

THE DRAGONFLIES OF THE REELFOOT LAKE AREA¹

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INTRODUCTION

Dragonflies have been the recipient of many names. Some of these are somewhat misleading as to their nature. The writer as a child knew them as "snake doctors" and "mosquito hawks," the former certainly misleading and the latter probably indicative of the true nature of the creatures. Included among the vernacular names are: "snake feeders," "devil's darning needles," "flying adders," and "horse stingers" (Howard, 1901). They are surpassed in beauty and grace in the insect world only by the butterflies.

The early stages of the dragonfly are spent in a water habitat. The nymph is carnivorous and some investigators have found that young fish are not immune to its predatory appetite (Wilson, 1920). In turn they have been found to constitute a portion of the diet of some fish (Baker, 1916; Wilson, 1920; and Pearse, 1921).

Six reports have been published dealing with the dragonfly fauna of Tennessee: Williamson (1903, 1923, and 1934) Wilson (1909 and 1912); and Byers (1930). Williamson (1903) collected dragonflies in the vicinity of Nashville during the period from September, 1900, to June 7, 1901. Wilson (1909) made a round trip on the Tennessee River from Paducah, Kentucky, to Riverton, Alabama, and back to Paducah, extending from August 20 to August 30. Two stops were made to collect dragonflies at points within Tennessee, one at Johnsonville on August 21 and the other at Savannah on August 23. Again Wilson (1912) followed the Cumberland River down in Tennessee and around into Kentucky during the summer of 1911. Williamson (1923) made an automobile trip across Tennessee, extending from July 25 to August 6. The itinerary for Tennessee began near Clarksville where two days were spent collecting the Odonata about Sycamore Creek. A few specimens were collected along the road from Nashville to Monteagle. Further collections were made at various points along the highway to Chattanooga. From Chattanooga he drove to Jamestown by way of Rockwood and Crossville and thence to Burnside, Kentucky. Occasional stops were made along the way to collect. Byers (1930) collected dragonflies from August 9 to 11

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in the vicinities of Sevierville, Gatlinburg, and Elkmont. Five species were reported.

Presumably, further studies of the Odonata fauna of other localities in Tennessee and extending over a longer period would be profitable.

At the suggestion of Dr. Jesse M. Shaver the author made a study of the dragonfly fauna of the Reelfoot Lake area. The investigation began June 12 and ended August 27, 1934. Data was obtained on the number and relative abundance of the various species, the seasonal, horizontal, and vertical distribution, food habits, enemies, and breeding activities of the Odonata of this area.

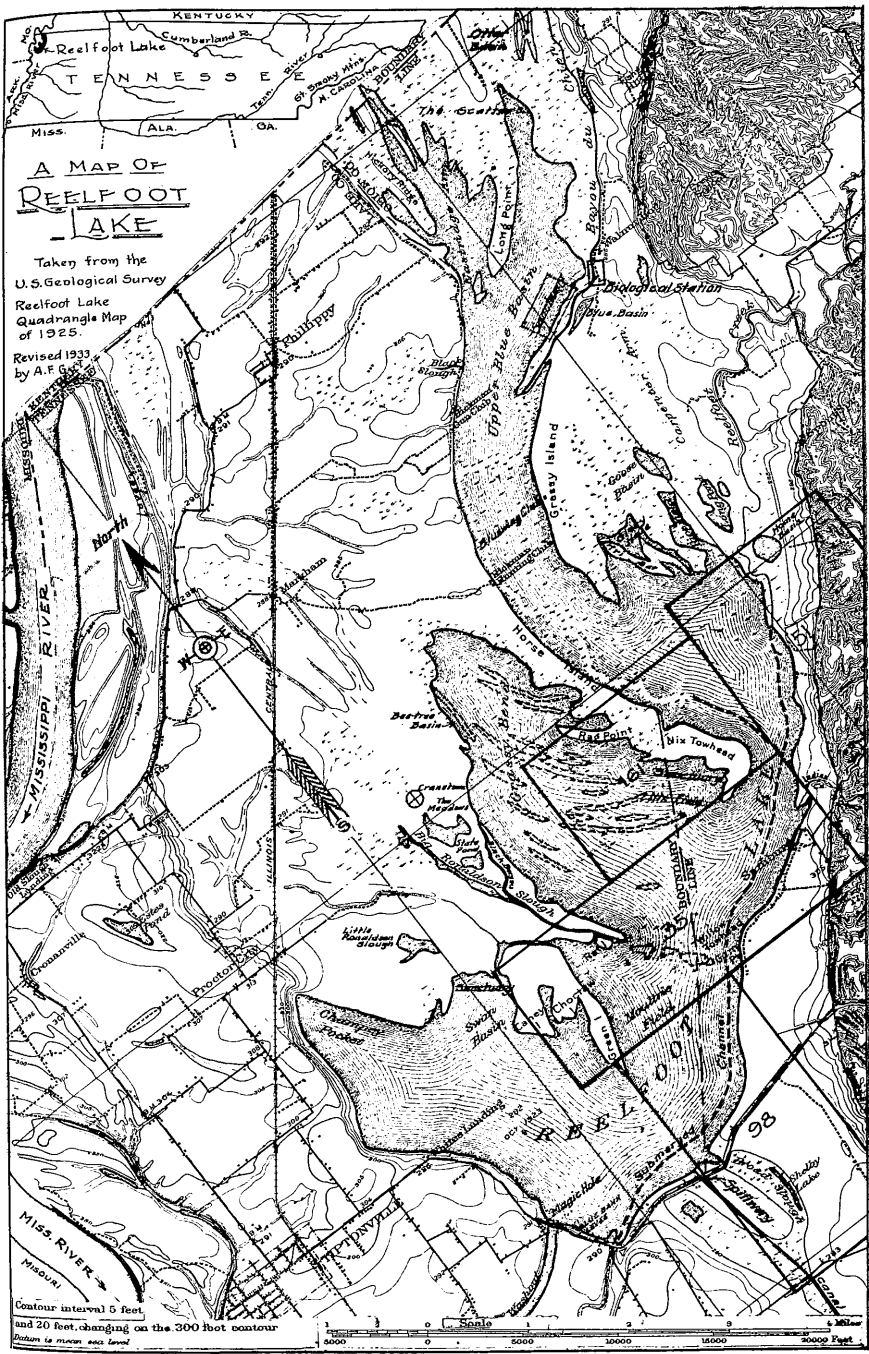
Visiting a stream or lake at one point does not determine the Odonata fauna for that day (Williamson, 1916, p. 5). Various reasons, such as temperature, soil differences, inlets and outlets, with corresponding differences in vegetation may result in a variation in the species of dragonflies to be found. Dragonflies are most active in hot quiet weather when the sun is shining. They have been found to vary in the kind and quantity of activity at different hours during the day (Wilson, 1920). One writer has called attention to the fact that some species colonize and others are local in distribution (Wilson, 1909, p. 667). It is therefore evident that with two localities of apparently the same ecological conditions, a given species may be absent in one and present in the other. The *Libellula luctosa* of Reelfoot Lake was an excellent example of this type of distribution. They were found colonized along the canals, beside the levee at Edgewater Beach, and no where else in the whole lake area, even when ecological conditions were apparently the same at some other points.

In view of the above facts, it was evidently necessary to survey the whole lake area in order to secure adequate data on the dragonfly fauna.

Boats were available for use in this investigation at Walnut Log, Samburg, and Spillway. All trips by boat out into the lake began at one or the other of these points. Hikes through the swamp and up and down the shores of Reelfoot Lake and along the streams that flowed into it began at any point arbitrarily chosen by the investigator.

A collector's outfit was used consisting of a net, a fly swatter, gun, and a creel containing Lepidoptera papers and vials filled with 70 per cent alcohol. The damsel flies were swatted to the ground or into the water with the swatter and placed in vials of alcohol. Dragonflies were netted and papered alive if possible. Specimens that could not readily be netted were shot with number 7½ shot. Some of the dragonflies were spread and dried, other were placed in alcohol, and some were left in the Lepidoptera papers.

Records were kept of the first specimens captured and of additions to the collection. Notes were also made of all species observed, their activity and relation to other species present. For purposes of identification the descriptions in Needham and Heywood, *Handbook of the Dragonflies of North America* (1929) were used.



The habit of colonizing on the part of some dragonflies, reported by Wilson (1909, p. 667), made it necessary for the investigator to study the entire shoreline and all adjacent ponds, sloughs, etc. Furthermore, it has been found that the activity and even the presence of dragonflies varies during the day (Wilson, 1920). Obviously, it was impossible during the period of the study for the investigator to make a complete survey taking into consideration the habits of the Odonata mentioned above.

Again it has been found that some species leave ponds as soon as they can fly and are not found there in the adult form (Wilson, 1920). Since very little study was made of the nymphs in the investigation, some species may have been overlooked. Other dragonflies, for example, *Sympetrum* (Needham and Heywood, 1929, p. 231) do not appear in the adult stage until late in the season. The field work was terminated August 27 and it is probable that some species were missed in this manner.

ACKNOWLEDGMENTS

The writer is especially indebted to Dr. J. M. Shaver for much helpful advice and the loan of necessary equipment, to the Tennessee Academy of Science for financial aid and for the use of the laboratory at the Reelfoot Lake Biological Station, to the State Game Warden, Mr. Damon Headdon, and his deputies for the use of boats, and to Mr. Compton Crook for help in field work. Thanks are also due Dr. C. F. Byers for checking the identification of specimens.

HABITATS AND OBSERVATION STATIONS

The Reelfoot Lake area does not offer a wide range of habitats for dragonflies. However, several somewhat distinct habitats were found with variations in conditions that apparently effected the distribution of the various species of the order Odonata. Such divisions may have been more or less superficial since some dragonflies can, and some do, roam over many miles (Needham and Heywood, 1929, p. 135; Tillyard, 1917, p. 333). There were some species, however, which seemed to have a decided preference for certain locations in the vicinity under consideration.

For convenience in making this study and treating the data that might be obtained, several stations were selected and observations made at them from time to time. These stations were selected arbitrarily in an attempt to secure representative data from as great a portion of the Reelfoot Lake Area as possible under the circumstances. In most instances there was evidently no great differences in environmental conditions. The following are brief descriptions of these stations.

Station 1. The fields in the vicinity of the Reelfoot Lake Biological Station were planted to cotton and corn in part, while a number of acres were allowed to grow up in weeds.

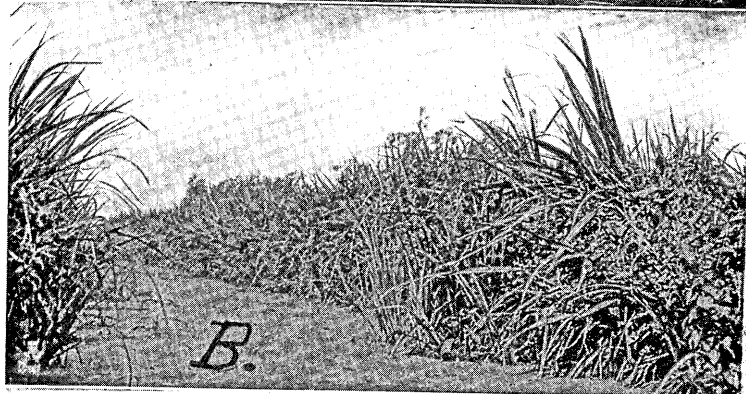
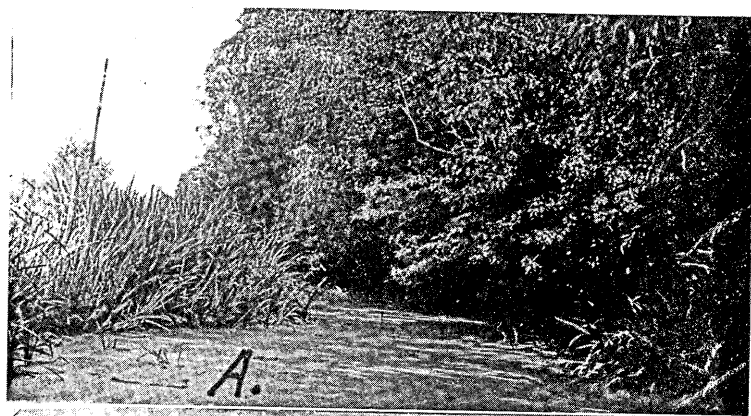


Fig. 1. *A*, Canal on east side of the levee (*Station 3*). The water was covered with duckweeds. *B*, The boat canal from Walnut Log to Reelfoot Lake (*Station 5*). *C*, Stock-watering pond in a pasture off of the Union City-Walnut Log road (*Station 10*).

Station 2. Many trips were made from Walnut Log along the gravel road that leads by Samburg to Lassater's Corner. The wooded bluffs were on one side and for the greater part cotton and corn fields on the other. At no place was the road more than two miles from the lake. Records were made of the species observed flying over or near this road.

Station 3. A levee has been thrown up along the southwestern end of the lake, thus making it possible to control the water level in the lake itself. A macadamized road runs along the top of this levee and ditches or canals run along one and occasionally both sides (Figs. 1, A). These canals were filled with water during the entire season and the characteristic water and marsh plants were found here.

Station 4. Bayou du Chien is a more or less shaded waterway lying along and somewhat parallel with the northeastern border of Reelfoot Lake. There was no perceptible current and in some places bunches of saw grass (*Zizaniopsis miliacea*) were to be found along its margins. The surface of the water was usually covered with duckweeds (*Spirodela polyrhiza*, *Lemna minor*, and *Wolffia columbiana*) and bald cypresses (*Taxodium distichum*) adorned its banks.

Station 5. Along the shores of Reelfoot Lake and in some places for hundreds of yards out into the lake were areas of comparatively shallow water where saw grass or wild rice is the dominant species of plant. In fact, to the casual observer the five to seven feet tall saw grass would appear to be almost the only vegetation. A boat channel has been cleared out through the saw grass marsh from Bayou du Chien at Walnut Log to the deeper water of the lake (Fig. 1, B). This canal is about eight feet wide and about half a mile in length.

Station 6. Johnson's Basin contained two or three feet of water throughout the drought that prevailed during the summer of this investigation. There were several acres of open water in this V-shaped pond. Along the margins and at one end trees have fallen and in many instances are half submerged and decaying. Button or "elbow" bushes (*Cephalathus occidentalis*) occurred along the margins and in occasional clumps about and over the pond. Bald cypresses were here, sometimes in water three feet deep. Most of the surface was covered with duckweed.

Station 7. Reelfoot Creek, during the period of this study, was a muddy, drift-choked body of water. At some places the water was three feet deep; at other points one could cross the channel on a dry stream bed. In other respects, excepting that there was no floating vegetation, Reelfoot Creek was very similar to Bayou du Chien.

Station 8. Eastridge arm extends from the northern end (see map) of Upper Blue Basin to and across the Kentucky state line. During the summer of 1934 this whole area was a mass of floating, submerged, and emergent vegetation. This made the task of propelling a boat through an undertaking of a very laborious nature. The observers were very glad to desist from the task for an hour or two occasionally even when the heat from the sun made resting a somewhat uncom-

fortable pursuit. During these pauses of from one to two hours excellent opportunity was presented for securing records on the presence of dragonflies and their activities. Due to the difficulty of getting in and out and moving after getting in only three trips were made into this area.

Station 9. Otter Basin was surrounded by a dense stand of virgin Bald cypress. There was about six or seven acres of open water margined by a thick growth of button bushes. When first visited, the water was about four feet in depth. As the drought continued, it rapidly evaporated and finally on the last visit it consisted of a small pool in the center of the basin (Fig. 2, B). On one visit thousands of dead fish floated about along the water margins and large numbers of Wood Ibises, Herons, and Egrets were present, apparently feeding upon these dead fish. There was no floating or submerged vegetation such as that found in most other bodies of water in this area.

Station 10. About two and one-half miles from the lake just off the Walnut Log-Union City road near Bob McCain's farm, the investigator found a pond that was serving, because of its location in a pasture, for watering stock (Fig. 1, C). During the period while observations were in progress this pond was considerably reduced in size due to the long drought that prevailed for most of the summer of 1934. The water in the deepest part was about three feet deep. The pond was bordered by dried mud flats badly cut up by the hoofs of cattle. There was no vegetation with the exception of a couple of scrawny almost leafless button bushes. A barbed wire fence, stretched across the pond, was fastened to an irregular row of posts in various stages of decay. The water heated by the rays of the midsummer sun was warm enough to be uncomfortable to a wading person.

Station 11. At Blue Bank (Fig. 2, A), a point on the southern end of the lake, there was an area along the shore high enough for a number of clubhouses to be built between the levee and the lake. There were a few shrubs and a number of cypress trees. The cypress trunks and knees marked the irregular shore line (Fig. 4, C). At the point for making observations in this study there was no floating and emergent vegetation. The *Macromias* seemed to find the shore line at this place a satisfactory hunting ground as a number of specimens were captured as they coursed in and out among the cypress knees along the shore line.

Station 12. Areas of shallow water marked by stunted cypress and protruding stumps characterized the lake at Walnut Log (Fig. 3). The stumps often had collected about them masses of submerged vegetation (Water-weed, *Elodea canadensis* and *Ceratophyllum demersum*). Herbs and sometimes shrubs had gained a foothold in the decaying crevices of many of the stumps. Other stumps were apparently covered by water—at least, during a part of the year—and had no herbs and shrubs. Along the shores in comparatively shallow water saw grass or wild rice was the dominant plant. The floating lily pads (*Nelumbo lutea*), masses of submerged water-weeds, float-

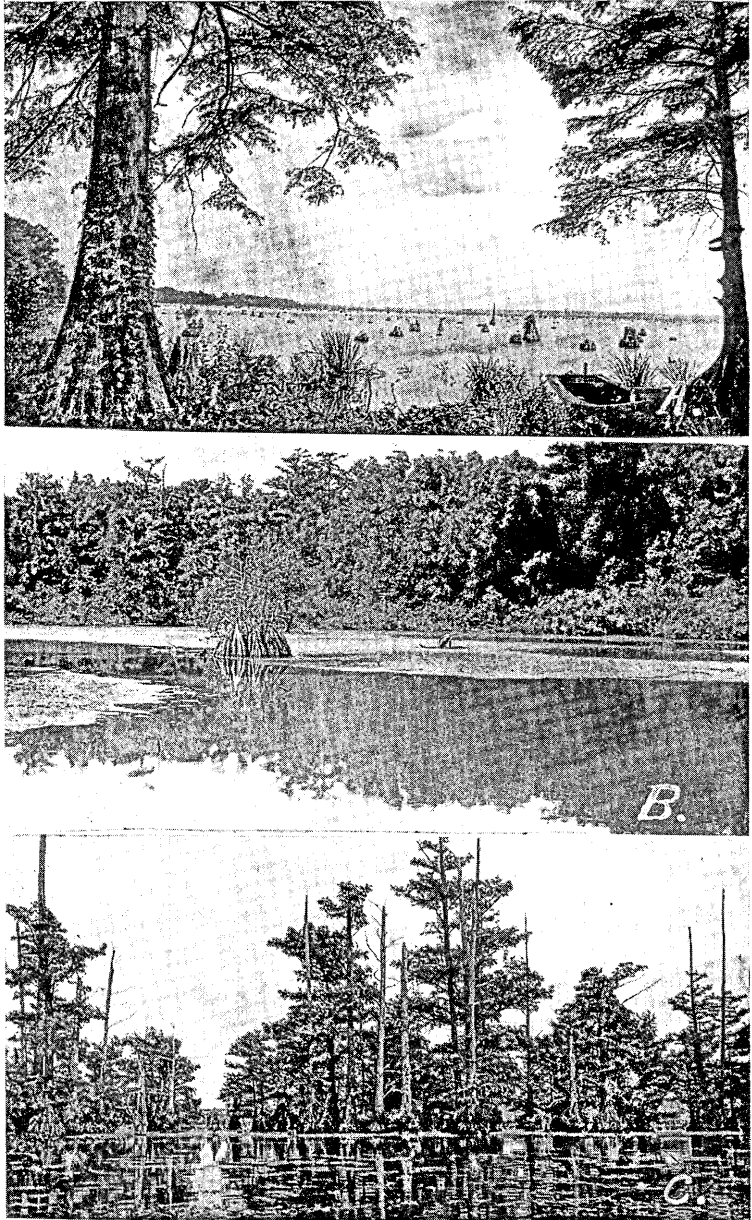


Fig. 2. *A*, Reelfoot Lake from Blue Bank (Station 11). *B*, Otter Basin during the very dry summer of 1934 (Station 9). *C*, The shore across the lake from Horse Island.

ing duckweeds, etc., were found along the margins and often far out into the lake (Fig. 5).

Station 13. Conditions similar to those described for the lake at Walnut Log prevailed for the lake at Samburg (Fig. 3).

Station 14. There were two or three open stretches of water, several hundred acres in extent and many feet deep, that were devoid of protruding stumps and vegetation. The Upper Blue Basin was an area of this type.

Station 15. The lake in the vicinity of Spillway had a greater depth than at Walnut Log and Samburg. While there were many protruding and submerged stumps that made rowing a somewhat precarious task for the amateur, there was almost a total lack of the

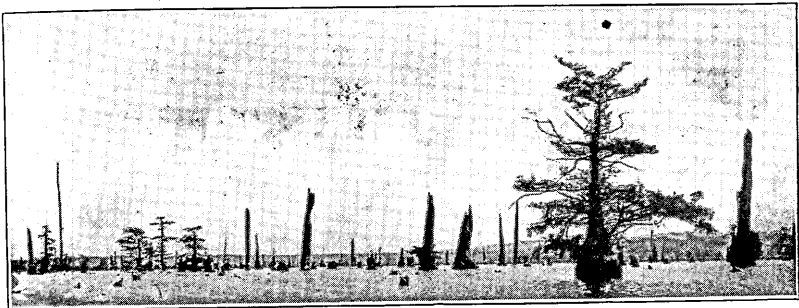


Fig. 3. Reelfoot Lake near Walnut Log. (*Station 12*).

submerged and emergent vegetation which tended to make the task of rowing a strenuous one in the latter two places.

Station 16. From the fields about the Biological Station a trail, which perhaps marked the course of an old logging road, led through the swamps or "Scatters" by way of Mud Basin to the Blue Wing Club. This trail was estimated to be three or four miles in length.

Station 17. Gladly Creek, a small gravel bottom stream with occasional waterfalls, flowed down from the hillsides in the immediate vicinity (Fig. 4, *A*). Numerous little valleys and ravines drained into it from the hillsides. Beech (*Fagus grandifolia*) and Tulip trees (*Liriodendron tulipifera*) seemed to be the characteristic large trees with shrubs of Papaw (*Asimina triloba*) and spice bush

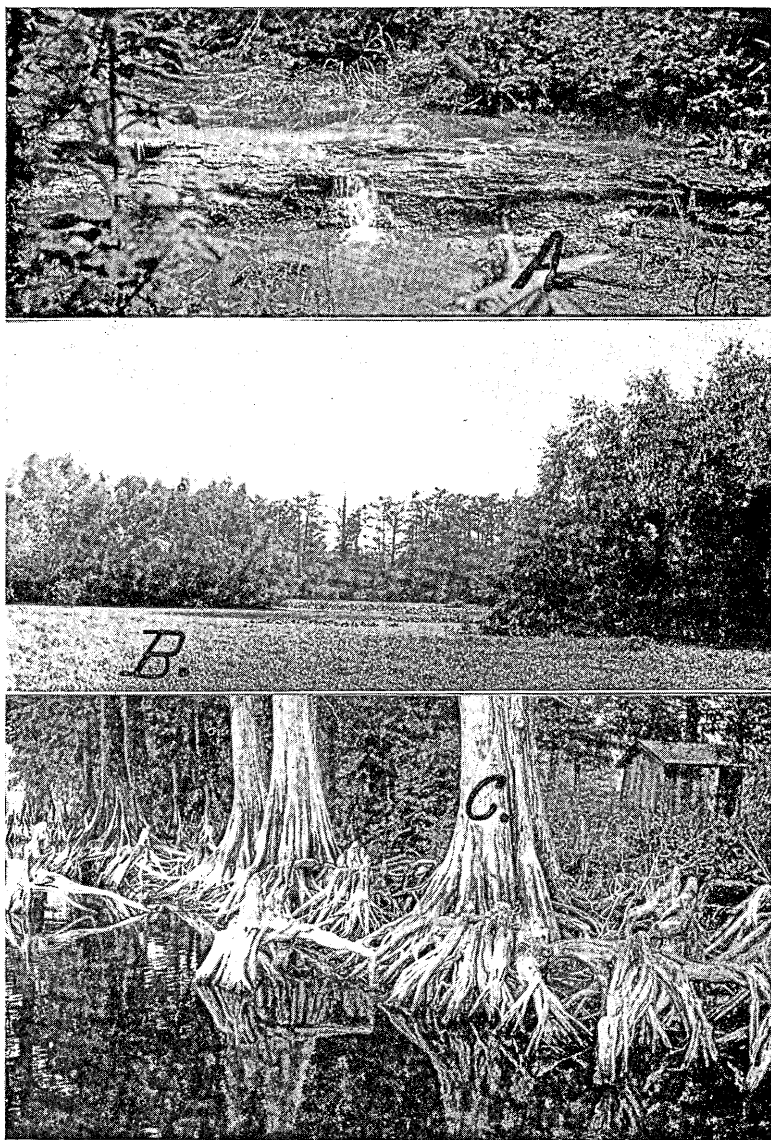


Fig. 4. *A*, A small waterfall in Glady Creek (*Station 17*). *B*, Little Ronaldson Slough was dry during a part of the summer of 1934 (*Station 18*). *C*, Exposed knees and bases of cypress trees at the time of low water on the shore at Blue Bank.

(*Lindera benzoin*). This type of stream seemed to be an exception for the Reelfoot Lake area. *Agrion maculatum* seemed to find favorable conditions here, for they were found by the hundreds at this station.

Station 18. Along the northwestern side of Reelfoot Lake lying between Swan Basin and Grassy Bend was a swampy, densely forested tract called the Ronaldson "Scatters." In the rainy season much of this area was covered with water. However, at the time of this study only a few pools of stagnant water could be found and these were rapidly disappearing. Big and Little Ronaldson Sloughs were

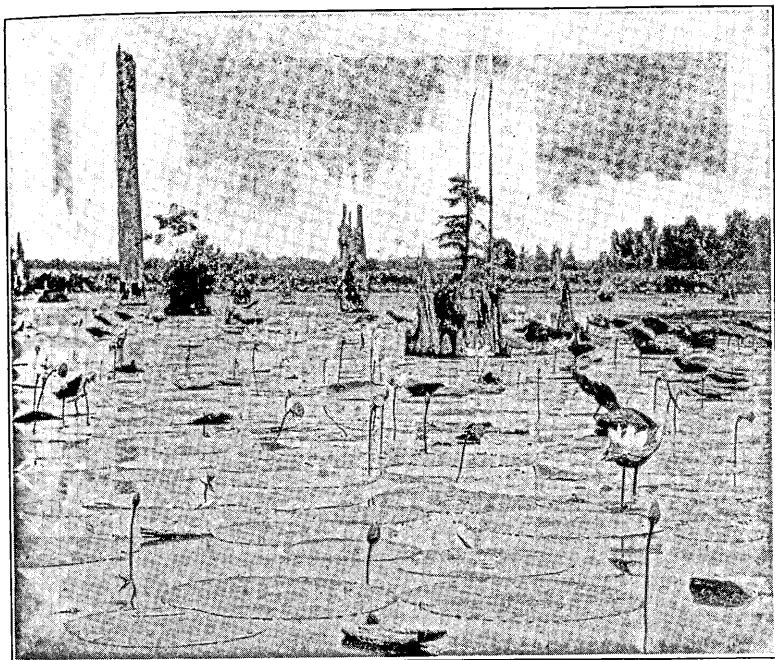


Fig. 5. The Water Lily Zone near Walnut Log.

eventually reduced to narrow dried mud flats with a few pools of water (Fig. 4, B).

Data were also secured when one or more trips were made to other areas in the vicinity. The following are some of the points visited: Eagle Pond, Mud Basin, Brewer Basin, Yonkapin Basin, Goose Basin, Black's Slough, "Scatters" in the vicinity of the Hickman Hunting Club, Broad Slough, Fishgap Hill, Cook Pond, Hickory Ridge "Scatters," Washout, Carpenter's Arm, Grassy Island, Green Island, Choctaw Island, Caney Island, and Grassy Bend.

DISTRIBUTION

Tables 1 and 2 indicate the distribution of the members of the two suborders of Odonata (Anisoptera and Zygoptera) over the areas studied. Either a capture or one or more sight records are indicated in the tables by the letter P. The data secured at the eighteen stations described above have been analyzed and used in compiling the tables.

From Table 1 it is readily seen that the following species are generally distributed over the Reelfoot Lake area: *Epicordulia princeps*, *Perithemis tenera*, *Libellula incesta*, *Libellula vibrans*, *Pachydiplax*

TABLE 1
The distribution of the species of the suborder Anisoptera in the Reelfoot Lake area

NAME OF SPECIES	STATIONS																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<i>Gomphus</i> sp.....				P*														
<i>Anax junius</i>	P	P	P	P	P				P			P	P					P
<i>Nasiaeschna pentacantha</i>	P			P	P	P	P		P	P		P						P
<i>Epiaeschna heros</i>	P	P	P	P	P	P		P	P	P					P			P
<i>Macromia taeniolata</i>	P		P	P			P				P							
<i>Epicordulia princeps</i>	P	P	P	P	P		P	P	P	P	P	P	P	P	P	P	P	
<i>Perithemis tenera</i>	P		P	P	P		P	P	P	P								
<i>Celithemis eponina</i>	P	P	P	P	P		P			P		P	P		P			P
<i>Libellula luctuosa</i>	P		P								P							
<i>Libellula incesta</i>	P		P	P	P	P			P	P	P	P				P		P
<i>Libellula vibrans</i>	P		P		P	P	P		P	P	P	P				P		P
<i>Plathemis lydia</i>	P		P		P	P		P	P									P
<i>Sympetrum vicinum</i>					P†													
<i>Pachydiplax longipennis</i>	P	P	P	P	P	P	P	P	P	P		P	P			P	P	P
<i>Mesothemis simplicicollis</i>	P	P	P	P	P	P	P	P	P	P		P	P		P	P	P	P
<i>Pantala hymenea</i>	P	P	P								P							
<i>Pantala flavescens</i>	P	P	P				P			P		P			P			P
<i>Trapezostigma lacerata</i>	P	P	P	P	P	P	P		P	P		P	P	P	P	P	P	P
<i>Trapezostigma onusta</i> †.....												P						
<i>Trapezostigma carolina</i>	P	P					P			P		P				P		

*The one specimen secured for this record was accidentally mutilated before the species could be determined.

†An autumnal dragonfly just beginning to appear at the close of the investigation.

‡One specimen obtained. See discussion of *Trapezostigma*.

longipennis, *Mesothemis simplicicollis*, and *lacerata*. These were usually found in great numbers and they were undoubtedly the most abundant species. *Anax junius*, *Trapezostigma carolina*, *Trapezostigma enusta*, and *Epiaeschna heros* were somewhat rare and only occasionally observed. The following species were restricted in their distribution: *Nasiaeschna pentacantha*, *Macromia taeniolata*, *Celithemis eponina*, *Plathemis lydia*, *Pantala hymenea*, and *Pantala flavescens*. The *Gomphus* sp. recorded may be termed accidental, while the one, *Sympetrum vicinum*, is presumably an autumnal dragonfly and was

captured late in the season. Since the investigation was terminated in late August, the distribution of the *Sympetrum* is not reflected by this single record. A distinct colony of *Libellula luctosa* was recognized at the levee.

The fields (*Station 1*) in the vicinity of the Biological Station appeared to be a favorite hunting territory for dragonflies. Seventeen of the twenty species of Anisoptera were found here. The levee (*Station 3*) was a close second in number of species with fifteen species recorded. The other stations with records were as follows: Reelfoot Creek (*Station 7*), thirteen species; the lake at Walnut Log (*Station 12*) and canal at Walnut Log (*Station 5*), twelve each; Bayou du Chien (*Station 4*), stock pond (*Station 10*), and Ronaldson Scatters (*Station 18*), eleven each; roadsides (*Station 2*), ten

TABLE 2
The distribution of the suborder Zygoptera in the Reelfoot Lake area

NAME OF SPECIES	STATIONS																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<i>Agriion maculatum</i>							P*											P
<i>Lestes rectangularis</i>				P	P													
<i>Lestes forcipatus</i> †.....																		
<i>Lestes inequalis</i>				P	P													
<i>Argia apicalis</i>			P	P		P					P							P
<i>Argia tibialis</i>																		P
<i>Enallagma geminatum</i>						P						P	P					
<i>Enallagma signatum</i>				P	P	P		P				P	P					
<i>Enallagma exsulans</i>			P														P	
<i>Enallagma civile</i>							P	P				P	P		P			
<i>Ischnura posita</i>	P		P	P	P	P					P	P	P			P		

*Only males of this species were found at this station.

†Caught on bluff at Fishgap Hill. This was not one of the regular stations.

species; Johnson's Basin (*Station 6*), Otter Basin (*Station 9*), and the lake at Samburg (*Station 13*), nine species each; Eastridge Arm (*Station 8*), shore at Blue Bank (*Station 11*), the lake at Spillway (*Station 15*), and the trail to Blue Wing Club (*Station 16*), seven species each; Gladly Creek (*Station 17*), six species. Only two species were recorded for the Upper Blue Basin (*Station 14*). The almost total absence of dragonflies from the Upper Basin may be explained by the fact that there were no resting places for the dragonflies or their prey over this large body of open water.

Table 2 indicates the distribution of the suborder Zygoptera. One or more records of the presence of this suborder in the area covered by the station is indicated as was done for Anisoptera by the letter P. Specimens were always secured for the record, because the author was unable to distinguish all the species of this suborder in the field. It appears from the table that *Ischnura posita* is the most widely

distributed species in this area, it being recorded from nine stations. Next in order in breadth of distribution are *Enallagma signatum* with records for seven stations and *Argia apicalis* with records for five stations. *Enallagma civile* was commonly observed near the end of the season only, and recorded for five stations. *Enallagma geminatum* was found at three stations. The following were recorded for two stations each: *Agrion maculatum*, *Lestes rectangularis*, *Lestes inequalis*, and *Enallagma exsulans*. *Argia tibialis* was only found along Glady Creek. One specimen of *Lestes forcipatus*, a female, was secured in a ravine on top of Fishgap Hill.

Five species were found along Bayou du Chien (Station 4). Four species were recorded for each of the following stations: boat canal at Walnut Log (Station 5), Johnson's Basin (Station 6), the lake at Walnut Log (Station 12), and the lake at Samburg (Station 13). Three species each were collected from the levee (Station 3), Blue Wing Club trail (Station 16), and Glady Creek (Station 17). Two species were caught at each of the following stations: Reelfoot Creek (Station 7), Eastridge Arm (Station 8), and Blue Bank (Station 11). One species was found at the fields station (Station 1) and one over the lake at Spillway (Station 15). Only males of *Agrion maculatum* were found at the Reelfoot Creek Station.

Seven species were recorded for each of the following stations: Bayou du Chien (Station 4), the lake at Walnut Log (Station 12), and Glady Creek (Station 17). Six species were found over the lake at Samburg (Station 13), five species along the canal at Walnut Log (Station 5), three species for the levee (Station 3) and Johnson's Basin (Station 6), two species for Reelfoot Creek (Station 7) and Eastridge Arm (Station 8). One species was found in the fields station (Station 1), one on the shore at Blue Bank (Station 11), one out over the lake at Spillway (Station 15), and one along the trail to Blue Wing Club (Station 16). No records were secured for the following stations: roadsides (Station 2), Otter Basin (Station 9), stock pond (Station 10), Upper Blue Basin (Station 14), and Ronaldson Scatters (Station 18). Only males of *Agrion maculatum* were found at the Reelfoot Creek station.

NOTES ON THE ODONATA OF THE REELFOOT LAKE AREA

SUBORDER ANISOPTERA ,

FAMILY AESCHNIDAE

SUBFAMILY GOMPHINAE

Gomphus Leach

One specimen of *Gomphus* was secured on the shore of Bayou du Chien, June 17. The specimen was accidentally mutilated before the species could be definitely determined.

SUBFAMILY AESCHNINAE

Anax Leach

Anax junius Drury. Only four records of *Anax junius* were secured before August, the first on June 19 over the Lake at Walnut Log. After August 9 they were common and were recorded in nine of the habitats listed in Table 1. By August 15 they appeared to have displaced *E. princeps* in the vertical distribution over the fields in the vicinity of the Biological Station. On August 19, in Grassy Bend, across the lake from Samburg, a pair of copulating *A. junius* were observed to fly up into the foliage of a stunted cypress. They rested about fifteen feet above the water surface.

Nasiaeschna Selys

Only one species of this genus is listed for the United States by Needham and Heywood (1929, p. 132).

Nasiaeschna pentacantha Rambur. The *Nasiaeschna pentacantha* was most at home when weaving in and out among the vegetation along the margins of the drift-choked Bayou du Chien and other similar waterways. They were relatively slow in flight and somewhat clumsy. One could hear them, as they coursed in and out of the wild rice, striking the leaves as they passed through. The first *Nasiaeschna pentacantha* was observed on June 16 over Bayou du Chien. The first capture was made near the same body of water in front of the Biological Station on the morning of June 17. Table 1 indicates the somewhat limited range of this species.

During a rain and also after capturing some other hapless insect for food, the *Nasiaeschna pentacantha* seemed to seek the shelter of trees and shrubs. On the afternoon of June 17 during a misty rain, which had been coming down almost the entire day, two *Nasiaeschna pentacantha* were caught and another was observed high up on the trunks of white maples on the island across Bayou du Chien in front of the Biological Station. Again on July 25, at Otter Basin, a *Nasiaeschna pentacantha* was found perched in a shrub near the margin of the pond. When captured it was making a meal of a *Pachydiplax longipennis*.

There are ridges that extend out into the lake marking areas of comparatively shallow water. These ridges support stunted cypress trees that seem to make a desirable hunting territory for *Nasiaeschna pentacantha*. One such ridge with its corresponding stand of cypress extends along the eastern margin of the Upper Blue Basin. Here on August 12 a female *Nasiaeschna pentacantha* caught a male *Trapezostigma lacerata* and immediately flew to a cypress limb and began what seemingly would have been a fine meal. When the observer succeeded in capturing this prize, the top of the head of the *Trapezostigma* had already been eaten.

On June 23, *N. pentacantha* was found to be common along Bayou du Chien up to and in Johnson's Basin. The females were ovipositing, unattended by the males, on dead logs, stumps and limbs, and the swollen bases of cypress about four to six inches above the water surface.

This species was fairly common in their favored haunts during the entire period of this study.

Ephiaeschna Hagen

Another genus with one species only listed for the United States.

Ephiaeschna heros Fabricius. The first positive record of *Ephiaeschna heros* was obtained at Black's Slough on July 20. At 7:30 P. M., July 26, a large number of dragonflies were observed coursing over the lawn of Walnut Log Lodge. All of these were *Epicordulia princeps* with the exception of three *Ephiaeschna heros*, two of which were captured. No breeding records were secured. Sight records were made for this species in eleven of the eighteen stations listed in Table 1.

FAMILY LIBELLULIDAE

SUBFAMILY MACROMELINAE

Macromia Rambur

One species of this genus was found at Reelfoot Lake.

Macromia taeniolata Rambur. The first specimens of *Macromia taeniolata* were secured on Bayou du Chien, July 2. They were not very widely distributed as may be ascertained by referring to Table 1. However, when the author learned enough about their habits, he could usually find them by seeking their favorite haunts. Almost invariably they could be found coursing along the shores of Bayou du Chien, Reelfoot Creek, and the lake itself at Blue Bank and Green Point. The shore at the State Club House located at Blue Bank yielded several fine specimens. The author would take a stand on the boat dock and almost invariably a large *Macromia* would come nosing along in and out among the swollen cypress trunks, knees, and exposed roots that lined the shore. The net was (after several fruitless attempts to capture by swinging in front) always handled so as to approach the dragonfly from the rear.

On the morning of August 3 the author noted some *Macromias* coursing along Reelfoot Creek below the bridge on the Walnut Log-Samburg road. A station was selected under a bluff near the water edge where some exposed roots of a giant sycamore tree (*Platanus occidentalis* L.) gave a foothold and the trunk partially shielded him from the view of the dragonflies as they approached from the right coursing down stream. No attempt was made to net them as they passed upstream. Three individuals of *Macromia taeniolata* were captured at this station in ten minutes. There were others coursing along the same shore line at the same time.

Needham and Heywood (1929, p. 164) quote Williamson (1915, p. 386) on the habits of *Macromias* as follows:

"Individuals follow the same track over and over, crossing the river at a certain point, returning over a certain patch of willow herb, turning out from the shore line at a clump of *Hibiscus*, and going and coming over the same or nearly the same course, and not following the pools in a circular manner. Moreover, individuals of successive generations have followed the same course as their predecessors as I have observed at the pools where I have found individuals most numerous, and where I have collected for several years. The configuration of the vegetation and water is a positive factor in determining the course of flight."

No breeding records were secured for this species.

SUBFAMILY CORDULINAE

Epicordulia Selys

Two species in this genus are listed for the United States. One species, *Epicordulia regina*, seems to be confined in its distribution to Georgia and Florida (Needham and Heywood, 1929).

Epicordulia princeps Hagen. The first specimen of *Epicordulia princeps* was secured June 26 in the vicinity of the bridge over Indian Creek near Samburg. They were not observed by the investigator coursing over Bayou du Chien until June 14. That they later ranged over almost the entire area is indicated in Table 1. They were recorded as present in all but three stations listed in the table.

The *Epicordulia princeps* were difficult to capture during the earlier period of the study because of their habit of remaining out over the water and keeping out of reach of the collector's net. However, later in the season they became more numerous and were to be found over the fields where capture was less difficult.

On both the afternoons of July 12 and 13 literally hundreds of dragonflies of several species appeared in the fields and in the neighborhood of the Biological

Station. Apparently they were feeding upon the large numbers of midges occurring there at the time. The different species of dragonflies seemed to be flying with an apparent definite relation to each other. There appeared to be what might be called a vertical distribution of the species. The *Epicordulia* were flying 10 to 20 feet from the ground; *Tramea lacerata* with an occasional *Tramea carolina* and one *Pantala flavescens* were coursing four to ten feet from the ground; *Libellula incesta* and *Libellula vibrans* were flying from rest to rest and coursing two to six feet from the ground. Flying along near the ground and perching on the ground and low vegetation were *Pachydiplax longipennis* and *Mesothemis simplicicollis*.

At 6:30 P. M. on July 25, over the lawn at Walnut Log Lodge, eight *Epicordulia princeps* were observed at a height of about twenty feet coursing in what was apparently an organized flock. On August 3 three such flocks of this species were observed containing thirty to fifty individuals each.

No ovipositing records were obtained. However, a number of copulatory flights were observed. Apparently copulation occurred while in flight.

SUBFAMILY LIBELLULINAE

Perithemis Hagen

One species of *Perithemis* is listed for the United States.

Perithemis tenera Say. The first *Perithemis tenera* were caught over a pool in Bayou du Chien on June 13. They were found to be common over most of the Reelfoot Lake area. Table 1 indicates their presence at twelve of the eighteen stations. The males far outnumbered the females, the females being seldom seen. Favorite perches for the amber-winged males were the low, moist tops of the snags of stumps protruding a few inches above the surface of the water. On a clear, hot, sunny day it was a rare thing to find one of these stumps without one or more *Perithemis tenera* resting on them.

The breeding and ovipositing habits of *Perithemis tenera* were rather varied. On June 25 while drifting along in a boat off Nix Towhead, the writer observed a pair copulating over a lily pad. Later the female deposited her eggs in the water caught in the depression on the same lily pad. She marked time in the air about the length of the abdomen above the surface and dipped the tip of it by bending into the water periodically. This continued for some time without a change in position. On August 2 at the stock pond station a pair were observed hovering around a twig about one inch in diameter and sticking out of the water a few inches. The male perched near the top of the twig and the female oviposited in the moist area, covered with algae, about three inches above the surface. Again on August 7 three records were secured of *Perithemis tenera* ovipositing on the algae-covered low protruding stumps in the lake off Spillway. While standing on the boat dock at the State Club House on the morning of August 18 the author saw two males and a female in tandem flight. After flying around for a few moments the leading male lost his hold and the remaining pair rested on the timber of the dock while copulating.

Celithemis Hagen

Needham and Heywood (1929) characterize the genus, *Celithemis*, as a common pond and marsh inhabitant. One species was found at Reelfoot Lake.

Celithemis eponina Drury. The first specimen of *Celithemis eponina* was secured among some weeds that grew along the shores of Bayou du Chien on June 17. Occasional records were obtained of the species until June 26 when they were observed to be increasing in abundance over the lake at Walnut Log. On June 29 at 2:00 P. M. a number of specimens were noted perched on weeds, fence posts, and shrubs along the Walnut Log-Union City road at Park's Farm. At 6:00 P. M. they had increased in number and in a short time the author

was able to fill a half pint jar with them. On July 17 at the stock pond station they were found to be abundant. They were perched on shrubs, weeds, fence posts, and the wire fence three to six feet from the ground about the pond and fifty yards from the water margin. On August 3 at the same station they were so numerous that the author caught three with one sweep of the net. By August 12 *Celithemis eponina* was declining in abundance.

Libellula Linnaeus

Three species of *Libellula* were found in the Reelfoot Lake area. Another species of this genus, *Libellula cyanea*, was found at a pond near Obion River, a scant twenty miles away.

Libellula luctosa Burmeister. The first record of *Libellula luctosa* at Reelfoot Lake was secured on June 27 when one specimen flew over the lake near the mouth of the boat channel. No other records were obtained until August 7 when a colony of the species was discovered along the levee canals at Edgewater Beach. Either they had just emerged or they had been overlooked in previous inspections of the same territory. The author was unable to locate other colonies in any other part of the area under consideration. Another single specimen was caught near the Biological Station later, on August 11. One individual was observed in a field by the Samburg-Walnut Log road on the same date.

From time to time during August the author observed individuals of *Libellula luctosa* as well as other species of dragonflies and insects enmeshed in the webs of a colony of garden spiders (*Miranda aurantia*) along the levee near Edgewater Beach.

These dragonflies were observed copulating and later the female ovipositing, unattended by the male, along the canals beside the levee on August 18.

Libellula incesta Hagen. A pruinose specimen of *Libellula incesta* was secured June 13 from the Bayou du Chien station. They were fairly common along Bayou du Chien at that time. Later, in July, they became common over most of the area, except the open lake where they were never found (Table 1).

On June 30, *L. incesta* were numerous along Bayou du Chien, while out over the lake at Walnut Log none were found, although other species were there in abundance. On July 2 they were found to be common along the shore and drifts at Johnson's Basin. It was noted that they seemed to prefer rather short flights, perching in between times on dead twigs and vegetation exposed to the sun. They would remain motionless for a minute or more and then would take a short flight, often returning to the same resting place. They were observed characteristically perching on vegetation beside the trail to Blue Wing Club in spots exposed to the sun, on July 6.

A *Libellula incesta* was observed busily flying in a peculiar zigzag manner near the gate to the Biological Station lawn on July 9. When the author approached it was feeding on a flock of midges.

Occasionally, a peculiar activity of *L. incesta* males was observed. One male would mark time in mid-air while another would fly over him; then the second male would mark time while the first male performed the same feat. This "leap frog" activity would continue for some time. On August 1 this interesting activity was observed over a pool in Bayou du Chien.

The following incident was noted at Blue Bank on August 18. A female *Libellula incesta* was ovipositing in shallow water off the shore. She marked time about two feet above the surface and periodically descended to the surface to wash the egg from the tip of her abdomen. A male was marking time in the air above her. Another male of the same species approached and was driven away by the first male. The first male then returned to his earlier station.

Libellula vibrans Fabricus. The first *Libellula vibrans* were found and three males were captured about a shaded pond on the island across the Biological Station on June 22. After the middle of July they were commonly found over

most of the Reelfoot Lake area excepting the open lake and Gladly Creek where they were never found (Table 1). On July 13, *L. vibrans* were common, flying from rest to rest about the fields that surround the Biological Station. They were commonly found on the Station lawn after this date, presumably feeding on the midges that were abundant. They were found at Johnson's Basin on June 23. A female was observed ovipositing in a clear pool of water. She would mark time about three feet above the surface and at intervals descend to wash the tip of her abdomen.

Plathemis Hagen

One species of *Plathemis* was found in the area studied.

Plathemis lydia Drury. The first record of the *Plathemis lydia* was obtained near Spillway on June 20. At that time several males were flying from rest to rest back and forth over a small stagnant pool of water back of Sam Morris's Cafe. Later (July 5) the first specimen, a male, was caught in a small cluster of willows near this same pool. No other records of *Plathemis lydia* were secured at this pool. Occasional sight records were obtained of *P. lydia* males at the following stations, fields (*Station 1*), levee (*Station 2*), Reelfoot Creek (*Station 7*), Otter Basin (*Station 9*), Gladly Creek (*Station 17*), and Ronaldson Scatters (*Station 18*). Only one record was secured for the fields station. They were common at the stock pond station and at a pond in a barn lot on top of Fishgap Hill. Breeding records were secured occasionally for the stock pond station and one was obtained at Gladly Creek on July 17. On this date three females were found at as many pools in this small stream. While the observer was trying to catch a *Plathemis lydia* male at a fourth pool a female dashed out of hiding and began ovipositing.

This species of dragonfly was never found out over the lake. They apparently preferred the small sunny pools of water and the stock pond station was obviously a favored hunting ground.

Pachydiplax Brauer

One species of *Pachydiplax* is listed for the United States by Needham and Heywood (1929).

Pachydiplax longipennis Burmeister. *Pachydiplax longipennis* was collected June 12 along the shores of Bayou du Chien. They were apparently second only to *Mesothemis simplicicollis* in abundance. This species was recorded as being present in all but three of the stations listed in Table 1. They appeared to be most abundant about floating and emergent vegetation in the lake in the vicinity of Walnut Log and Samburg. This dragonfly was recorded as present in abundance along the shores of Bayou du Chien on the first day of this investigation, June 12, and for the same station they were found to be apparently equally numerous on August 23 near the end of the period.

In the afternoon of August 8, *Pachydiplax longipennis* were observed resting in considerable numbers on telephone wires along the road from the Spillway to Tiptonville. They were all facing in the same direction, abdomens pointed almost vertically upward and wings drooped in a manner characteristic of the species. Other records were obtained of this peculiar habit both before and after this date. Peculiarly enough, this seemed to be the only species that chose this resting place.

Needham and Heywood (1929, p. 25) have this to say about the egg-laying habits of *Pachydiplax longipennis*: ". . . The female blue pirate (*Pachydiplax longipennis*) is unattended by the male. She flies along at a constant level, the length of her abdomen above the water, and now and then swings the tip of it down against the surface to wash off her eggs."

". . . When ovipositing over open water they have a curious habit which I have not observed in other dragonflies. They do not rise and descend again between strokes of the abdomen against the surface of the water, but fly hori-

zontally close to the surface and from time to time strike downward with the abdomen alone, presumably washing off the eggs. In the midst of vegetation, however, they fly down and up again, as do other species."

The author noted a peculiar variation of the above described egg-laying activities of this interesting species. On July 10 a pair of *Pachydiplax longipennis* were observed copulating over the waters of Bayou du Chien. Upon separation from the male the female marked time about the length of her abdomen above the surface, periodically dipping the tip of her abdomen as she pivoted around in the same location. The male alternately perched on a small twig and flew around in the immediate vicinity. Other observations seemed to indicate that this was the rule rather than the exception for this particular species at Reelfoot Lake.

While many instances were noted in which *Pachydiplax longipennis* were victims of other dragonflies, they appeared to live in no fear of them and were constantly associated with them. One very interesting record was secured on August 7, near White's Landing: a *Pachydiplax longipennis* alighted upon the back of a resting *Libellula incesta* and remained there for several minutes before flying away unmolested by the much larger dragonfly.

On August 17 a steady downpour of rain occurred while observations were being made at the Stock Pond Station. A *Pachydiplax longipennis* was observed during the rain resting on a vertical weed stem about eighteen inches from the ground, head up. The wings were held over the back forming about a 90° angle. Water was removed from the face several times by using the front legs and feet.

Mesothemis Hagen

Mesothemis was represented at Reelfoot Lake by one species.

Mesothemis simplicicollis Say. Specimens of *Mesothemis simplicicollis* were collected on the first day of this investigation on June 12. This species was found to be abundantly present in practically the whole of the Reelfoot Lake area. The one exception was the Upper Blue Basin where there were no resting places. Table 1 indicates their general distribution, for they are recorded as present in all but one of the habitats treated by the table. They were apparently more numerous than any other species throughout the time observations were being made (June 12-August 2/).

Mesothemis simplicicollis habitually flew from rest to rest about the sunny margins of ponds and other bodies of water, fields, floating and emergent vegetation, protruding stumps in the lake, etc. They rested on the bare ground, low vegetation, lily pads, and protruding stumps, and when an insect suitable for food came within range, they would dart out, seize the prey, and often return to the same resting place.

These dragonflies were found to feed upon a wide range of insects, including other dragonflies almost as large as themselves and one record was obtained of cannibalism. The following records are typical of the food habits: on the morning of August 6, while the author was resting from the strenuous task of rowing in the vegetation-choked waters of Eastridge Arm, a *Mesothemis simplicicollis* captured a *Pachydiplax longipennis* (a specimen almost as large as itself). At noon, August 10, on the grounds of Blue Wing Club, a *Mesothemis simplicicollis* was captured with another of the same species in its grasp. When netted the victim had already lost its head to satisfy the appetite of what might well have been his brother. Again on July 10 at 2:30 P. M., *Mesothemis simplicicollis* was found to be congregating about protruding cypress stumps out in the lake near Upper Blue Basin and damselflies were climbing out of the water and transforming on these stumps (evident from the large number of fresh exuviae and teneral specimens present). The *Mesothemis simplicicollis* were found to be preying upon these helpless damselflies. On July 30 these dragonflies were found congregated about some cattle in the barn lot at Walnut Log Lodge. They were found to be feeding upon small Dipterous

insects that were on the sows. One caught a deerfly (*Chrysops* sp.).

The following incident was recorded on August 13. A *Mesothemis simplicicollis* was caught over a sunny pool of water in the "Scatters" near Big Ronaldson Slough with a small feather in its "leg basket." When this specimen was netted, it was gnawing upon the end of the feather. It is the author's opinion that the dragonfly had been deceived and caught the feather for an insect as it floated through the air. The reader may draw his own conclusion.

The *M. simplicicollis* were in turn preyed upon by other insects. Robber flies (*Asilidae*) and larger dragonflies were found to feed upon them. On the morning of July 11 the author was hiking along the shore of Bayou du Chien about a half mile above Walnut Log when a *Mesothemis simplicicollis* was noticed on the ground right side up. Close scrutiny revealed that a small robber fly had pushed its proboscis through the soft area at the base of the hind legs and seemed to be sucking the body juices from the dragonfly. The legs of the dragonfly were securely locked around the robber fly. When the dragonfly was picked up by the observer, the robber fly extricated itself and moved around and sank its proboscis in the left compound eye of the dragonfly and continued sucking. On June 16 a *Masiaeschna pentacantha* caught a *Mesothemis simplicicollis* on the border of a cottonfield near the Biological Station.

Spiders probably account for many of the casualties sustained by this species. On August 12 a number of protruding cypress stumps along the margins of the Upper Blue Basin were examined. Many Odonata were found enmeshed in the webs that had been spun by spiders about these stumps. *Mesothemis simplicicollis* was apparently a major victim, probably because of their habit of collecting about these stumps.

Sympetrum Newman

Needham and Heywood (1929) characterize the *Sympetrum* as an autumnal dragonfly.

Sympetrum vicinum Hagen. The *Sympetrum vicinum* were rarely found during the investigation. The first specimen was discovered July 14 in a small ravine at Fishgap Hill. Another was captured, July 29, among some weeds on the trail to Blue Wing Club. A third specimen was taken from some weeds on a bluff of Reelfoot Creek, August 3. No other specimens were found.

Pantala Hagen

Two species of *Pantala* were found at Reelfoot Lake. No breeding records of either species were secured.

Pantala hymenea Say. The first record of *Pantala hymenea* was secured August 9 at Otter Basin. A specimen was shot August 11 in a field near the road just north of Samburg. Two more records were secured August 12 along this road. On August 15 they were found along this road again and also along the road from Tiptonville to Union City.

Pantala flavescens Fabricus. An individual *Pantala flavescens* was observed coursing over the lake at Walnut Log, June 19. No other records were obtained until July 16 when a specimen was captured at the stock pond station. Sight records of individuals were occasionally made until August 11 when the numbers of this species sharply increased along the road from Tiptonville to Walnut Log. Twenty individuals were counted on that date as the observer drove along in a car. A large number of both *Pantala flavescens* and *Pantala hymenea* were congregated in a field near Boyette's Camp on August 15. They were apparently feeding on midges that literally filled the air.

Trapezostigma Hagen

Three species of this genus were found at Reelfoot Lake. *Trapezostigma lacerata* was very abundant. The specimens of the other

two species found were as first identified as *Trapezostigma carolina*. Only a few specimens were secured since they were not very common and difficult to capture. The writer has since made a careful study of all material collected and found a specimen which appears to be *Trapezostigma onusta*.

Trapezostigma lacerata Hagen. *Trapezostigma lacerata* was another widely distributed species. They were found in every station except Eastridge Arm. The writer is of the opinion that the failure to record them there was probably accidental since they forage over great areas. The first records of this species were secured on the lake at Walnut Log, June 19, when they were observed courting and ovipositing. Specimens were shot on June 30 at the same place. This was one of the species found to be abundant in the Reelfoot Lake area.

Trapezostigma lacerata was found coursing over a field on top of Fishgap Hill on July 14 some two miles from the lake.

Bromby (1929) reports records of actual attempts at oviposition on the part of dragonflies along tarvia strewn highways. The author secured records of three species attempting oviposition over macadamized highways. *Trapezostigma lacerata* was one of the species observed attempting ovipositing in this manner.

Trapezostigma lacerata was found coursing over a field on top of Fishgap *onusta* was secured at the Walnut Log lake station. This is the only definite record secured.

Trapezostigma carolina Linnaeus. The first record of *Trapezostigma carolina* was secured on June 27. On June 30 a specimen was shot over the lake at Walnut Log. They are shown in Table 1 to have been found in six stations.

FAMILY AGRIONIDAE

SUBORDER ZYGOPTERA

Agrion Fabricius

Agrion maculatum Beauvius. Male specimens of *Agrion maculatum* were caught along Reelfoot Creek (Station 7) on July 16. No females were found there at anytime. This is probably explained by their preference of running water for oviposition (Needham and Heywood, 1929). This species was found in abundance along Glady Creek (Station 17) on July 17. Both males and females were secured for the collection. Several females were observed ovipositing in the running water of this small stream.

FAMILY COENAGRIONIDAE

SUBFAMILY LESTINAE

Lestes Leach

A more detailed study of the *Lestes* of the Reelfoot Lake area probably would show them to be present in greater numbers than indicated by the specimens secured in this investigation. A number of observations were made of members of this genus copulating and flying across the canal (Station 5). They usually disappeared in the saw grass before any attempt could be made to net them.

Lestes inequalis Walsh. Two records were made of *Lestes inequalis*. One was secured in a clump of lizards tails on the banks of Bayou du Chien (Station 4), the other from the saw grass (Station 5) on June 20.

Lestes rectangularis Say. Specimens of *Lestes rectangularis* were secured among the clumps of saw grass along Bayou du Chien (Station 4) on June 22 and June 23.

Lestes forcipatus Rambur. One specimen was secured in a ravine on top of Fishgap Hill.

SUBFAMILY COENAGRIONINAE

Argia Rambur

Argia apicalis Say. The first specimen of *Argia apicalis*, a female, was secured over a duckweed covered pool in Bayou du Chien (Station 4) near the outlet to Johnson's Basin. Male and female specimens were taken along Glady Creek (Station 17) on July 15 and again on July 18. Male and female specimens were also found along the levee (Station 3) on August 22.

Argia tibialis Rambur. Male and female specimens were found along Glady Creek (Station 17) on July 18.

Enallagma Charpentier

The *Enallagmas* were the dominant damselflies of the vegetation-choked waters of the lake proper. They were abundant about the floating lily pads, duckweeds, and drifts of water-weed collected about the stumps, and were the characteristic damselflies of the lake at Walnut Log, Samburg, and Grassy Bend. Six species were found.

The appendages of the male are held securely by the female when flying in tandem during oviposition. The author observed an interesting incident in connection with this habit. On June 26 out in the lake at Walnut Log (Station 12) a *Mesothemis* seized the male of a tandem pair by the thorax and flew about over the water; the female apparently was oblivious of the plight of the male and continued so while under observation.

Enallagma geminatum Kellicott. Two specimens of *Enallagma geminatum* were taken from the lake at Walnut Log (Station 12) on June 20. Three pairs were secured at the same station on August 12. Again on August 19 a pair was caught in Grassy Bend.

Enallagma signatum Hagen. *Enallagma signatum* were collected over the lake at Walnut Log (Station 12) on June 20, and again at Samburg (Station 13) on June 25. A mating pair was caught over Bayou du Chien (Station 4) on July 2. The appendages of the male were caught and held firmly by the female. When the female was resting on a floating piece of bark, ovipositing, the male was forced into a vertical position with his head thrust straight up into the air. This characteristic appeared rather comical when hundreds were found to be ovipositing in a mass of waterweeds within an area of a few square feet on August 26. One male was secured at Glady Creek (Station 17) on July 18. This species was common in Grassy Bend on August 19.

Enallagma exsulans Hagen. Three male specimens of *Enallagma exsulans* were secured, two on August 18 at Glady Creek (Station 17) and at the levee (Station 3) on August 22.

Enallagma civile Hagen. *Enallagma civile* males were common in August about floating and emergent vegetation. However, they were extremely difficult to capture.

Ischnura Charpentier

Ischnura posita Hagen. This species was found in abundance and was the most widely distributed of the Zygoptera at Reelfoot Lake.

IV. SUMMARY

1. A survey was made of the Odonata fauna of the Reelfoot Lake area extending from June 12 to August 27, 1934. Data was collected on the distribution, habits, and number of species in the area.

2. Thirty-one species representing twenty genera were found. Twenty of these belonged to the suborder Anisoptera and eleven were members of the suborder Zygoptera.

3. Four species were found to be general in distribution. Twenty-seven species were apparently limited in distribution, because of preference for certain types of habitats. Three species were rarely found and one species was found to be colonized.

4. The number of species and the number of individuals markedly increased during the latter part of July and the first part of August.

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