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The Bionomics of the Culicidae of the Dallas Area¹

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Little work has been done on Texan mosquitoes. In 1922 Dyar listed 43 species from Texas, 10 of which were recorded from near Dallas. Cushing (1934) listed the mosquitoes of Brazos County. McGregor & Eads (1934) in their work on the mosquitoes of Texas, divided the State into 17 approximately equal areas. They gave a total list of 54 species, of which 19 were reported from the area that included Dallas County. Fisk & LeVan (1941) published notes on the mosquitoes of Brownsville. The State Health Department of Texas published (1944) a booklet, "The Mosquitoes of Texas", which is the most complete work on the mosquitoes of the State. It included keys and descriptions, as well as ecological and distributional notes on the 75 species listed. O'Neill, Ogden, & Eyles (1944) supplemented McGregor & Eads' list with nine species. Hollingsworth (1948) listed the mosquitoes from the neighborhood of Nacogdoches.

True mosquitoes belong to the order Diptera, family Culicidae, subfamily Culicinae. They are small, slender, 2-winged, soft-bodied insects with the body and appendages covered with hair-like scales. They have a wing expanse varying from 2.5 to 15 mm. Each wing has six horizontal veins that extend to the margin. These are covered with scales, and the wing margin is fringed with hair-like scales. Mosquitoes range in color from gray through the browns to black. Lighter colors give distinct markings. Mouth parts are modified for piercing and sucking. The antennae are composed of fifteen segments, the sensory antennal hairs are arranged in whorls, and these hairs are more dense in the

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male than in the female. Mosquitoes have complete (holometabolous) development.

Life Cycle.—In a general way the life histories of all mosquitoes are similar, but in detail very dissimilar. Mosquitoes go through four distinct stages in their life cycle: egg, larva, pupa, and adult. These are summarized as follows: (1) *Egg.* Mosquito eggs are variable in size and shape. The number laid usually varies from 40 to several hundred. They may be laid singly or in rafts. *Psorophora* and many *Aedes* lay their eggs singly in moist or dry depressions in the ground where they remain until moisture covers them. They may remain viable for months or even years in the dry state. (2) *Larva.* All mosquito larvae are aquatic, although air-breathers. The genus *Mansonia* extracts oxygen from air spaces in submerged plants. Other genera secure their oxygen through the surface film. Species living in fresh water far outnumber those living in brackish water. Sixteen hours to four days are required for incubation. During growth the larva molts four times before pupation. Larval life varies from five days to several months depending on species, temperature, and quantity and quality of food. Except for *Psorophora* and Megarhinini larvae (which are carnivorous and predaceous) mosquito larvae feed on microscopic organisms and detritus. Currents of water are set up by the mouth bristles and bits of food are swept into the mouth. *Anopheles* larvae usually feed on the surface, while Culicine larvae feed below the surface.

(3). The pupa is a non-feeding stage in which reorganization and development proceed at a rapid rate. Unlike the pupa, the larva is heavier than water and requires muscular effort to ascend. The pupal stage lasts rarely more than three days. (4). *Adult.* Time of emergence is a critical time in the survival of the species. Emergence is accomplished by intake of air and increased muscular action. A split occurs in the pupal skin over the region of the thorax and the adult emerges. The whole process is completed in a very few minutes. The adult may rest for several hours, during which the cuticle hardens and its characteristic color pattern appears. The adult then flies away to feed and breed. The female usually lays eggs within a few days after emergence.

Habits and Habitat.—Adults vary greatly in their time of

activity. Most species of the temperate region are nocturnal in habit. This category includes the house mosquito of the South (*Culex quinquefasciatus*) and some *Aedes*. Others, such as the yellow fever mosquitoes (*Aedes aegypti*) and all members of the Tribe Megarhinini, are diurnal in habit. Some mosquitoes, particularly the genus *Anopheles*, are crepuscular in habit.

Adults may be grouped according to their food preferences. Those mosquitoes that attack any vertebrate animal are termed "zoophilous" (some *Culex* and some *Anopheles*). Those mosquitoes that show a preference for human blood are termed "anthropophilous." Most *Anopheles*, many *Aedes* (including *aegypti*), and other domesticated species fall under this heading. Mosquitoes that feed on plant juices and nectar are termed "phytophilous." This group includes the males of all species and members of the Tribe Megarhinini.

The different species of mosquitoes vary in their choice of an oviposition site. Some species show little preference; whereas others show great care in the selection of a site for egg laying. I observed a loss of selection by some species during dry periods. One species (*Anopheles quadrimaculatus*), commonly thought to oviposit only in slow-flowing, clear streams was found ovipositing in muddy, standing water. Some Culicine species believed to oviposit in standing water were found ovipositing in slow-flowing streams. Sites chosen may be any one of the following: swamps, slowly-flowing streams, holes in trees, hoof-tracks, temporary or permanent pools, moist or dry depressions in the ground, artificial containers, etc. Normally, the mosquitoes of the Dallas area prefer a shaded or semi-shaded site for oviposition.

In tropical and temperate regions many species pass the winter in the adult stage. Females hibernate in trees, caves, cellars, barns, and under bridges and similar shelter. Most larvae cannot withstand freezing. Many warm-climate mosquitoes, and all northern species, pass the winter in the egg stage. Chandler calls this the common method of hibernation.

Sexual behavior in mosquitoes is interesting, and varies among the species. The males of most species swarm just before mating occurs, usually toward evening. They hover over some tall object as a lamp post or tree-top. Females fly into the swarm and pairing occurs. Swarms of mixed species

have been reported. In some species the males actively seek out the females. *Aedes aegypti*, for example, mates on the wing during daylight. Normally, only one mating is required for the female.

Length of Life.—This is very difficult to determine in the mosquito's natural environment. *Culex* adults are short-lived. Individuals of *Aedes aegypti* have been kept alive for five months under artificial conditions. It is generally thought that females are longer-lived than males. The more favorable the condition, the shorter the life span. Females die soon after completion of egg laying. Those species that lay eggs at intervals are longer-lived than those that lay all eggs in one batch.

Economic Importance.—Mosquitoes are directly associated with the transmission of several important human diseases. They are the sole vectors of four diseases: malaria, yellow fever, dengue fever, and filariasis. They may also transmit equine encephalomyelitis and myiasis. Frequently, real-estate values have been lowered where mosquitoes are present in large numbers.

Field and Laboratory Methods.—Collections were made at favorable locations near Dallas. Many types of mosquito breeding habitats were visited. Collections were made during the period of March to August. Equipment used for collection of larvae included a white enameled dipper, a small jar for each collection site, labels and a notebook. During July a New Jersey light trap was employed. Adult mosquitoes were taken in their resting places, and while feeding, by use of a chloroform killing-jar.

Larvae were reared to the adult stage in the collection jars. After allowing the newly-emerged adult to harden for twenty-four hours, it was killed and mounted on a small paper triangle in the usual manner. This proved to be an excellent method of mounting.

Adults were identified by use of Matheson's keys (1944, *Handbook of the Mosquitoes of North America*) and the keys of Randolph and O'Neill (*The Mosquitoes of Texas*). The latter proved to be the more useful.

KEY TO THE SUBFAMILY CULICINAE OF THE DALLAS AREA

The key below has been prepared with a view to quick classification of the 21 species referred to in this paper. It is not designed to be a comprehensive key. The worker who collects mosquitoes elsewhere will

probably find Matheson's keys (*Handbook of the Mosquitoes of North America*) or those in *The Mosquitoes of Texas* more useful.

KEY TO ADULTS

- 1a. Scutellum evenly rounded, marginal setae evenly distributed... 2
 1b. Scutellum trilobed, marginal setae grouped on each lobe
 —(Tribe Culicini)— 6
- 2a. Apical half of proboscis curved downward, large iridescent species.....(Tribe Megarhinini) *Megarhinus septentrionalis*
 2b. Proboscis straight, moderate sized species, wings usually spotted
 —(Tribe Anophelini)— 3
- 3a. Wings entirely dark scaled.....*Anopheles quadrimaculatus*
 3b. Wings with areas of white scales..... 4
- 4a. Costal margin dark except at extreme tip.....*Anopheles curicans*
 4b. Costal margin with a white spot at outer third..... 5
- 5a. Wing fringe white-spotted only at the end of veins 1, 3, and rarely 5,2.....*Anopheles punctipennis*
 5b. Wing fringe white-spotted at the end of each vein
 —*Anopheles pseudopunctipennis*
- 6a. Postspiracular bristles absent..... 7
 6b. Postspiracular bristles present.....14
- 7a. Spiracular bristles absent.....(Genus *Culex*)— 8
 7b. Spiracular bristles present.....(Genus *Culiseta*) *Culiseta inornata*
- 8a. Tarsal segments banded with white..... 9
 8b. Tarsal segments not banded with white.....10
- 9a. Proboscis banded with white, palpi tipped with white
 —*Culex tarsalis*
 9b. Proboscis not banded with white, but pale ventrally, palpi entirely dark.....*Culex coronator*
- 10a. Abdomen with very narrow apical bands.....*Culex apicalis*
 10b. Abdomen with basal bands or none.....11
- 11a. Abdomen with distinct bands.....12
 11b. Abdomen without distinct bands.....13
- 12a. Pleura with spots of white scales, scales at fork of vein 2, long and slender.....*Culex salinarius*
 12b. Pleura without spots of white scales, scales at fork of vein 2, short and flat.....*Culex erraticus*
- 13a. Abdominal bands rounded posteriorly, second marginal cell not over three times as long as its petiole.....*Culex quinquefasciatus*
 13b. Abdominal bands not evenly rounded though somewhat irregular, second marginal cell four to five times as long as its petiole
 Culex restuans
- 14a. Spiracular bristles absent.....(Genus *Aedes*)—15
 14b. Spiracular bristles present.....(Genus *Psorophora*)—18
- 15a. Tarsi banded with white.....16
 15b. Tarsi not banded with white.....17
- 16a. Mesonotum dark with a silver lyre-shaped pattern, scutellum white scaled.....*Aedes aegypti*
 16b. Mesonotum and scutellum dark scaled.....*Aedes vexans*
- 17a. Mesonotum with a median dark line bordered by two silvery lines, legs dark including tip of femur.....*Aedes trivittatus*
 17b. Mesonotum with a median dark line which widens posteriorly, legs dark except tip of femur which is white scaled.....*Aedes triseriatus*
- 18a. All tarsal segments white banded basally.....19
 18b. Fourth and fifth tarsal segments entirely white—*Psorophora ferox*
- 19a. Mesonotum entirely covered with scales, with a median yellow line.....*Psorophora ciliata*
 19b. Mesonotum with bare areas, without a median yellow line.....20
- 20a. Abdomen distinctly banded, tibia with a row of white spots
 Psorophora confinnis
 20b. Abdomen without distinct bands, tibia with mixed black and white scales.....*Psorophora discolor*

ECOLOGICAL ACCOUNT OF THE SPECIES

Tribe Anophelini

Genus *Anopheles* Meigen*Anopheles curicans* Wiedemann

Only one specimen was collected. It was associated with Culicine larvae early in May in a small rock-lined fish pond.

Anopheles pseudopunctipennis Theobald

One adult was taken in a privy near Wahoo Lake in early August. The larvae had previously been taken from the lake in large numbers.

Anopheles punctipennis (Say)

This species is the most common and widespread *Anopheles* in the Dallas area. It was collected from early May to August, frequently with Culicine larvae. The larvae were taken in clear water, both slow-flowing and standing, and usually in a shaded or semi-shaded area. Adult specimens were taken in resting places, such as public toilets, especially near Bachman's Lake and Wahoo Lake. One specimen was taken in a light trap.

Anopheles quadrimaculatus Say

This species was first taken in early July from Wahoo Lake. The larvae were among a dense growth of *Ceratophyllum*. Several adults were taken in late July while they rested in toilets near Bachman's Lake and Wahoo Lake. Several larvae were taken from a standing, muddy pool on Forney Road. Although they tolerate muddy water, these larvae more frequently are found in clear streams and pools.

Tribe Culicini

Genus *Aedes* Meigen*Aedes aegypti* (Linnaeus)

This species was collected in late July at a residence in south Dallas. The larvae were collected from a small metal chicken-feeder which had been placed under a pile of boards. Psychodid larvae and *Chironomus* larvae were present though in smaller numbers.

Aedes triseriatus (Say)

This diurnal species was taken in mid-July in a wooded area at the south end of Alaska Street, Dallas. Other specimens were taken from Kessler Swamp in early August, while attempting to feed. This species is a tree-hole breeder, but no larvae were taken.

Aedes trivittatus (Coquillett)

Larval specimens were taken in mid-May from a grassy-margined tire track by the roadside on Lawther Drive. An adult specimen was taken in a wooded area at Clarendon and Marsalis streets in early July.

Aedes vexans (Meigen)

One specimen was taken in early May from a rock-lined fish pool on Bryan Street near downtown Dallas. It was found associated with other Culicine larvae and *Anopheles curicans*.

Genus *Culex* Linnaeus*Culex apicalis* Adams

One individual was taken early in July in a water hole at Coombs Creek Road and Illinois Street, Dallas. The pool had sparse vegetation, and was clear and shaded. Other Culicine larvae and *Anopheles punctipennis* were found associated with it.

Culex coronator Dyar & Knab

This species was collected along with *Culex apicalis*, *C. erraticus*, and *Anopheles punctipennis* at Coombs Creek Road and Illinois Street early in July. The pool was shaded, and the water was clear and standing.

Culex erraticus (Dyar & Knab)

This species was collected along with *Culex apicalis*, *C. coronator*, and *Anopheles punctipennis* early in July at the same locality noted for *C. coronator*, above. Adult specimens were taken while they rested in a toilet near Bachman's Lake in late July.

Culex quinquefasciatus Say

This species was collected during the period from May to August. This species and *C. tarsalis* were the most abundant and widespread *Culex* in the Dallas area. *C. tarsalis* was found in greater numbers in early summer and *C. quinquefasciatus* in late summer. Larvae were taken from a horse-trough, a small can of stagnant water, and water-holes in wooded areas. Oviposition sites were generally well shaded with the exception of the horse-trough at the zoo which was shaded only a part of the day. Adult specimens are commonly taken in houses.

Culex restuans Theobald

This species was collected from March to August, although

more prevalent in early summer. It is widespread around Dallas. Oviposition sites were shaded or semi-shaded (except for a temporary pool by the side of an unfinished building at the end of Vickery Boulevard). Larvae were found in large and small artificial containers, forest pools, temporary pools, and over-flow pools with grassy margins. Adults were taken while they rested in a toilet near Bachman's Lake.

Culex salinarius Coquillett

Specimens were taken during the period of March to August. Larvae came from temporary pools with grassy margins. Adults were taken from Bachman's Lake as they rested.

Culex tarsalis Coquillett

This species was collected from March to August, but was found in greater numbers in early summer; *Culex quinquefasciatus*, however, was collected in greater numbers in late summer. Larvae of *C. tarsalis* were found associated with other Culicine and Anopheline larvae. They were taken from a rock pool, a temporary roadside pool, and from a temporary pool under a water tower at Owens and Wilkes Streets. Adults were collected while they rested in large numbers from a toilet near Bachman's Lake.

Genus *Culiseta* Felt

Culiseta inornata (Williston)

Only one species of genus *Culiseta* was found to occur near Dallas. One larval specimen was taken early in March from a rock pool on Bryan Street near downtown Dallas. An adult was taken in mid-April from a lighted porch near Elam, Texas. This species is relatively rare near Dallas, at least during the period of April to August.

Genus *Psorophora* Robineau-Desvoidy

Psorophora ciliata (Fabricius)

One adult was taken in early June from a screen covering a lighted window in Kleberg, Dallas County, Texas. This species is large, and the females are vicious biters. It is relatively rare near Dallas. The larvae are predaceous; none was collected in the present study.

Psorophora confinnis (Lynch Arribalzaga)

Larvae were collected with *Anopheles punctipennis* in early July in Irving, Texas, from a muddy-bottom water-hole

with no marginal vegetation. One specimen was taken from a light trap in late August.

Psorophora discolor (Coquillett)

One adult specimen was taken while feeding in mid-May in the 5100 block of Harry Hines Boulevard.

Psorophora ferox (Humboldt)

Larvae were taken in early May from a temporary forest pool in the Forest Hills section. Larvae were also taken from a temporary grass-margined pool near White Rock Lake. One adult was taken in the 600 block on Winston Street.

Tribe Megarhinini

Genus *Megarhinus* Robineau-Desvoidy

Megarhinus septentrionalis Dyar and Knab

One female specimen was taken in the 600 block on Winston Street, in mid-May. She was apparently trying to oviposit in a water barrel.

SUMMARY AND CONCLUSIONS

1. Collections of both larval and adult mosquitoes were made during the period of March to August in favorable locations in the Dallas area. Distributions and habits of the mosquitoes of the area are given.

2. The Table below contrasts results of present collections with those of Dyar, and McGregor & Eads. The work of McGregor & Eads takes in a larger area than Dallas County, but we may assume that the mosquito fauna of that section of Texas is similar to that of the Dallas area.

TABLE

Species	Dyar	McGregor & Eads	Present Work
<i>Aedes aegypti</i>	+	+	+
<i>Aedes nigromaculis</i>	—	+	—
<i>Aedes triseriatus</i>	—	+	+
<i>Aedes trivittatus</i>	—	+	+
<i>Aedes vexans</i>	+	—	+
<i>Anopheles curicans</i>	—	—	+
<i>Anopheles pseudopunctipennis</i>	—	+	+
<i>Anopheles punctipennis</i>	—	+	+
<i>Anopheles quadrimaculatus</i>	+	+	+
<i>Culex apicalis</i>	—	—	+
<i>Culex coronator</i>	—	—	+
<i>Culex erraticus</i> ³	+	+	+
<i>Culex quinquefasciatus</i>	—	+	+
<i>Culex restauns</i>	—	+	+
<i>Culex salinarius</i>	—	+	+
<i>Culex tarsalis</i>	+	+	+
<i>Culiseta inornata</i> ⁴	+	+	+
<i>Megarhinus septentrionalis</i>	+	+	+
<i>Orthopodomyia signifera</i>	—	+	—
<i>Psorophora ciliata</i>	—	?	+
<i>Psorophora champerico</i> ⁵	+	?	?
<i>Psorophora confinnis</i>	—	+	+
<i>Psorophora cyanescens</i>	—	+	—
<i>Psorophora discolor</i>	—	—	+
<i>Psorophora ferox</i>	+	+	+
<i>Psorophora varipena</i>	+	—	—

³Reported by Dyar as *Culex inhibitor*.

⁴*Psorophora champerico* was reported by Dyar in 1922. A species by this name is not reported by Matheson (*Handbook of the Mosquitoes of North America*) nor in the *Mosquitoes of Texas*. This specific name has probably either been invalidated or the species has been shifted to a correct genus.

⁵Reported by Dyar as *Culicella inornata* and by McGregor & Eads as *Theobaldia inornata*.

3. It is seen from the Table that the present study established new distributional records for *Culex apicalis*, *C. coronator*, *C. salinarius*, and *Psorophora discolor*.

4. *Aedes nigromaculis*, *Orthopodomyia signifera*, *Psorophora cyes-cens*, and *P. varipens*, which have been reported by previous workers were not taken in this study.

5. The present study showed the genus *Culex* to be the most abundant one in number of individuals and species. *Culex tarsalis* was the most abundant species in early summer and *C. quinquefasciatus* was most abundant in late summer. *Anopheles punctipennis* was the most abundant and widespread *Anopheles* in the neighborhood of Dallas.

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The Texas Species of *Psoralea* (Leguminosae)

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Twenty-five species and two varieties of *Psoralea*, distributed among three segregate genera, were recognized from Texas by Rydberg (1919) and by Tharp and Barkley (1945, 1946). Fourteen species and four varieties, of which one species and three varieties are newly described, are recognized in the present synopsis, all treated under *Psoralea*. For the most part the dismemberment of the genus is entirely reasonable as far as Texas species are concerned. Indeed at least one of the segregate genera of Rydberg could be further divided. *Pediomelum rhombifolium*, with slender elongate stems, strictly axillary, capitate, long-peduncled inflorescences, peculiar scarlet-brown corollas, and branched below-ground stem bases, is quite unlike the species with which it is usually associated. While admitting the justifications for recognizing separate genera, I prefer to follow Torrey & Gray, Vail, and Macbride in treating *Psoralea* as a single large and somewhat heterogeneous assemblage, but one of obviously closely allied groups, paralleling *Astragalus*. It is interesting to note that a recent South African student has gone so far as to merge with *Psoralea* a genus previously placed in a different tribe (Salter, 1939).

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