept as far as possible on all species in this study. Both pinned and alcoholic material was used for reference and study.

Collecting was begun with a standard rake net; the insects were disturbed by the rake and then picked up by the net. This type of net is excellent for small aquatic species, but was less useful in surface collecting, or for collecting larger aquatic species. Ward's Apron Net proved especially useful in vegetation-zones, as well as for those insects that swim downward when disturbed. For fast work the net is, however, too cumbersome. A minnow seine was useful only in collecting the larger species. I found a short-handled standard dip net fairly useful in collecting smaller striders. Since no net proved of value as an all-purpose net, I made a net that could be used on the surface as well as in deeper water. Baiting for specimens proved to be not very successful. Individuals were not abundant in the region baited; and bait traps should be tried in more populous areas. During the migration season many aquatic insects are attracted to bright lights. Collections at suitable places yielded bebstomatids and corixids sparingly to abundantly.

*Habitats:* The habitats herein listed from which periodic collections were made show as great a diversity as was available in the Dallas vicinity:

- 1.) *Commerce pool*—An artificial pool ten feet in di-

ameter and one foot deep, on the campus of Southern Methodist University. Its water-supply came from dripping hydrant. The bottom was a rich muck, with abundant Protozoa and microscopic algae, as well as many water lilies. During the early winter, a mass of leaves served as cover for such Hemiptera as *Notenecta*, *Buenoa*, *Arctocorixa*, *Gerris* and *Velia*.

2.) *White Rock Creek* — This sluggish mud-bottomed creek flows into White Rock Lake and at the time collections were being made there was little vegetation in the creek. Two different localities were selected for study in the creek. One was about two miles up the creek from its entrance into the lake; the other about a half mile up stream from this inlet. The upper habitat proved barren of aquatic Hemiptera, but its sloping, sandy banks proved very good for gelastocorids. This region had little vegetation and consequently the gelastocorids were unhampered in their predatory habits. The lower course of the creek is heavily wooded. The creek itself had little vegetation, and showed intermittent pools and riffles. The pools were heavily silted, and proved a very good locality for *Gerris marginatus*; a few corixids and quite a number of gelastocorids were also found. Since the creek was dry earlier in the spring it was somewhat surprising to find as many specimens as we did.

3.) *White Rock Fish Hatchery*—At the lower end of White Rock Lake are twenty artificial ponds with good collecting for *Ranatra*, *belastomatids* and *corixids*. At the point where these ponds drain into a general drainage ditch, is abundant vegetation, chiefly *Myriophyllum*. The immediate area is protected by trees as well as by the White Rock Lake dam. These ponds show considerable variation, since some had not been drained during the winter months and others had. Those which had retained water over the winter proved most productive. These ponds were 150x200 feet in size; being artificial, most of them had very little shallow water and offered small collecting area. Generally, they were well supplied with cattail; those that contained water all winter had also abundance of *Spirogyra*. Insects from this area were heavily parasitized with *Hydracinidae*.

4.) *Bachman's Lake*—This long rather narrow lake covers an area of forty acres. Its bottom at the lower end is sandy, but at the upper end is very mucky. Cattails grow in scattered areas around the lake. In the fall there were abundant gerrids and belostomatids generally distributed in the lake, with a few corixids in the upper portion. As far as vegetation is concerned, the lake has abundant vegetation in the fall but scarcely any in the spring. This lack of spring vegetation is caused by high waves in winter which wash the vegetation out.

5.) *Bachman's Spillway*—This habitat is very diversified. A small stream, fed by seepage water from the dam, carries the water through a few pools and riffles through approximately three hundred yards of marshy ground. In the pools were found a number of gerrids, corixids, veliids and Hydrometridae. The veliids and gerrids were found in the stream both above and below the pools. Some hydrometrids were found at the edge of the pool. The stream had a good supply of plant and animal food for fishes and other aquatic forms. Veliids were found along the banks of the stream, under some concrete slabs.

6.) *Elam Springs*—This stream flows through post-oak timber southeast of Dallas. The bottom has little vegetation, being limestone in part of the stream and shifting sand in other parts. The water is slightly acid. Water striders, most of them *Gerris remigis*, were collected at all times. The young were found throughout the winter in all their instars. Except for *Gelastocoris* and *Velia* very few other aquatic Hemiptera were to be found in this area.

7.) *Bachman's Creek*—This creek runs along the Northwest Highway north of Dallas and empties into Bachman's Lake. The creek has a limestone bottom, with large amounts of *Spirogyra* and larger plants. There were a few trees on the banks; and much grass and weeds overhung the water. Corixids, *Notonecta* and *Gerris* were obtained in abundance.

8.) *Wood County, Texas*—Ellis Lakes in Wood County were also observed. The lakes are situated in the midst of

a pine forest which extends down to the water's edge. The water is slightly acid with a range of pH 6.2-6.7. At various places on both lakes were found extensive beds of cattails and numerous water lilies. The water was well supplied with microalgae and small crustacea which should provide plenty of food for aquatic insects and fishes. This is my only locality for the lesser corixid, which has not been identified. Five species of notonectids are found in the lower lake, two of which are new records for the state. Very few gerrids were collected.

9.) *Tram Pond*—This stock pond was situated near the lower Ellis Lake and contained numbers of young fishes. It was about 150 feet long by 100 feet wide with a maximum depth of six feet; spring-fed, with a pH of 6.2. The banks were sloping and near the edge *Myriophyllum* was growing rather abundantly. There were also a number of cattails in the upper end of the pond. The pond contained but one species of aquatic Hemiptera, the corixid *Palmocorixa buenoi*.

## ECOLOGY AND SYSTEMATIC REPORT

MESOVELIIDAE Douglas & Scott, 1867

814 *Mesovelvia mulsanti* White, 1879

Ranges from New England west to Illinois and southwest to Florida, Texas, Mexico and Brazil. It is common in Dallas, Henderson and Wood counties. Found upon and about filamentous algae as well as any other surface vegetation. When frightened they run out on the surface film instead of rowing as do the gerrids. The young (apterous) forms of the adult show degrees of green coloration varying from darker shades to yellowish green. Adult winged specimens are easily distinguished from their green substrate, by the silvery sheen of their wings. With their long legs, they can run very fast either on water or on a bed of algae. This is probably the most widely distributed of the aquatic and semi-aquatic Hemiptera. In this area it was taken throughout the year but most abundantly in late fall and early spring.

Butler (1893) says the species is carnivorous. He fed it a variety of small insects among them a springtail (*Smyntburus*), a *Crambus*, a chalcid and a hydro-metrid; he believes the usual food to be small Diptera and Hymenoptera. Prof. H. B. Hungerford (1919) tells of one which attacked a fly as it crawled out of the water. The fly flew some distance but the little mesoveliid hung on with his beak inserted in the abdomen.

They undoubtedly feed on crustaceans as they come to the surface; and aphids found on water lily pads may also constitute a part of their diet. These crustacea are found abundantly in algae. Frequently young *Mesovelvia* attack forms which are too large for them, and doubtless are killed.

In mating, contact lasts usually no longer than one minute in this species. The male frequently remains perched upon the female's back while she lays eggs and attempts (and often consummates) mating between her labors. The abundance of

these insects is easily understood when we consider the data presented by Hungerford: One of his females emerged August 1, began to lay August 3, and died August 12, having laid 44 eggs, an average of nearly four eggs each day of her life. The average life-span is a little over three weeks.

Adults of this species fly easily short distances from pool to pool; the species may also be transported in the egg stage, well protected in the stem of certain aquatic plants.

The behavior of this species has been studied well, experimentally, since its culture and observation are easy.

#### HEBRIDAE August & Serville, 1843

Species of this family are minute, plump-bodied insects. The adults of the genus *Hebrus* are always winged but *Merragata* is the dimorphic representative. Only six species of this family are reported from the United States. I have not included any of these in this paper, since my studies on the (at least one) species in the Dallas region are not completed. No species has been previously reported from Texas.

#### HYDROMETRIDAE Billberg, 1820

1281 *Hydrometra martini* Kirkaldy, 1900

This water-measurer has been collected in Ont., Me., N. Y., N. J., Pa., Md., D. C., N. C., Fla., Ind., Ill., La., Ariz., Iowa and Texas. I have not found it abundant in Dallas, Kerr or Comal counties, Texas, but did take it in large numbers in Hays County, Central Texas. I have collected it at Dallas in September, November, March and April. The species lives on weeds, in pools of quiet water. There they suck the juice from insects falling into the water. In Hays County on April 6 and 7, 1939, I found them abundant in bladderwort (*Utricularia*) in water which was 70° F. They lacked well-developed wings, and some individuals seemed to be in a very early instar. My observations show them more numerous in spring than in the fall.

One specimen was taken in March, walking four feet from the water's edge near White Rock Creek. Possibly he was coming out of hibernation. Since the species overwinter as adults, most of my individuals were taken on the water surface or on floating vegetation in the creek. They move about on the surface rather slowly; seldom take to flight, but rely upon protective mimicry and cursorial processes to escape enemies. When disturbed they usually hide on vegetation and seem to be more active in the morning than in the afternoon. When the sun is bright, they seek the shade of various plants, especially the bladderwort. They have been known to feed on small midges emerging to the surface; this may account in part for their "preference" for stagnant water. They attack mosquitoes and small ostracods, and Hungerford found them to be cannibalistic. Such economic importance as they possess lies in their ridding ponds and pools of mosquitoes and midges, which are pests to mankind. They seem to be more easily disturbed by action of food-animals beneath the surface than by action above the surface.

The male has as acquired secondary sexual characteristics two notched projections on the ventral side of the sixth abdominal segment, close to the incisures between the sixth and seventh segments. These projections are believed to help the insect maintain its balance, so as not to break through the surface film. Martin (1900) describes an oviposition in which the female exuded from the genital opening a drop of gummy substance which she pressed upon the chosen egg-support (which is usually located above the water level.) As she walked away the egg was freed. Eggs hatch in from four to twenty days. Martin (1900) gives five as the number of instars, and the life-span as about a year. I have taken nymphs in November as well as in April, in Dallas County. (cf. Hungerford 1919, p. 93.)

#### GERRIDAE Amyot & Serville, 1843

1283 *Gerris remigis* Say, 1832

Its known range is Quebec, Ont., Me., N. H., Mass., Conn., N. Y., N. J., Pa., Md., N. C., Ga., Mich., Ill., Colo., N. Mex., Ariz., Calif., Ore., Iowa and

Texas. Reported in Texas from Hays, Comal, Henderson, Wood, Kerr, Travis and Dallas counties.

This species, the largest in this area, occurs in all of the habitats examined, and is perhaps the most generally distributed of the Gerrids. Although most frequent in a moving stream, they have been found abundantly in pools with a wide range of hydrogen ion concentration (pH. 6.2-8.3). They were found both in polluted and fresh water. They are active in sunshine and in rain, skating across the water on their prothoracic and metathoracic legs, with the mesothoracic legs as propelling organs. Field observations show that only the tarsi touch the surface film of the water. Streams and ponds in wooded areas are more frequented. When disturbed, the insects usually go to open water; a few go to the bank and stop near some leaf or stick until danger has passed. They are very alert, and when disturbed move very fast on the surface of the water, sometimes heading for the bank to avoid the net. Occasionally they appear to dive, if constantly pursued. When placed on a dry bank, they soon reach water by jumping three or four times toward the water and then crawling the remainder of the distance. Laboratory experiments show no choice between light and darkness, but an ability to distinguish between light-flashes. Many of the forms are wingless while others have well-developed wings. I have never seen one in the air, and doubt whether many fly.

They feed upon almost any insect which falls into the water, and take many insects as they emerge from the water. They capture corixids and notonectids as they come to the surface for air, and when hungry probably attack almost anything which offers food. Several species of Gerrids, (chief among which is *Gerris remigis*) are cannibalistic. I fed them on several kinds of meat, but they displayed only slight preference for beef liver, beef heart, and steak. Several would feed on a small piece of beef at the same time. These insects are also known to feed upon snails when hungry.

I observed them mating during the entire year, but an appreciable increase was noted in February. The eggs are attached not in masses but singly, to stems of aquatic plants just beneath the surface of the water. Sometimes the eggs form a chain on the plant, like a string of sausages. Each egg is attached to the stem with a water-proof glue. They hatched in the laboratory in a little less than two weeks, and the newly hatched young then went about in search of food. There are five instars, each of which lasts about a week. The various instars look very different from the adults, the nymphs having a white "W" on the pronotum. This marking is absent in the adult winged insect. The young are found throughout the year, jumping about on floating vegetation much like small spiders. In the northern United States these insects hibernate as adults under shelter and show gregarious tendencies.

I observed two Gerrids, starved for a week, sucking the juice from a weaker member. They are very general feeders in the laboratory, but must have fresh food. One pair observed mating during a forty-eight hour period deposited seven eggs during the following two days, upon the stem of *Myriophyllum*. These eggs hatched in twelve days.

1288 *Gerris marginatus* Say, 1832

Range, Quebec and New England west to the Pacific and south to North Carolina, Georgia and Texas. Taken in Dallas and Wood counties in Texas.

This species occurs in slow moving streams which flow through timberland, as well as in ponds and lakes. It occurs throughout the year in the adult stage, and during the winter months is found in protected areas. Occasionally, *G. Remigis* and *canaliculatus* are associated with this species. This insect is usually winged, but the wings, apparently, are used only for migration. It moves with unusual speed over the surface on a sunny day.

The insect feeds much as does the preceding species. Although good scavengers of the water, they prefer to catch and kill their own food. They probably take some food which otherwise might go to young fishes, but on the other hand furnish considerable fish food.

Mating activities (which are greatest in March) seem to last for some hours if undisturbed. Eggs are deposited as in *G. remigis*, and there are probably five nymphal instars.

1290 *Gerris canaliculatus* Say, 1832

Range, New England and New York west to Ohio and southwest to Georgia and Florida; common in some localities of Dallas and Wood counties, but not recorded from Texas by VanDuzee, Hungerford or Blatchley.

This insect was observed most abundantly along the spillway of Bachman's lake. Our individuals measure about two-fifths of an inch. The species differs from *G. marginatus* in having an obvious sternal groove which extends to the venter. The whole lower surface is yellow with a silvery sheen. Most of the specimens were collected from rapid water well protected with plants of various kinds; some were taken in the lower edge of the pool which fed the stream. Although most of the specimens were taken in the fall, a few were collected in various habitats throughout the year. They seem to "prefer" a habitat with facilities for hiding, and their speed exceeds that of most gerrids on the surface film. When sunshine is brightest they congregate in the shade of an overhanging bank or of vegetation. They are active on cloudy and rainy days. They feed upon insects that come to the surface for air and those that drop into the water. Probably chronomids make up much of their diet.

Bueno (cf. Hungerford, 1919, p 118) describes five instars, and says that he reared thirty individuals, all macropterous, from one apterous female.

1294 *Limnogonus besione* Kirkaldy, 1902

Recorded in Ohio, Michigan, Kansas, Florida, Daytona, Panama, and (now) Texas. Common on Bachman's Lake, Dallas County, during October; also taken in Comal and Hays counties.

While individuals taken in September were not concentrated, they were gregarious during October. I found many near the bank of Bachman's spillway, in cattail areas. A few were taken in the heavy vegetation of the stream which flows from the pool. Although winged forms were found in Hays County during early April, the majority were wingless. These insects frequent banks where they can catch any insect which may come to the surface or which might fall into the water from an overhanging branch. At San Marcos, they associated with *Metrobates besperius* and *Velia brachialis*. They show considerable variation in size. San Marcos individuals were definitely larger than those found in early fall in Dallas County. None of the individuals taken in the Dallas area was winged. I found no *besione* during the winter months; perhaps they were hibernating in some nearby shelter. When most abundant they frequently collide with each other as they skid over the surface film. Such "collisions" are especially noticeable when they are disturbed. Hungerford (1919) calls *L. besione* a "lacustrine" species; I have found this species in a stream a foot wide, in abundant vegetation. Most of the individuals were taken in a pool a hundred feet across, fed by a stream of sufficient force to keep the pool in constant motion. Feeding habits resemble those of other gerrids. On April 7 and 8 they were found mating in a pool at San Marcos, Hays County, which maintained a constant temperature of 70° F. the year around. Since winged forms were found in early April, it would appear that they overwinter as adults, a condition at variance with Hungerford's experience, who states that they overwinter in the egg stage. This is probably true for the northern form—I have made similar observations at Dallas. San Marcos, Hays County, is two hundred miles south of Dallas, and the unusual temperature of the pool was probably the deciding factor which enables *L. besione* to overwinter as adults. Mating which was observed (at San Marcos) on April 7 and 8 indicates egg-laying in the spring.

1295 *Metrobates besperius* Uhler, 1878

Range, Ontario and New England west to Michigan, Kansas, Iowa and Texas; and southwest to South Carolina. Common in Comal and Hays counties, Texas. Rare in Dallas County.

Color and size vary slightly in this species. The male is smaller than the



female, and can be recognized by the protruding ventral segment. I have collected small numbers in Dallas County, although large numbers were found in early April at San Marcos. They were also quite abundant at New Braunfels, Comal County, in Comal Springs. This species has been supposed, previously, to be lacustrine, but here again unusual temperature conditions like those at San Marcos may account for habitat differences. Although no winged specimens were taken, they are said to occur. This insect has been found only in permanent bodies of water, and is probably distributed by overflows. It appears gregarious, sometimes associated with *Lemnigonus besione* Kirk. In its feeding, these insects remind one of a flycatcher. They glide over the surface, occasionally leaping from the water to grasp mosquitoes, midges and other insects. Little is known regarding their reproductive cycle.

(1296+) *Trepobatus knighti* var. Drake & Hottes, (1925)

The range is not known by this author, however it is common in autumn in Dallas County, where it was one of the most abundant of the fall species. On September 27, 1938, they were the most numerous insects in Bachman's spillway, in schools of over a hundred individuals associated with *Rbeumatobatus hungerfordi*. For three days they were the most numerous of the aquatic Hemiptera; but on October 9, only a few individuals were found. On November 1, three pairs were observed mating in the field and again on Nov. 17, with a water temperature of 64° F.; they then disappeared and have not yet appeared this spring. (April 10, 1939). They are very agile on the surface film; they seem to "prefer" small pools or slowly moving water with abundant algae. Groups of individuals break up easily and quickly reassemble. Food consists, probably, of ostracods and other microcrustacea, and immature insects. No heavy rain fell during this period, which might have caused them to scatter; it therefore may be inferred that winter is passed in the egg stage. This conclusion is not in agreement with Hungerford's finding for *Trepobatus pictus*; but his observations were made on laboratory specimens.

1298 *Rbeumatobatus hungerfordi* Wiley

Abundant in streams and lakes near Dallas, where they are gregarious and associated with *Trepobatus knighti*. They are usually found near a bank or some protected area. The secondary sexual characteristics of this species are marked: the hind legs of the male are curved and deformed in a curious way, with singular chitinous processes whose size makes them unique among known Heteroptera. The structure of the male antennae is also remarkable and unprecedented among Heteroptera. In Collembola, the male *in copulo* winds his antennae around those of the female; it would be interesting to see if this were also true of this species. Copulation in *R. hungerfordi* is still unobserved. During late September and October I collected this species in abundance at Bachman's spillway, Bachman's Lake and its affluent, Bachman's Creek. In certain areas they are the most abundant of the Gerrids. They were not found during the winter or early spring months. They are extremely agile, and scatter quickly with disturbance. They move by jumping, and are extremely hard to pick up in a net, since their jumps may measure four or five inches. I have collected only wingless forms. Food of this species probably consists of microcrustacea and insects which drop into their habitat, or which they capture as they emerge. *Rbeumatobatus hungerfordi* probably overwinter in the egg, as they disappear late in October and had not reappeared by early April.

#### VELIIDAE Amyot and Serville, 1843

1311 *Rbagovelia armata* (Burm.), 1835

Recorded for Texas and Mexico; I caught two species in Kerr County, not yet determined by Hungerford as to species.

1314 *Velia brachialis* Stal., 1860

Known in this country from Georgia, Florida and Texas and probably a distinct Southern form. Collected commonly in marshy areas in Dallas County; also taken in Hays, Kerr, Comal and Travis counties.

This species shows little size variation in the adult stage. It is gregarious both in winter and summer. On February 6 a large number of torpid veliids were taken in a grassy area under rocks at Bachman's spillway. Some of these were placed in an aquarium but lived only a month. In early April I found large numbers congregated in the same locality with other veliids.

My material showed little if any color variation. Most of them were wingless. This species seems to "prefer" warm sunshine, but individuals are also active on rainy and cloudy days. Slow-flowing water is more frequented than that of pools or swift-flowing streams. The speed of *Velia brachialis* on the land is as great as on water. When danger approaches the insect shows a tendency to hide. *Velia* is both predaceous and cannibalistic, and has been found feeding on dead insects that had fallen on the water-surface. Eggs are deposited on floating vegetation just beneath the surface of the water. It has been said that under favorable conditions they live two years; the average span of nymphal life is 27 days. In early April a number of nymphs were taken at San Marcos, Hays County.

1316 *Entacora signorti* (Guerin, 1857)

Recorded from Mass., N. J., Md., N. C., New Hamp., Ga., Fla., Calif., Texas and Mexico. Girard (1885) reports it (July 20) in Corpus Christi, Texas. Not reported for Dallas County. It is said to live on moist spots near pale sands. (cf. Hungerford, 1919 p. 57.)

1317 *Pentacora hirta* (Say, 1832)

Range Quebec, Conn., N. Y., N. J., Fla., Ind., and Texas. Reported from Dallas County. I found it very near the water on muddy flats of Bachman's lake; but nowhere else in the county. Numbers of Diptera and gelastocorids were found in the same general locality. This species when disturbed at once flies or crawls into some crevice. They probably feed on the Diptera living in their habitat.

1323 *Saldula major* (Prov. l., 1872)

Range: Quebec, Ont., Me., Mass., R. I., N. Y., Pa., Md., Mich., Ill., Wisc., Iowa, Mo., Kan., Tex., N. Mex., Minn. and Sask. I have not found this species in Texas.

1325 *Saldula orbiculata* Uhler, 1877

Ranges throughout Mass., N. Y., Pa., Ohio, Ill., Tex., and Calif.; but not found by me in Texas.

1328 *Saldula interstitialis* (Say, 1825)

Recorded in Quebec, Ont., Me., Mass., N. Y., N. J., Pa., Md., Fla., Ind., Ill., Iowa, Mich., Mo., Dak., Neb., Colo., Texas, N. Mex., Idaho and Calif. Not found in Dallas County.

1334 *Saldula sphaelata* (Uhler, 1877)

VanDuzee gives the distribution as Mass., N. J., Md., Fla., and Texas. Parshley adds Maine and Rhode Island. Not found in Dallas County.

1342 *Micracanthia humilis* (Say, 1832)

Distribution given as Ont., Me., Mass., R. I., N. Y., N. J., Pa., Md., D. C., N. C., Ga., Fla., Ohio, Ill., Iowa, Colo., Calif., and Texas. Not recorded from Dallas County.

NOTONECTIDAE Leach, 1815

1349 *Notonecta irrorata* Uhler, 1878

Distribution given as Ont., Me., Mass., R. I., N. Y., N. J., Pa., Md., D. C., Montana and southwest to North Carolina, Florida, Kansas and Texas. Rare, but taken in Dallas, Wood and Henderson counties, Texas.

On Dec. 5, 1938, two individuals were collected in Henderson County from a pool in which were found many corixids. One was taken in Dallas County (October 30, 1938) in Commerce pool associated with *Notonecta undulata, indica*, and

corixids. Later observations on the pool showed no signs of Hemiptera. Possibly the gold fish in the pool ate all of the insects during the winter months. This species shows less color-variation than the other species. It is a greenish brown, and probably hides in a similar background, awaiting food. It is said to fly to deeper water during winter months and to return to shallow water for breeding.

I collected it on the lower Ellis Lake, Wood County, in about the same habitat as *Notonecta ubleri*, in relatively clear as well as in turbid water. They seem to "prefer" turbid water, and can remain submerged if supports are available. Their hind legs are used as oars. Predators, they probably feed on corixids, ostracods, and insects which they can overcome. Eggs are deposited within plant tissue during the spring, and hatch in about a week. There are five instars, and the life-span is a year or more.

1350 *Notonecta ubleri* Kirkaldy, 1897

Ranges from Massachusetts and southwestward to Florida and Louisiana; known in Illinois. This is a new record for Texas: Dr. E. P. Cheatum found an individual (June 3, 1935) in Dallas County; and I found two in Wood County. February 5 and 26, 1939, associated with *Notonecta raleighi*. My locality was a rich vegetation-zone (water-cress, *Typha* and lilies), where water had a pH of 6.8. Large numbers of Crustacea and damsel-fly nymphs furnished food to *N. ubleri*; it probably also feeds from the surface film.

1352 *Notonecta undulata* Say, 1832

Its known range covers lower Canada, the entire United States and extends through Mexico and Central America to Chile. Large numbers were taken in Dallas and Henderson counties, but only a few in Kerr and Wood counties. This exceedingly pretty species varies much in color, some being nearly albinos, others being nearly black. Between these two extremes are many shades of color. I have not observed flights of this species, but the literature shows that they fly during certain seasons of the year. While in the water they are exceedingly lively, and are fast swimmers. They frequent stagnant pools and are seldom found in fresh water. Several individuals were taken from the Commerce pool. One, taken on a board about six inches from the water, was apparently "sunning" itself. When picked up it displayed plenty of activity. A swarm of "*N. glauca*" which in September, 1846, extended twenty-five or thirty miles on the headwaters of the Mississippi (fide S. G. Simpson) was doubtless *N. undulata*, according to Hungerford (1919). These nymphs are said to feed especially on ostracods and other entomostraca, and will devour each other unless isolated. Mating takes place beneath the surface, in the early spring. The eggs are glued to some submerged support and hatch in from five days to two weeks. There are five instars, found during summer and fall. In the laboratory I have observed them ovipositing on sticks and upon legs and bodies of ranatrids.

1354 *Notonecta raleighi* Bueno, 1907

Ranges from New Jersey west to Northern Illinois and southwest to North Carolina; I collected it in Wood County, where it was rare—a new record for Texas. This species resembles a dwarf *variabilis*, but can easily be distinguished by its cephalic structure. Color ranges from pearly-white to straw-yellow and black. The hemelytra are often mottled black and yellowish. Only eight specimens have been taken (Feb. 5, 26, 1939), all from the lower Ellis Lake in Wood County. The weather was rainy at the time. Two were found in flowing water and four were taken in the lake near the inlet (Feb. 5, 1939). Three weeks later two more specimens were taken in this habitat. They were found associated with *N. ubleri*; their habitat contained abundant entomostraca and algae. Water-cress, *Typha*, and pond lilies also were abundant in the lake. Towering high above the north side of the lake, and extending down to the point where these insects were taken, were great pine trees. *Notonecta raleighi* like *N. undulata* probably feed upon the small *Daphnia* and other crustacea in the tangled masses of *Spirogyra*.

1355 *Notonecta indica* Linne, 1771

Its known range is Texas, Ariz., Nev., Calif., Ore., and Utah; I took it quite generally in Dallas County in the same areas as *N. undulata* (which it much resembles) and *Buenoa margaritacea*. The species is extremely active, and its enemies probably find it hard to catch. Some larger hydrophilids may attack it when they are cornered. The species favors a habitat interlaced with sticks, leaves, and debris. A shallow pond with a brush pile is an ideal habitat for this species. Food is much the same as for other members of this genus. One was observed devouring a fly, and they probably also attack small crayfish and fishes. Bueno (1902) states that the eggs of this species (together with those of one or two corixids) are used as human food in Mexico under the name of *buantle*. (cf. Hungerford 1919, p. 168)

1361 *Buenoa albida* (Champ, 1901)

I have not collected this species, although VanDuzee reports it for Mexico and Texas.

1362 *Buenoa margaritacea* Bueno, 1908

Ranges from Vermont and Massachusetts south to Titusville, Florida, and west to South Dakota and Kansas. Taken abundantly associated with *Arctocorixa alternata* in Dallas, Wood and Henderson counties and once in Kerr County. This species was found in large numbers both in the Commerce pool (Dallas) and in Henderson County. It seems to be gregarious. The best habitat was a clear pool in Henderson County in water from three inches to a foot deep, where the mucky substrate supported watercress and various higher plants.

These little insects are well adapted to an aquatic life. They do not rest at the surface film as do most of the Notonectids but swim in the pool, and even rest in mid-water some distance below the surface. Like others of the *Notonectidae*, they must come to the surface for air. Their activities are not limited by sunshine, clouds or rain. I have not observed flight in this species, but am sure they take to the air when oviposition occurs, since the adult has been taken in habitats whither flight only could have carried it. These insects are said sometimes to resemble in color mother-of-pearl. Living individuals vary in color; some have a hemielytron pearly to lustrous, others range from white through bluish to nearly black. They feed on micro-crustacea, which they seize out with the long spines of the fore legs. When the four anterior legs are brought together they form a basket from which the insect feeds upon these minute crustaceans. Although *Buenoa* relies usually upon microscopic crustacea for food, it is also known to attack forms as large as smaller corixids. Eggs are placed within plant tissue, so are hard to find in the field. There are five instars. Adults can be taken in early spring and late fall in this area; nymphs were taken as late as November.

1363 *Buenoa platycnemis* Fieb., 1844

Recorded from N. Y., N. J., D. C., Ill., Calif., and Texas but not collected by the present writer.

1365 *Plea striola* Fieb., 1844

This species ranges through Mass., N. Y., N. J., Fla., Ill., Ia., Kan., Texas and California; it is rare in Dallas County. With the possible exception of corixids, this is the smallest of our aquatic hemiptera. Two specimens were taken near a *Typha* bed on the east side of Bachman's Lake. It has been suggested that they feed on plant juices, but Hungerford (1919) has observed them closely, and has frequently seen them eating ostracods and other small crustaceans. They are believed to overwinter as adults and lay their eggs in June.

## NAUCORIDAE Fallen, 1814

1367 *Pelacoris* spp.

This genus is new for Texas. My collections show two species; but lack of males makes determinations uncertain (*vide* Hungerford, *in litt.*) One of these was taken

in the rich vegetation of Ellis Lake, Wood County (February 4, 1939.) The other was taken in a bed of bladderwort (*Utricularia*) at San Marcos, Hays County (April 7, 1939). According to Bueno, (1903) the eggs became adults in approximately seventy-seven days. DeGeer (1773) noted that they fly at night.

1369 *Ambrysus pulchellus* Montd., 1897

Collected by Belfrage (1869-82) and recorded for Texas, but not taken by the present writer.

1371 *Ambrysus circumcinctus* Montd., 1910

Recorded for Texas.

1373 *Ambrysus melanopterus* Stal, 1862

Recorded for Texas and Arizona.

1376 *Ambrysus puncticollis* Stal, 1876

Reported from Texas and Arizona.

1378+ *Ambrysus* near *variegatus* Usinger

I have not taken this insect in Dallas County, but have collected it in Hays, Kerr, Travis and Comal counties. Of all the localities examined, that in Kerr County was the best—Wallace Creek, a stream with alternating ripples and pools in which large quantities of *Chara* and other water plants were abundant. *Ambrysus* was taken in the riffles. This was unusual, since Uhler found them in quiet waters adjacent to streams and in standing pools, especially those with abundant grass. The species is protectively colored, resembling their greenish background. In the Kerr County locality, many damsel fly naiads as well as numerous beetle larvae and ephemeropterid nymphs were present. Individuals taken in Kerr County were markedly smaller than those in Travis County. It may be that one is a variety of the other, but a large series must first be examined. Although *Ambrysus* sp. indet. does take surface food, it undoubtedly "prefers" under-surface feeding. It has been said to feed on snails; it is probably true that it feeds upon beetle larvae and damsel-fly nymphs in the *Chara* beds.

This species probably overwinters as adults, hidden in the vegetation or buried in mud. The eggs are believed to be placed upon submerged plants. I have never found eggs, although several nymphal stages were collected in early April in all the above-mentioned counties (1903). It would seem that egg laying took place late in February or early in March; it may have continued throughout the winter in the milder climate.

1378+ *Ambrysus bungerfordi* Usinger

Recorded in Comal and Kerr counties, Texas. These insects were found associated with *A. variegatus* but are not as abundant. They were taken in riffles like the preceding species, and are frequently associated with them. Oviposition is probably similar to that of *A. variegatus*.

#### NEPIDAE Latreille, 1802

1380 *Curicta bowardi* Montd., 1910

Recorded from Victoria, Texas (VanDuzee).

1383 *Ranatra americana* Montd., 1910

Distribution given for Texas, Pennsylvania and Iowa. Blatchley (1926) states that this species is a synonym of *R. fusca*.

1385 *Ranatra nigra* H. & S., 1853

Ranges from Ont. and N. Eng., west to Minn. and Kansas; south to Arkansas and Florida; common in Dallas County, Texas. Variable in size, the length of

the abdomen being 30-38 mm. and the caudal filament 19-26 mm. This ranatrid was taken in large numbers in vegetation, Bachman's Lake; and buried in the mucky substrate at the White Rock hatchery.

The individuals from the drainage ditch of the White Rock hatchery habitat were heavily parasitized. One individual upon which these water mites were counted showed 85 nymphs attached to legs, and five attached to the thorax. The meta-thoracic legs had the most parasites, and the prothoracic legs were free in all observed instances. These mites belong to the genus *Hydrachna* and are parasitic as nymphs, but release their hold and have free-swimming habits in the adult stage.

This insect swims very little. If picked up by its body it usually feigns death, but if picked up by the caudal filament, it attempts to escape (Holmes, 1906). Some of these ranatrids were taken at a depth of from one inch to one foot where they were walking on submerged cattail. On November 5, 1938, I found 36 of these ranatrids under a rock in a temporary pool. This may have indicated (a) gregariousness; (b) they may have been there for protection, since numerous fish were present; or, (c) aggregation may have been associated with lack of water and low temperature.

*R. australis* and *R. buenoi* were found in much smaller numbers under the same rock. They doubtless were feeding on some of the smaller insects as they came within grasping distance of the forelegs. They act as traps and when stimulated by food they are brought together with great force and speed. Swammerdam's (1737/8) account, based on work done about 1660, says "it destroys like a wolf among sheep, twenty times as many as its hunger requires". I believe this insect is a general feeder and killer. Its raptorial attacks are instantaneous, reflex-like; therefore, they probably kill much fish food as well as fingerling fishes. When drouth comes this species probably burrows deep into the mud, and remains in a torpid state until the water supply is renewed. It shows pronounced color variation; those collected in a zone rich in vegetation show distinct greenish tinge; while those collected in dead grass have a corresponding color; and those collected in a limestone habitat are light in color. The eggs are said to be deposited within plant tissue. In the laboratory, this species fed on corixids, cockroaches, moths and flies. I have observed the mating behavior of this species neither in field nor laboratory. Field-records show little seasonal change in regard to numbers. From laboratory observations it appears they are primarily nocturnal. They hide under leaves in daytime and at night are found in the open aquarium with fore legs extended awaiting some unfortunate victim.

(1386+) *Ranatra buenoi* Hungerford, 1923

Blatchley reports this species as Southern, from Missouri to Florida, Louisiana and Texas. Recorded from Dallas County in October and November. Its habitat is similar to the preceding form, and it is not abundant in this area.

(1386+) *Ranatra australis* Hungerford, 1923

Typically Southern; North Carolina and Florida, west to Kansas, Louisiana and Texas. This species has been collected in the open water of Bachman's Lake, and in stagnant pools with abundant vegetation in the immediate vicinity of the lake. All collected species of this genus seem to "prefer" the same type of habitat. They have been taken from clear water, but seem more abundant in turbid water. *R. australis* is strictly a predator in feeding habits.

#### BELOSTOMATIDAE Leach, 1815

1387 *Benacus griseus* (Say, 1832)

VanDuzee gives records for Quebec, Ont., most of the northeastern states, central states and as far south as the West Indies. It is said to occur in sluggish waters of ponds and streams. During the mating season (which is early summer) it is attracted to electric lights. Hidden in protected places, it awaits the approach of food in the form of frogs, minnows, etc. It grasps its prey with its powerful

prothoracic legs, and sucks the blood. Eggs of *B. griseus* are large and spherical; and are attached to stems of rushes and other water plants.

1388 *Lethocerus americanus* Leidy, 1847

Ranges from Quebec, Me., Mass., Conn., N. Y., N. J., Pa., Va., Ohio, Tenn., Ill., Mich., Minn., Colo., Texas and California. It is recorded in Texas from Jefferson, Wharton, Dickinson, Hidalgo, Bell, Brazos, Dimmit and Dallas counties. After *Benacus griseus*, this is the largest of the aquatic Hemiptera, varying from 45 to 60 mm. in length. Perhaps the best collecting for this "giant electric-light bug" is found at lights near low lands. Since L. O. Howard in 1900 took one from under ice, they probably overwinter as adults. In the early spring of 1938 I collected a large number at electric lights near White Rock Lake. Matheson (1907) tells of a flicker's being attacked by a belostomatid, which inserted its beak on the back of the bird's head and clamped its legs about the bird's beak. Without doubt, these insects are the most predaceous of all the aquatic insects; they have been known to attack frogs, fish, snails and many other kinds of animals. They must do considerable harm wherever they occur in abundance. The feeding habits are much the same as those of *Benacus griseus*. Two egg masses, attached to the under surface of a board in rich vegetation were taken near Dallas in 1934 by Dr. E. P. Cheatum.

One contained sixty-eight, the other sixty-one eggs. The life-history of this insect is not well known.

1392 *Lethocerus annulipes* (H. S., 1846)

Recorded for Texas, Colorado and California; similar to *L. americanus* in habits.

1393 *Belostoma fluminea* Say, 1832

Its known range extends from Quebec and New England, west to Manitoba and Colorado; southwest to Florida, Louisiana and Arizona. This, our most common species in the Dallas area, is found active throughout the winter months. During early winter, many nymphs were found in *Chara* at Bachman's Lake. Many adults have been found in the drainage ditch from the brood ponds of White Rock fish hatchery, clinging to leaves near the bank, apparently hiding during the day. The individuals (nymphs) taken near White Rock Lake are heavily parasitized with the red water-mite *Hydrachna*. These attached specimens superficially look like well-fed lice, except that they are nearly legless and the body is not divided into distinct regions. The nymph parasites after feeding upon their hosts, release their hold and swim freely in search of food and a place to deposit their eggs. Dr. Ruth Marshall, the specialist to whom I sent the mites, could not identify the species; and the life-history is not known. As for the host,—*B. fluminea* doubtless feeds on any organism in the pool which they can overcome. They even attack and suck blood from their own young. Undoubtedly this species, as a predator, is of economic importance to fishermen. One male, taken in Travis County early in April, had a number of freshly-laid eggs on his back; a female was also taken in the same dip. The life-span of this species extends a little over a year. In the laboratory they ate with relish moths, cockroaches, flies and reduviids. Laboratory experiments show that they are usually photo-negative; but a few reacted positively to bright light. This is contrary to their behavior during the mating season, when they fly from one body to another and are attracted to electric lights. Probably physiological changes and conditions that occur during the breeding season causes the reversal in the sense of the reaction.

1394 *Belostoma lutarium* (Stal, 1855)

Reported in R. I., N. Y., N. J., N. C., Fla., and Texas; taken in Dallas County in vegetation-zones at Bachman's Lake and the White Rock fish-hatchery. Similar to *B. fluminea* in many respects but *lutarium* ranges southward. They are about as abundant near Dallas as the preceding species, and are usually found in the

same habitat throughout the year. During October a large percentage of nymphs were found in dense beds of *Chara* near Dallas. Their color varies with their background; those taken from beds of rich vegetation are nearly green, while others taken among dead leaves are brown. Food and breeding habits and reactions to light are similar to those of *fluminea*. Mating takes place in the water, and lasts intermittently for hours. The eggs are placed on the back of the male and hatch in about two weeks. There are five instars and under favorable conditions the adult lives a year or longer.

1396 *Belostoma bifoveatum* (Hald., 1852)

Reported for Texas, from the vicinity of Fort Gates (present Gatesville, in Coryell County, *type locality*.) It was collected by Lt. Horace Haldeman of the army post at Ft. Gates. [See Stansbury, *Report on the Great Salt Lake*, 1853, p. 370.]

1399 *Belostoma fusciventris* (Duf., 1863)

Reported as occurring in Texas, New Mex., Ariz., and California.

1401 *Belostoma testaceum* (Leidy, 1847)

Reported in N. Y., N. J., Pa., D. C., N. C., S. C., Michigan and Texas: Collected at Gatesville, Coryell County, by Lt. Horace Haldeman, in the early 1850's. Cf. S. S. Haldeman's "*Zaitba rectulata*" (1853) [= *Belostoma testaceum* (Leidy, 1847).]

1402 *Abedus ovatus* Stal, 1862

Recorded for Texas, New Mex., Ariz., as well as Mexico.

1403 *Abedus breviceps* Stal, 1862

Two specimens from Dallas County, one of which was collected in 1935, the other July 4, 1934. This insect is raptorial and can make a severe wound. It is believed they make a chirping noise by means of the renal spiracles. Feeding habits are similar to those of *Belostoma*. Oviposition may last for two nights and as many as seventy to one hundred and seventy-five eggs are deposited on the back of the male. The male aerates the eggs by raising his wings to allow a good circulation of air. These eggs hatch in ten to twelve days and the male rises to the surface where the young emerge. The life-span of the species is probably over a year.

GELASTOCORIDAE Kirkaldy, 1887

1408 *Gelastocoris vicinus* Champ., 1901

VanDuzee lists it from Southern and Western States.

1409 *Gelastocoris variegatus* (Guer., 1844)

Range; Maryland, Florida and Texas; south and west throughout Mexico, the West Indies, Central and South America (Uhler & Champion.)

1409+ *Gelastocoris cucullatus* Martin,

This species is not listed by Blatchley, Hungerford or VanDuzee. It is probably a southern species, I have taken it in Dallas, Hays, Kerr, Comal, Kendall and Williamson counties, Texas. Near Dallas, it was the most abundant, and perhaps the only species of this genus. It occurs along shady banks, mud flats and on leaves in damp areas, being most abundant at the upper locality at White Rock Creek, and at Elam Springs. The body superficially has a dirty, warty appearance; but closer observation shows it mottled with many colors. The color of *G. cucullatus* is highly protective, and it is very difficult to see them unless they move. The males of our common forms show the more vivid red markings. The females are usually drab and variegated. Color varies with the substrate upon which these insects live, ranging from drab to nearly black, some even showing a greenish tinge. On limestone, they are nearly white.



Although adapted for flying, it is doubtful if this species can use its powers of flight to advantage. *Gelastocoris cucullatus* and *rotundatus* both hide in crevices while awaiting the approach of insect prey, and at the appropriate time pounce upon it with the ferocity of a lion. One which I found sucking the juice from a grouse locust, jumped several times a distance of three or four inches with the captured specimen in its prothracic legs before it was captured. I brought both into the laboratory and, within an hour after the insects were taken, found the weight of the prey 35 mg. and the toad bug 44 mg. These data illustrate not only the ferocity but also the strength of these tiny insects. Uhler found little food-discrimination; they seize the larvae of ground beetles and almost any other kind of insect which comes their way. Hungerford tells of one insect that held half a dozen lace-bugs at one time. This species was taken March 11, 1939, when mating was at its height. Males were deep red in color, merging with the background. During March, large numbers mated on the sunny bank of White Rock Creek. They have also been observed mating throughout April, in other habitats. Mating continues for hours, and the female can jump nearly as far with the male on her back as when unencumbered. It has been stated that they oviposit in the ground, but I have never observed this. Of 500 specimens taken, none has been in a nymphal stage. They probably overwinter in some protected area. I was able to keep them alive in the laboratory but found no eggs or nymphs in such cultures.

1409 *Gelastocoris rotundatus* Champ.

Eight specimens were taken in Kerr County, Texas. I believe this a new record for Texas. Neither VanDuzee, Hungerford, nor Blatchley record it for Texas. A few scattered individuals were taken among rocks on the bank of Wallace Creek in Kerr County. They too, blend well with their background. This species is less active but more wary than *G. cucullatus*. They probably feed on small carabids and insect larvae like the preceding species. Little is known of the life history.

OCHTERIDAE Kirkaldy, 1906

1412 *Ochterus americanus* (Uhler, 1876)

Range extends from Massachusetts and New York, west to Illinois, Nebraska, and Kansas; southeast to Florida and Cuba, and southwest to Texas and Arizona. It was taken in Dallas County, and was also found among plants brought to the laboratory from a bog in Anderson County. It may have been transported in the egg stage. Uhler states that this is a gay, active little insect, living among grass and weeds on margins of brooks and ponds from Massachusetts to Texas. The legs are slender and fitted for running, but not adapted for seizing and holding prey. The beak is sharp as a fine needle, a deadly probe, extremely thick and stout at the base.

CORIXIDAE Leach, 1815

1417 *Callicorixa kollarii* (Fieb., 1851)

Recorded for Canada, Mass., Pa., Fla., Texas and Alaska.

1420 *Arctocorixa abdominalis* (Say, 1832)

Recorded by VanDuzee for Texas, California and Mexico.

1421 *Rambocorixa acuminata* Uhler, 1897

Recorded from northern Illinois, Missouri, Kansas and Texas (Eastland County). I found it in Dallas, Henderson and Wood counties. This species is known in literature and in VanDuzee's checklist and catalogue as *R. balanoidis* Abb. My specimens are described by Hungerford as *R. acuminata*. It is the most abundant of our corixids and is doubtless the most abundant of the aquatic Hemiptera. Under favorable conditions (mucky substrate, plenty of food and two to six inches of stagnant water) these insects multiply like flies. On January 21, 1939, they were observed so abundantly in certain little bays at "Uncle Jack's Place" near Seagoville, that an estimate of numbers was made. Random sampling justified the estimate that there were nearly nine corixids per cubic inch of water. The area considered was nine feet long and four feet wide; the water averaged four inches in depth. The

number of corixids in this neck of water was, therefore, approximately 140,000; surely a very good place for a fish to dine!

While truly aquatic, these insects occasionally do leave the water. Conditions under which flight occurs are lack of oxygen in the water, over-dense population, mating activities, and unfavorable circumstances. In the borrow pit in which this species was so abundant the pH was 8.3 and the oxygen ran 9.4 ppm. Since they fly much at night, probably only few of these insects get back to their native habitat. Some undoubtedly get back to water but most of them perish in their night activities, especially if they come near lights. I have taken this species at night at my desk on the third floor of Hyer Hall in May. Therefore it seems probable that they can fly some distance, since the nearest habitat, the Commerce pool, is 150 yards away.

Some of our corixids are parasitized by the water mite *Hydrachna*. Since only a few were parasitized, this infestation is probably not of much importance. Little is known of the life-history of these ectoparasitic hydrachnids, but I have raised them to the free-swimming stage.

Corixids feed very largely on *Spirogyra* and other filamentous algae, which prove excellent food. I observed corixids scooping up ooze from the bottom where were abundant Euglena, diatoms, desmids and other algae, and ciliates. Since other organisms were few in numbers in this locality, it seems safe to assume that the corixids were feeding upon these microorganisms, as Dr. Hungerford has suggested elsewhere. Eighty-one per cent of the individuals of *R. acuminata* taken in the borrow pit were females. This is based on 65 individuals taken at random from a lot of about 1400. I counted the number of well-developed eggs in fifty females, and found from none to twenty eggs in each, (the average being eight). Abbott (1912) states that they lay their eggs upon crayfish, and that he has found as many as 3,000 eggs on one crayfish (cf Blatchley, 1926, 1067.) When placed in a battery jar, female *R. acuminata* began to lay eggs on willow leaves. A wire screen was placed in the jar for support. The next day there were large numbers of eggs laid on the wire, most abundantly at depths of two to four inches, and in gradually diminishing numbers to the bottom of the 7½ inch jar. They hatched in eight to nine days at room temperature and the adults died soon thereafter.

The abundance of corixids make them valuable as food for certain predatory fishes. The stomach and intestine of one 11.5 inch bass contained six corixid heads, twelve mesothoracic wings, nine corixid eggs within the abdomen of a corixid, and perhaps twelve other eggs. The problem as to what effect if any the digestive juices have upon the eggs of corixids, I have not had time to work out. Corixids are also preyed upon by many other aquatics—even by members of their own group.

Thomas Gage (1625), a traveler in Mexico, mentioned the sale of cakes made of a "kind of froth" from the Mexican lakes. Thomas Say (1832) found adult corixids an article of food in the Mexico City. Guerin Meneville (1857) published a long account on this subject in some five journals, and Virlet d'Aoust (1858) also gave a similar account. According to the story, bundles of rushes are placed in shallow lakes and upon them eggs (termed by the Mexicans "anayactl" or waterface) were deposited, collected, and made into cakes. These also are eaten *au naturel* or with green chiles. They look like fish roe when cooked and are called "*Aubaubtl*?" or water wheat. (cf. Hungerford, 1919, 36-37.) Corixids undoubtedly do more good than harm in the waters of our lakes. Their prolific reproductive capacity makes them an excellent source of fish food and, since they do so little damage, they probably are the most beneficial of the aquatic Hemiptera.

#### 1422 *Arctocorixa alternata* Say, 1825

Ranges from New England, west to Illinois and southwest to Missouri; Van Duzee includes Florida. It was abundant in Dallas County during the entire collecting period. It occurs in a variety of waters, such as stagnant pools, running streams in which grass is plentiful, and in most every pool which is at least two months old. They seem to favor sluggish, dirty water; but also occur abundantly

in clear water. Although this is one of our most abundant water bugs in the fall, Blatchley (1926) does not mention the species as occurring south of Missouri. The food of *A. alternata* probably consists of rotifers, oligochaetes, nematodes, Protozoa and Algae. The species overwinters as adults and the nymphs can be taken early in March in this area. Copulation takes place beneath the surface and, as in most aquatic insects, lasts for hours. Oviposition begins shortly thereafter, and continues for a number of days; Hungerford states the first eggs even hatch before the last are deposited.

1424 *Arctocorixa calva* (Say, 1832)

Van Duzee lists it for Ont., Me., Mass., Pa., Colo., Texas and Alaska.

1427 *Arctocorixa dispersa* (Uhl., 1875)

Occurs in Texas, Nevada and California.

1436 *Arctocorixa inscripta* (Uhl., 1894)

Recorded in Texas, Colo., N. Mex., Arizona and California.

1440 *Arctocorixa laevigata* Uhler, 1893

Recorded by Hungerford from Rhode Island, New Jersey, and Maryland; also described from Utah and California. One specimen was taken December, 1938, in the drainage ditch of the White Rock fish hatchery, in a rich bed of *Myriophyllum*. The water of the ditch was about two feet deep, and the muck was about a foot deep. The water was clear with a temperature of 64°.

1445 *Arctocorixa pectenata* Abbott, 1913

Blatchley records it only from Marietta, Georgia. I took one specimen in abundant vegetation in the upper end of lower Ellis Lake, Wood County, Texas.

1444 *Arctocorixa minor* Abbt., 1913

Recorded by VanDuzee as a variety of *A. nitida*, which is found in Me., Md., N. C., and Ga. Six specimens were taken February 26, 1939, in a very muddy pool with waterlilies, cattails and *Spirogyra*, in Wood County. Two were taken from the upper Ellis lake (February 4, 1939), in water with pH of 6.9, associated with the crustaceans *Daphnia*, *Asellus*, and *Gammarus*. This species has not been found near Dallas; and is not abundant in February in Wood County one hundred miles east of Dallas. Their food probably consists of filamentous algae.

1457 *Arctocorixa stigmatica* (Fieb.) 1851

VanDuzee lists it as a North American species.

1460 *Arctocorixa compacta* Hungerford

Taken in Uvalde County, Texas, according to records at Texas A. & M. College.

1462 *Palmacorixa buenoi* Abbot, 1913

Ranges from Massachusetts and New York west to Michigan, and Kansas and south to North Carolina, Georgia and Texas. Taken in Dallas, Wood and Henderson counties. At Dallas, these insects were taken from the influent stream of Bachman's Lake. This particular habitat was grassy and in it were numerous snails, shrimp, odonate naiads, dytiscids, and halipids. The outlet of the lake also contained a few specimens. This species was found throughout the period of my study.

*Graphocorixa gebardi* Hungerford

Taken April 3, 1934, and June 6, 1935, in Dallas County by Dr. E. P. Cheatum. This is the only Texas record to my knowledge.

*Coriscella edulis* Champ.

I have found this species in Dallas County; the collection at A. & M. College also has individuals from Hidalgo County. Many individuals of an average-sized

form were found abundantly in a roadside pool, December 5, 1938. This pool contained various plants and grasses, and a small amount of *Spirogyra*. *Coriscella edulis* has been found in Bachman's Creek, White Rock spillway and Bachman's spillway. They frequent clear water, feed much the same as other corixids, and appear to overwinter as adults in this area.

*Morphocorixa compacta* Hungerford

I found this species in Wallace Creek in Kerr County, April 8, 1939. A number of adult individuals were taken in a spring-fed pool containing much *Spirogyra* and detritus. Their food probably consists of algae, microcrustacea and immature insects. Since all specimens taken were adults, they probably overwinter in the adult stage.

1469 *Trichocorixa* sp. Kirk., 1908

Listed from Hidalgo County in the Texas A. & M. College collection.

### SUMMARY AND CONCLUSIONS

(1) A brief study (September, 1938-April, 1939) of aquatic and semi-aquatic Hemiptera of the Dallas region has been made, and bionomic notes of species from diverse habitats presented. Collections were also made in various counties of Central Texas.

(2) This paper lists 33 genera and 71 species (25 genera and 41 species in *my own* collections) for Texas. Of these 71 species, 26 were not recorded as Texas forms by Van Duzee (1917), Hungerford (1919), or Blatchley (1926).

(3) Since lack of time prevented identifications of the veliids, saldids, and hebrids, they could not be included in the present paper; hence this checklist is incomplete for Dallas County.

(4) Two new records of notonectids (*Notonecta uhleri* and *N. raleighi*) were taken for Ellis Lake, Wood County, during February, 1939.

(5) Two species (*Treptobatus knighti* var. D. & H. and *Lemnogonus hesione* Kirk) previously reported as lacustrine were found in *flowing streams*.

(6) Although most of the species were found throughout the year, a few species were missing from our winter collections.

(7) The habitat presenting most diverse fall collecting was that at Bachman's spillway. For winter collecting, the drainage ditch of the White Rock hatchery proved best, giving (among a large number of species) several *Belostoma flumineum*, *B. lutarium*, *Ranatra nigra*, and *Arctocorixa alternata*. The best spring collecting at Dallas in number of species was the influent stream of White Rock Lake, with many gerrids, gelastocorids, veliids, and corixids.

(8) One of the best collecting areas visited in the state was at San Marcos (early April, 1939).

(9) Economically, belostomatids and ranatrids were found to be very destructive to aquatic life; corixids were of importance as food for insects, fish, and man.

(10) The most populous area was at "Uncle Jack's Place" near Seagoville, with nearly nine *Ramphocorixa acuminata* per cubic inch of water space. Reproductive capacities seem high for this species, since the average number of eggs was found to be ten.

(11) While all species are at least in part carnivorous, Hungerford gives records of some which feed upon some vegetable (algal) material.

(12) Insects from the White Rock hatchery drainage ditch were heavily parasitized with *Hydrachna*; this did not seem to prove harmful to the host.

(13) Copulation in most of the aquatics usually lasts for an hour or more.

(14) *Ranatra* (said to hibernate gregariously in the north), was found singly in various habitats, throughout the winter.

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