

THE ODONATA OF LOUISIANA¹

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There is no publication dealing with the Odonata of Louisiana on a statewide basis. Information is scattered in the literature and may be found under the following categories: (1) broad regional works with incidental mention of Louisiana; (2) faunal lists with incidental mention of the Odonata; (3) lists of the Odonata from particular portions of the state; (4) taxonomic studies including Louisiana material.

Hagen (1861) lists 19 species from Louisiana and in 1875 he records 14 as does Banks in 1892. Calvert (1893) lists nine species; Muttkowski (1910) records eight; Needham and Heywood (1929) nine; and Needham and Westfall (1955) list 56. Specific localities are not given for most of these records.

Among the papers which focus on Louisiana but which give only incidental mention to the odonates are those of Shufeldt (1884), Hine (1904, 1906), Glick (1939) and Behre (1950).

Many publications deal with restricted portions of the state. The earliest of this type is the unpublished manuscript of Foster and Smith (1901) which lists 60 species from "Lower Louisiana". Foster (1915), in another unpublished manuscript, lists 14 species from Mound in Madison Parish and Montgomery (1927) records 28 from Madison and Tensas Parishes. The most significant contribution is the work of the late Dr. Mike Wright who published extensively on the Odonata of the Southeastern States. Particularly pertinent to Louisiana are his papers of 1937, 1939, and 1943a, but all are restricted to the southern part of the state.

Primarily because of the Wright collections many recent taxonomic studies include Louisiana material. Among these are contributions by Borror (1942), Gloyd (1940), Walker (1952) and Westfall (1943).

The above sources and a few others list a total of 94 species from Louisiana. Twenty-three of these could not be verified by the writer. One-hundred-and-one species were collected or seen by the writer, 30 of which are new state records.

For areas other than Louisiana important information on the ecology of the Odonata is given by Howe (1921), Kennedy (1915, 1917, 1922b, 1928, 1938), Walker (1941, 1953) and Williamson (1932, 1934). Distribution and seasonal abundance of Indiana species is given by Montgomery (1942, 1944, 1947, 1948). Species composition in relation to physiography, climate and habitat has seldom been undertaken on a state or regional basis. Byers' (1930) analysis

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of the ecology of the Odonata of Florida is perhaps the most comprehensive work of this type.

The present study summarizes data from well over 1,000 collections obtained in all parts of Louisiana during a 20 year period. It presents the first statewide list of species, notes the habitat and behavior of many species, and analyzes distribution in relation to physiography, climate, and habitat.

Many persons assisted in this study. To all of them I extend my sincere thanks. Numerous collections were made by Drs. G. H. Penn and R. D. Suttkus of Tulane University and by my former students J. F. Aycock, L. L. Ellis, L. E. Hornuff and E. N. Lambremont. I was able to study specimens at various institutions in Louisiana because of the interest and cooperation of Drs. J. H. Roberts and O. W. Rosewall of Louisiana State University, Dr. L. T. Graham of Southwestern Louisiana Institute, Dr. J. E. Sublette of Northwestern Louisiana State College and Mr. W. J. Harman of Louisiana Polytechnic Institute. Dr. Sublette and Mr. Harman also personally obtained specimens in their areas. Drs. P. P. Calvert, E. M. Walker, M. J. Westfall and Mr. C. Cook checked certain determinations. I am particularly indebted to Mrs. L. K. Gloyd who not only checked many determinations but also provided unpublished notes which clarified taxonomic difficulties. Drs. T. H. Hubbell and E. J. Kormondy allowed me to study material at the University of Michigan Museum of Zoology, and Dr. Kormondy provided an important file of correspondence between Messrs. E. Foster and E. B. Williamson. Numerous studies of Dr. W. T. Penfound on various plant communities of Louisiana and my personal contact with him furnished an excellent background for this study.

This investigation summarizes collections and observations which began in 1935. Collections were from three sources: (1) those by the writer with detailed notes on habitat and often on behavior; (2) those by members of the Department of Zoology, Tulane University, where the habitat for each collection was described by a checking system and where the extent and accuracy of the information varied somewhat with the collector; (3) collections, from institutions other than Tulane, which gave only locality, date, and collector. It is apparent that information from all sources was not equivalent.

Although each of the state's 64 parishes were represented (fig. 1), collections were most frequent in Orleans and St. Tammany Parishes.³ The rest of the state was sampled by planning the routes of many trips to include all physiographic areas and a variety of habitats. Collections were from all spots along the line of travel which seemed favorable. Both nymphs and adults were taken. However, many collections of *Libellula*, *Gomphus*, and *Macromia* nymphs and all collections of Zygoptera nymphs are omitted because I was not sure of the species.

³ *Parish* is the term used in Louisiana for the unit corresponding to county in all other states.

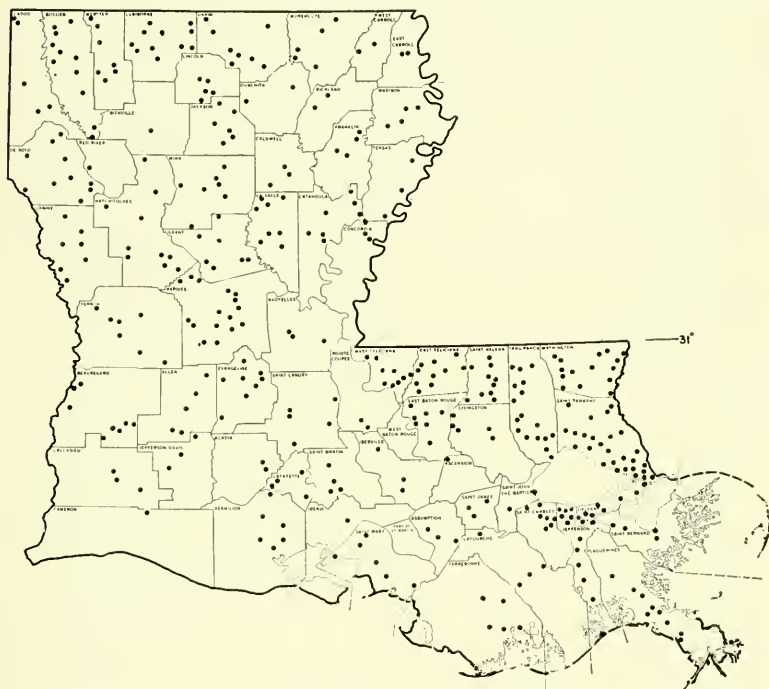


Figure 1. Louisiana parishes and collecting sites. Each of the state's 64 parishes was sampled and 101 species were taken in over 1,000 collections.

Collections were made with traditional net techniques. Original notes were always recorded in the field and are either in the card file of the invertebrate collection of Tulane University or in my notebooks. Adults were papered and nymphs placed in vials of 70% alcohol. Most specimens are in my personal collection, some are in the Tulane collection, and some at other colleges in Louisiana. Representative series were sent to the University of Michigan Museum of Zoology, the Philadelphia Academy of Natural Science, and Cornell University.

CLIMATE

The following salient features of the climate of Louisiana are largely from Dyke (1941). The climate is subtropical because of latitude and proximity to the Gulf. The mean annual temperature is 67° F for the state; 64.1° F in the extreme north and 70.8° F at the mouth of the Mississippi. Mean monthly temperatures (Table 1) vary from 51.8° F in January to 82.3° F in August. The growing season is 220 days in the north and 320 days in the south. From 1950 through 1954 the average January minimum never dropped below 30.9° F anywhere in the state.

TABLE 1.
MEAN MONTHLY TEMPERATURES AND RAINFALL FOR LOUISIANA

Month	Temperature (degrees F)	Rainfall (inches)
January	51.8	4.89
February	54.7	4.54
March	59.8	4.70
April	67.2	4.63
May	73.8	4.46
June	80.4	4.81
July	82.2	6.05
August	82.3	5.07
September	78.0	3.83
October	69.1	3.29
November	58.3	3.78
December	52.9	5.17
Mean annual—67.0		Average annual—55.22

Rainfall is abundant throughout the state during all months and Visser (1955) states that the average annual precipitation of 55 inches is the highest of any state in the country. The wettest month is July with an average state precipitation of 6.05 inches, and the driest is October with a precipitation of 3.29 inches. Average annual precipitation is 46 inches in the northwest and 62 inches in the southeast.

PHYSIOGRAPHY

All of Louisiana is within the Gulf Coastal Plain. Most of the State is west of the Mississippi and belongs to the West Gulf Coastal Plain. The part of the state east of the Mississippi and north of Lake Pontchartrain is usually called the Florida Parishes and is entirely within the East Gulf Coastal Plain. East and West Coastal Plains are divided by the Mississippi Alluvial Plain with an average width of about 50 miles and a length of 596 miles through the state.

Holland (1944) divides the state into two main physiographic sections, the Tertiary Uplands in the northwest and the Quaternary Lowlands throughout the rest of the state. He further subdivides the Quaternary Lowlands into eight units which include outcrops of each Pleistocene terrace and the alluvial cones of each major river.

A preliminary survey showed little correlation between odonate distribution and the smaller physiographic units given by Holland. There were no species peculiar to the Bentley terrace, the Ouachita alluvial cone, etc. Instead of using these units, four large vegetation types were chosen which correspond in general with the physiographic areas of Holland (1944) and of Viosca (1933). In doing this I wish to stress that I am not proposing a new division of physiographic areas or of major vegetation types, but am merely grouping existing units. These four large areas (fig. 2) are characterized briefly as follows:

1. *Pinelands*. This includes the Tertiary Uplands and all Pleisto-

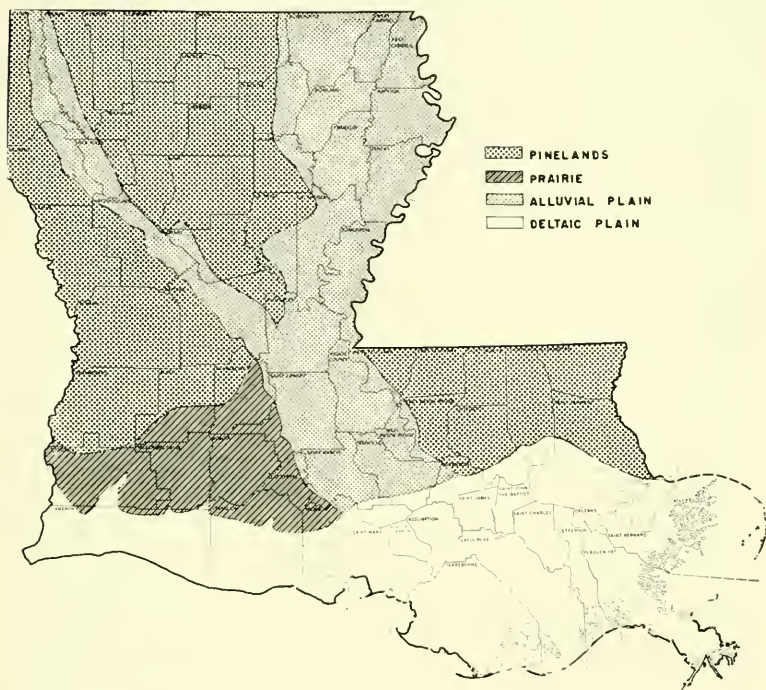


Figure 2. Major physiographic-vegetation areas of Louisiana.

cene terraces except the southwestern Prairie. The Tertiary Uplands of the northwest are primarily shortleaf pine forests. In this area are the highest lands of the state with elevations of approximately 500 feet. The terraces are primarily longleaf or loblolly pine forests. A variety of lentic and lotic habitats are present as a result of the varied topography. The pinelands are the only area in the state where swiftly flowing, clear streams are present. Farms are few and human population density is low. Collecting sites are numerous and varied.

2. *Alluvial*. The alluvial plain of the Mississippi north of Lake Pontchartrain and the alluvial plans of the Red and of the Ouachita Rivers are included here. The forests are primarily mixed hardwood of red gum, oak, elm, and hackberry. Some of the best agricultural lands in Louisiana are along the rivers in this area.

3. *Prairie*. This small area corresponds to Holland's Prairie terrace of southwestern Louisiana. The land is flat with a calcareous hardpan near the surface and the streams are very sluggish. There is a dense human population engaged mainly in rice and cattle growing. Rice cultivation results in extensive wet areas in season and in numerous irrigation canals. All localities are substantially alike and collecting was often impractical because of the dense rural population.

4. *Deltaic*. This area, identical with Holland's Deltaic plain unit, forms a wide band across the southern part of the state. An arbitrary line from the northern shore of Lake Pontchartrain, westward along the northern boundary of Cameron Parish to Texas, forms the northern boundary. The Gulf of Mexico forms the southern boundary. This very recent area was formed by extensions of the deltas of the Mississippi, Atchafalaya, Calcasieu, Sabine, and other rivers. Bordering the streams are the higher front lands which were originally live oak forests but are now mostly cultivated. Elevations are lower away from the streams so that the front lands gradually give way to cypress-tupelo gum swamps and still farther back to fresh water marshes. There are numerous collecting sites in the fresh water swamps, marshes, and borrow pits but most sites are substantially alike. The area is bordered on the south by brackish and salt marshes, but it should be emphasized that abundant fresh water habitats are present in the deltaic plain.

Certain of the habitats recognized in each physiographic unit require description. Borrow pits, very frequent in south Louisiana, are pond-like excavations which provide fill for highways. They may be as wide as 35 feet and extend for miles. Old, well established borrow pits are heavily vegetated and in deltaic areas are often completely covered by dense growths of water hyacinth (*Eichornia crassipes*) and alligator grass (*Alternanthera philoxeroides*).

Lakes in Louisiana never have rocky shores. Many are simply overflow areas of streams and are heavily vegetated with bald cypress (*Taxodium distichum*) and tupelo gum (*Nyssa aquatica*). Locally such areas are called swamps by some, lakes by others. The deep oxbow lakes are always referred to as lakes, but they are often bordered by large swampy areas or by fresh marshes or both so that differences between lake, swamp, and marsh are difficult to define.

Sloughs are small, shallow, static, acid waters in the pinelands with dense stands of black gum (*Nyssa biflora*) and usually with smaller numbers of pond cypress (*Taxodium ascendens*). Sloughs are very different from the extensive swamps of the alluvial and deltaic areas where the waters are invariably alkaline and where the dominant trees are bald cypress (*Taxodium distichum*) and tupelo gum (*Nyssa aquatica*).

Bayou, a term applied to many kinds of streams in the state, is actually a very sluggish stream whose current is reversible. Such streams occur primarily in southern Louisiana where the gradient is very slight. In this study the term bayou is omitted and collections from them are included under the expression sluggish streams.

LIST OF SPECIES

The 101 species collected in Louisiana and seen by the writer are summarized in the following list. The 30 species recorded from the state for the first time are marked with an asterisk.

PETALURIDAE (one species): *1. *Tachopteryx thoreyi*.

CORDULEGASTERIDAE (two species) : *2. *Cordulegaster fasciatus*, 3. *C. maculatus*.

GOMPHIDAE (13 species) : 4. *Progomphus obscurus*, 5. *Aphylla wilsoni*, 6. *Hagenius brevistylus*, *7. *Ophiogomphus mainensis*, *8. *Erpetogomphus designatus*, 9. *Dromogomphus spinosus*, *10. *D. spoliatus*, 11. *Gomphus (Arigomphus) submedianus*, 12. *Gomphus (Gomphus) flavicaudatus*, *13. *G. (G.) hodgesi*, *14. *G. (G.) lividus*, *15. *G. (Stylurus) amnicola*, *16. *G. (S.) plagiatus*.

AESHNIDAE (nine species) : 17. *Gomphaeschna antilope*, *18. *G. furciliata*, *19. *Basiacchna janata*, 20. *Boyeria vinosa*, 21. *Anax junius*, *22. *Anax longipes*, 23. *Coryphaeschna ingens*, 24. *Nasiaeschna pentacantha*, 25. *Epiaeschna heros*.

LIBELLULIDAE (43 species) : 26. *Didymops transversa*, *27. *Macromia georgina*, 28. *M. taeniolata*, *29. *Neurocordulia alabamensis*, 30. *N. molesta*, *31. *N. virginensis*, 32. *Epicordulia princeps*, 33. *Tetragoneuria cynosura*, 34. *Helocordulia uhleri*, 35. *Somatochlora linearis*, 36. *Perithemis tenera*, *37. *Celithemis amanda*, 38. *C. elisa*, 39. *C. eponina*, 40. *C. fasciata*, 41. *C. ornata*, 42. *Macrodiplex balteata*, *43. *Orthemis ferruginea*, 44. *Ladona deplanata*, 45. *Libellula auripennis*, 46. *L. axilena*, *47. *L. flavida*, 48. *L. incesta*, *49. *L. luctuosa*, 50. *L. needhami*, 51. *L. pulchella*, 52. *L. semifasciata*, 53. *L. vibrans*, 54. *Plathemis lydia*, 55. *Erythrodiplax berenice*, 56. *E. connata minuscula*, 57. *E. umbrata*, 58. *Sympetrum ambiguum*, 59. *Tarnetrum corruptum*, 60. *Erythemis simplicicollis*, 61. *Cannacia grvida*, 62. *Pachydiplax longipennis*, 63. *Miathyria marcella*, 64. *Tramea carolina*, 65. *T. lacerata*, 66. *T. onusta*, 67. *Pantala flavescens*, 68. *P. hymenea*.

AGRIONIDAE (four species) : 69. *Agrion dimidiatum*, 70. *A. maculatum*, 71. *Hetaerina americana*, 72. *H. titia*.

LESTIDAE (three species) : 73. *Lestes disjunctus australis*, *74. *L. inaequalis*, *75. *L. rigilar*.

COENAGRIONIDAE (26 species) : 76. *Argia apicalis*, *77. *A. bipunctulata*, 78. *A. fumipennis*, 79. *A. moesta*, 80. *A. sedula*, 81. *A. tibialis*, 82. *A. violacea*, *83. *Nehalennia integricollis*, *84. *Tleallagma duecki*, *85. *Enallagma basidens*, 86. *E. civile*, 87. *E. concisum*, 88. *E. divagans*, *89. *E. dubium*, 90. *E. durum*, 91. *E. exsulans*, 92. *E. geminatum*, 93. *E. signatum*, *94. *E. traviatum*, *95. *E. vesperum*, *96. *E. iceewa*, *97. *Ischnura kellicotti*, 98. *I. posita*, 99. *I. prognatha*, 100. *I. ramburi*, 101. *Anomalagrion hastatum*.

Habitat data for each of these 101 species are given in the following section. An additional 23 species reported in the literature are discussed separately under the heading "Records of species not seen by the writer".

Distribution within the state for most species is listed by parishes. Specific locality as well as parish is given for species recorded from Louisiana for the first time and for those with unusual distribution. Literature records are given in the paragraph headed "Louisiana Records", and data on specimens collected or seen by the writer are listed in the paragraph headed "Collections". The total number of collections of each species seen by the author is given in parentheses.

Because ease of capture of the adults varied greatly with the species depending on behavior and flight patterns and because many nymphs were too young to permit species determination, the exact number of individuals collected is not recorded except for scarce species.

Estimates of abundance are given for certain species.

As collecting was neither random nor equivalent in all areas, precise statistical methods are not used to show frequency of occurrence. Instead frequency percentage figures are often used to present comparisons of species composition in relation to physiography and habitat. These figures are recorded only when there are 10 or more collections of a species. Frequency percentages figures do not always total 100 because a listing of infrequent areas and habitats would be too lengthy.

PETALURIDAE

*1. *Tachopteryx thoreyi* (Hagen)

Collections.—*St. Tammany*. Talisheek, April 3, 1955, 1♂, 1♀; *Union*, Marion, June 24, 1950, 1♂, E. N. Lambremont, ("flying in an open spot in an oak forest").

The Talisheek specimens were from sunny openings in the pine woods. The male perched five feet above ground on the trunk of a pine about 50 feet from the edge of Talisheek Creek; the female was flushed from low weeds and flew a few feet to the trunk of the nearest pine where it was captured at a height of five feet. The female carried a female *Didymops transversa* which had been reduced to a half-eaten thorax, wings, and abdomen.

CORDULEGASTERIDAE

*2. *Cordulegaster fasciatus* Rambur

Collections.—*Webster*. Caney Lake, January 28, 1950, 1 nymph, A. Chaney.

This collection is a considerable westward extension of the range of this southeastern United States species recorded by Needham and Westfall (1955) from only Georgia, Florida, and North Carolina. The nymph was taken, with *Cordulegaster maculatus*, from a shaded, sand-bottomed creek with clear water.

3. *Cordulegaster maculatus* Selys

Louisiana Records.—Needham and Westfall (1955). *St. Tammany* (Wright, 1939).

Collections.—*Webster*, Caney Lake, January 28, 1950, 2 nymphs, A. Chaney. These nymphs were part of the collection described above for *C. fasciatus*.

GOMPHIDAE

4. *Progomphus obscurus* (Rambur)

Louisiana Records.—Foster and Smith (1901), Needham and Westfall (1955). Grant (Byers, 1939; Wright, 1939). *St. Tammany* (Byers, 1939; Wright, 1939; Bick, et al, 1953).

Collections.—Allen, Bossier, Claiborne, East Baton Rouge, East Feliciana, Grant, Livingston, Rapides, *St. Tammany*, Tangipahoa, Union, Vernon, Washington, West Feliciana (53 collections of nymphs, nine of adults).

P. obscurus was collected only in pinelands along swiftly flowing

streams. Adults commonly rested on sunny sand bars and often returned to the same spot, yet were difficult to capture.

The creeks where nymphs were collected were sand (56%) or gravel (22%) bottomed, devoid of vegetation, and less than 15 inches deep. There is a marked discrepancy between 53 collections of nymphs and nine of adults. Byers (1939) discusses this matter and summarizes the ecology of the species.

Adults were collected from April 14 to July 17, but as Needham and Westfall (1955) record a flight season from February (Florida) to September (Texas), I am confident that adults are present in Louisiana earlier than April 14 and later than July 17.

5. *Aphylla williamsoni* Gloyd

Louisiana Records.—Needham and Westfall (1955). Orleans (Wright, 1939, 1943a; Needham, 1940; Bick and Aycock, 1950). St. Charles (Needham, 1940; Wright, 1943a). St. Tammany (Wright, 1939).

Collections.—Beauregard, Hollingsworth, September 9, 1952, 1 ♀; Jefferson, Kenner, October 27, 1952, 3 nymphs; East Baton Rouge, Baton Rouge, September 27, 1953, 1 ♀; Orleans, New Orleans, July 11, 1949, 1 ♂.

All collections were from southern Louisiana and the Hollingsworth collection is the westernmost record of the species. Habitat data are based on personal knowledge of the eight collections reported in the literature and on the four detailed above. Nine collections were from the deltaic plain in the vicinity of New Orleans, two from the pine-lands and one from an alluvial area.

Seven collections of nymphs were from exposed, mud-bottomed ponds with three to four feet of water where vegetation was scanty or absent and two were from sluggish streams. All nymphs, except those in transformation, were taken by sifting the bottom muck through a Needham scraper.

The writer collected but one adult, a female perched two feet above ground on a small weed adjacent to a pineland pond. In Florida, Mr. Aycock collected 220 nymphs from a limestone pit but no adults except those in transformation. Gloyd (1936) considers the adults shy, restless, and rapid in flight.

Adults were taken in Louisiana during June, July, and September. Hornuff (1950) states that emergence extends from late April to late July. Needham and Westfall (1955) report a flight season from April 14 to November 2 in Florida.

6. *Hagenius brevistylus* Selys

Louisiana Records.—Needham and Westfall (1955). Grant (Wright, 1939, 1944). St. Helena (Wright, 1939). St. Tammany (Bick, et al, 1953).

Collections.—Allen, East Feliciana, Rapides, St. Helena, St. Landry, St. Tammany, Tangipahoa, Vernon, Washington (17 collections of nymphs, two of adults).

This species was limited to swiftly flowing streams in the pinelands of southeastern and central Louisiana. Nymphs were nearly always in the shallow water of sand-bottomed streams among log drifts and accumulated debris. Byers (1930) notes that *brevistylus* is a stream form in Florida but that it occurs in both streams and lakes in Michigan.

Adults were collected on June 4 and July 16.

*7. *Ophiogomphus mainensis* Packard

Collections.—Tangipahoa, Roseland, October 2, 1948, 2 nymphs; Washington, Varnado, January 19, 1952, 4 nymphs.

There are no previous Louisiana records of this northeastern United States species but Needham and Westfall (1955) report it from Alabama. The above Louisiana records are the westernmost for the species.

The nymphs from Roseland were in shallow water at the margin of the Amite River at a spot where the river is wide, swiftly flowing and devoid of vegetation or debris. The bottom was covered with gravel which afforded excellent concealment for these brown nymphs. Other odonates were not taken at this distinctive habitat. The nymphs from Varnado were taken with *Erpetogomphus designatus*, *Progomphus obscurus*, *Hagenius brevistylus*, and *Macromia* sp. from the swiftly flowing Pushepatapa Creek in darkly stained water, two to 24 inches deep.

*8. *Erpetogomphus designatus* Hagen

Collections.—Washington, Varnado, January 19, 1952, 1 nymph, R. D. Suttus. This nymph was part of the Washington Parish collection described for *O. mainensis*. It is difficult to account for the apparent scarcity in Louisiana of this widespread eastern United States species which the writer found easy to capture and common at several localities in Oklahoma.

9. *Dromogomphus spinosus* (Selys)

Louisiana Records.—Foster and Smith (1901), Needham and Westfall (1955). Grant and St. Helena (Wright, 1939). St. Tammany (Wright, 1939; Bick, et al, 1953).

Collections.—Allen, East Feliciana, Iberia, Grant, Livingston, Madison, Rapides, St. Helena, St. Tammany (12 collections of nymphs, seven collections of adults).

Sixteen collections were from the pinelands, two from alluvial areas and one from the deltaic plain. Nymphs were taken most often with *Hagenius brevistylus*, *Progomphus obscurus*, *Didymops transversa*, and *Macromia* sp. from small, shallow, sandy creeks.

The flight season was from June 8 to September 11.

*10. *Dromogomphus spoliatus* (Hagen)

Collections.—Bossier, East Feliciana, St. Tammany, Tangipahoa, Washington, Webster (ten collections of nymphs).

D. spoliatus was collected only in the pinelands of two widely separated areas, northwestern Louisiana and the Florida Parishes. All collections were from streams, but two were from pools isolated from the flow, and two were from large expanded portions of swamplike streams. *D. spoliatus* was taken with a variety of both lentic and lotic species including *Erythemis simplicicollis*, *Somatoclora linearis*, *Tetragoneuria cynosura*, *Libellula lydia*, *Progomphus obscurus*, *Boyeria vinosa*.

11. *Gomphus (Arigomphus) submedianus* Williamson

Louisiana Records.—Needham and Westfall (1955).

Collections.—Morehouse, Perryville, June 25, 1950, 1 ♀; *Rapides*, Holloway, July 31, 1953, 1 ♂.

Both collections were from alluvial areas in the northeastern quarter of the state. The individual from Holloway perched on the ground in the extensive flats bordering Catahoula Lake and the Perryville individual perched on weeds in an open field near a sluggish stream.

12. *Gomphus (Gomphus) flavocaudatus* Walker

Louisiana Records.—Needham and Westfall (1955, page 213): "Probably to be considered a variety of *exilis*." *Tangipahoa*, Hammond, March 26, 1938, seven males (type locality, Walker, 1940).

Collections.—St. Tammany, Tangipahoa, Washington (14 collections of adults including 26 males, 10 females and one tandem pair).

This species was collected only from the pinelands of the Florida Parishes near deeply stained, acid water. Most collections were from lentic water including sloughs, ponds, and borrow pits; two collections were adjacent to swiftly flowing creeks.

The largest number of individuals was taken four miles east of Hammond where six flew low along a roadside ditch having little vegetation and five along a large well established borrow pit almost covered with *Nuphar*. At Slidell, ten individuals were collected as they perched low on vegetation some 50 feet from the margin of a small pond. In spite of careful search of all apparent transformation sites at this pond when teneral adults were present in the immediate area, nymphal skins were not found.

G. flavocaudatus adults were collected between March 3 and May 7, a pair in tandem was taken on April 3, but none were collected during many trips to the above localities between June and September. It seems clear that *flavocaudatus* is an early season form.

*13. *Gomphus (Gomphus) hodgesi* Needham

Collections.—St. Tammany, Talisheek, March 1, 1954, 3 ♂, teneral; March 12, 1955, 3 ♂, 1 ♀, 1 pair in tandem, all teneral; April 3, 1955, 1 ♀ (three collections of adults).

The three Louisiana collections were in the immediate vicinity of Talisheek Creek which is a swiftly flowing, cold, pineland stream, 10 to 15 feet wide. The bottom is mostly sand and the depth varies from a few inches to three feet. There are scattered patches of

Potomageton in the stream and marginal patches of *Zizaniopsis*. Three teneral males were taken in full sunlight among weeds at the cleared area around the bridge and the others were collected on low shrubs in exposed portions of the pine woods approximately 50 feet from the creek. Adults did not fly along the creek or perch at its immediate edge.

All Louisiana collections were between March 1 and April 3 and in spite of many trips to Talisheek adults were not collected previous and subsequent to these dates. Needham (1950) records adults in Alabama and Mississippi on March 1, April 16, and May 17. Although the total number of collections of *hodgei* in Louisiana is only three, a brief early flight season is indicated.

*14. *Gomphus (Gomphus) lividus* Selys

Collections.—Lincoln, Ruston, April 19, 1940, 1 ♂; March 31, 1940, 1 ♀ (Louisiana Polytechnic Institute); Natchitoches, Provencal, April 10, 1953, 2 ♂; Tangipahoa, Natalbany, April 3, 1954, 2 ♂ (four collections of adults).

G. lividus was collected from widely separated localities in the pinelands. Habitat data are available for only the Natalbany and Provencal collections which were from small, shallow, sandy creeks in heavily forested areas. Individuals of *G. lividus* frequently perched on the sand of creek beds and often returned to the same spot when disturbed, yet they were difficult to capture. This behavior pattern is similar to that of *Progomphus obscurus*.

*15. *Gomphus (Stylurus) amnicola* Walsh

Collections.—Washington, Varnado, along Pearl River, June 2, 1948, 1 ♀, L. L. Ellis. This northeastern United States species is reported from Alabama (Needham and Westfall, 1955) but not from any other Gulf State.

*16. *Gomphus (Stylurus) plagiatus* Selys

Collections.—Caldwell, Columbia, August 1, 3, 6, 1948, 2 ♂, 1 ♀, L. L. Ellis; Catahoula, Harrisonburg, 1 ♀ ("caught by a robber fly"), June 14, 1950, E. N. Lambremont; West Carroll, Wallace Landing, August 29, 1949, 1 ♂, 1 ♀; St. Tammany, Indian Village, August 26, 1955, 1 ♀, R. D. Suttus (six collections of adults).

Five collections were from alluvial areas in the northeastern part of the state and one from the pinelands of the southeast. All specimens were from sunlit areas.

Collections are too few to generalize on the flight season but the collection of *plagiatus* adults on August 29 was the latest for any species of *Gomphus* in Louisiana.

AESHNIDAE

17. *Gomphaeschna antilope* (Hagen)

Louisiana Records.—Needham and Westfall (1955). Orleans (Gloyd, 1940).

Collections.—*Orleans*, New Orleans, April 11, 1949, 1 ♂; May 14, 1949, 2 ♀.

These New Orleans collections are the westernmost for the species. The three specimens were all taken in buildings. Such indoor collections are not unusual as Gloyd (1940) records a female from the ninth floor of a building in a built-up section of Philadelphia and another female from the third story of the U.S. National Museum in Washington.

All Louisiana collections of *Gomphaeschna* nymphs were from swamps. Martin (1940) records a nymphal skin, believed to be *Gomphaeschna*, from an unspecified locality in Louisiana. The habitat is described as a densely shaded, pineland, black gum swamp, with black, acid water (pH 5.1-5.3), and mud bottom. Needham and Westfall (1955) state that this skin seems to be *Gomphaeschna* by exclusion. Two nymphs in my collection are *Gomphaeschna* but since nymphs of *antelope* and *furcillata* have not been differentiated these specimens can not be placed as to species. One nymph was from a swamp at Kelley's in Jackson Parish, the other from a swamp near Lafayette in Lafayette Parish. Both these swamps have been either drained or dammed and cleared subsequent to collecting the nymphs.

*18. *Gomphaeschna furcillata* (Say)

Collections.—*Orleans*, New Orleans, February 3, 1950, 1 ♀; February 10, 1953, 1 ♀; February 10, 1954, 1 ♂; February 29, 1956, 1 ♀; *Jackson*, Eros, April 1, 1950, 1 ♂; *Madison*, Tallulah, April 7, 1950, 1 ♀ (six collections of adults).

G. furcillata occurred in widely separated localities in the deltaic plain, pinelands, and in alluvial areas. All collections of adults were early in the season between February 3 and April 7. On the Tulane University campus one adult was collected on almost the same date in early February for each of three years. The flight season in Louisiana is probably longer than these early records show as Needham and Westfall (1955) record adults in Michigan as late as August.

*19. *Basiaeschna janata* Say

Collections.—*Washington*, Varnado, three miles east, January 19, 1952, 3 nymphs, R. D. Suttkus.

These nymphs were collected with *Hagenius brevistylus* and *Boyeria vinosa* from a small tributary creek of the Pearl River in a heavily wooded area. The brown, flowing water, six to 30 inches deep, covered a bottom of silt and gravel.

20. *Boyeria vinosa* (Say)

Louisiana Records.—Foster and Smith (1901); Needham and Westfall, (1955). Grant (Wright, 1939). St. Tammany (Bick, et al, 1953).

Collections.—Bossier, Grant, East Feliciana, Livingston, Natchitoches, Rapides, St. Helena, St. Tammany, Tangipahoa, Vernon, Washington, West Feliciana (37 collections of nymphs).

Although widely distributed *Boyeria vinosa* occurred solely in the

pinelands. Nymphs were taken from flowing streams, most often in clear water (80%), with sandy (67%) bottoms. Living adults were collected neither by Byers (1930) in Florida nor by the writer in Louisiana. However, on August 10, 1954, a complete set of wings in good condition was collected in a dry creek bed at Provencal in Natchitoches Parish. The situation here appeared similar to that described by Williamson (1932) who surmised that the severed wings which he found were "discarded fragments from a *Hagenius* lunch counter". The absence of adults in Louisiana collections is doubtless due to the limited number of collections at sunset when *vinosa* becomes active.

21. *Anax junius* (Drury)

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955). Cameron (Hine, 1904). Jefferson (Wright, 1944; Behre, 1950). Madison (Foster, 1915; Montgomery, 1927; Glick, 1939). Orleans (Wright, 1944, 1946a; Penn, 1950). Plaquemines (Wright, 1943a). St. Tammany (Bick, et al, 1953).

Collections.—Allen, Beauregard, Calcasieu, Cameron, Claiborne, Concordia, East Baton Rouge, Evangeline, Franklin, Iberia, Iberville, Jefferson, Lafayette, Lafourche, Lincoln, Madison, Natchitoches, Orleans, Ouachita, Plaquemines, Rapides, Richland, St. Bernard, St. Charles, St. Martin, St. Mary, St. Tammany, Tangipahoa, Terrebonne, Vermilion, Vernon, Washington, West Feliciana (73 sight records of adults, 71 collections of adults, 56 collections of nymphs).

A. junius was collected in 33 parishes, was widely distributed in every physiographic area, but was less frequent and abundant than the ubiquitous *Pachydiplax longipennis* and *Erythemis simplicicollis*. The green darner seldom occurred in swarms as did *Libellula needhami* and *Pantala flavescens*. Yet once, on September 27, 1953, over the marshes of Grand Isle in the Gulf I saw more dragonflies than ever before in a limited area and estimated that at least 1,000 adults of *junius* were in a swarm. Hundreds of individuals of *Tramea carolina* and *Pachydiplax longipennis* were also in the swarm. Since prolonged flight in any one direction was not noted this great concentration was probably the result of mass emergence rather than of migration. On the same date, 12 dead but undamaged individuals were collected along the beach near the water's edge and one dead specimen was carried down into the hole of a crab.

On each of two occasions an adult of *A. junius* dove among a swarm of *Pantala flavescens*, captured one and descended swiftly to the ground where both captor and prey were lost from sight.

Nymphs were collected nearly always (92%) in lentic water which was most often ponds (47%) but they were also taken from a variety of other habitats including one collection from a brackish marsh and one from a swiftly flowing pineland stream. The habitats were nearly always (92%) mud bottomed and were usually heavily vegetated.

A. junius was collected during every month of the year and adults were absent only between December 14 and January 19. This is the

longest seasonal range of any anisopteran in Louisiana. The flight season for 1948 was from April 1 to December 4, for 1949 from January 22 to October 16, for 1950 from March 10 to December 14, for 1951 from March 3 to December 6, for 1952 from January 19 to October 27, for 1953 from March 22 to November 13, and for 1954 from May 6 to November 21.

*22. *Anax longipes* Hagen

Collections.—St. Tammany, Hickory, May 23, 1954; 1 adult; Indian Village, August 30, 1953, 1 adult (two sight records of adults).

Bick (1953) reports this species from Mississippi and summarizes the United States distribution. The individual at Indian Village flew swiftly over a large, shallow pond and allowed but a brief glimpse; the one at Hickory flew more slowly and followed a fairly regular path in an exposed portion of a slough.

23. *Coryphaeschna ingens* Rambur

Louisiana Records.—Cameron (Hine, 1906). Jefferson (Wright, 1944; Behre, 1950). Orleans (Wright, 1946a). Plaquemines (Wright, 1943a). St. Tammany (Wright, 1943a, 1944; Bick, et al, 1953).

Collections.—Allen, East Baton Rouge, Jefferson, Lafayette, Orleans, St. Bernard, St. Charles, St. Helena, St. James, St. Tammany, Tangipahoa, Terrebonne, Vernon (20 collections of adults, 19 of nymphs).

Although recorded from North Carolina and from northern Mississippi, *C. ingens* was restricted to the southern half of Louisiana where it occurred with equal frequency in the pinelands and in the deltaic plain.

All nymphs were from heavily vegetated ponds or from roadside borrow pits.

A swarm was noted at sunset on May 4 along a road through a swamp and six specimens were captured. Wright (1943a) reports frequent swarms just before dusk, and at Pearl River during September saw a swarm estimated at 200 dashing after gnats and tipulids. He (1944, 1946a) discusses damage to honey bees by *C. ingens* in the New Orleans area.

The limits of the flight season were April 15 and October 3.

24. *Nasiaeschna pentacantha* Rambur

Louisiana Records.—Williamson (1899); Foster and Smith (1901); Needham and Westfall (1955). Madison (Montgomery, 1927). Orleans (Hagen, 1875). St. Tammany (Bick, et al, 1953).

Collections.—Ascension, Assumption, De Soto, East Baton Rouge, Jefferson, Iberville, Lafayette, Natchitoches, Orleans, Plaquemines, Richland, St. Charles, St. Tammany, Tangipahoa, Washington (27 collections of nymphs, 17 of adults).

This species was widely distributed but infrequent and never abundant. Fifty-four percent of all collections were from the deltaic plain, 39 percent from pinelands. Eight collections of adults were in buildings. Nymphs occurred in lentic or in very sluggish water, mostly in borrow pits, swamps and ponds.

Adults were collected between March 30 and October 12.

25. *Epiaeschna heros* (Fabricius)

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955). Cameron (Hine, 1906). Orleans (Shufeldt, 1884; Penn, 1950).

Collections.—Allen, Bossier, Caddo, Cameron, East Baton Rouge, East Feliciana, Evangeline, Grant, Iberville, Jackson, Jefferson, Lafayette, Lafourche, Livingston, Natchitoches, Orleans, St. Charles, St. Landry, St. Tammany, Tangipahoa, Terrebonne, Washington, Webster, West Feliciana, Winn (45 collections of nymphs, 21 of adults).

E. heros occurred in all physiographic areas but was most frequent (60%) in the pinelands. Adults were seldom abundant, but on one occasion along a small, swiftly flowing, pineland creek, approximately ten individuals flew a straight course without perching and seven were easily captured. On July 4, at the edge of an extensive swamp about 20 individuals were observed as they repeatedly flew into a large swarm of *Libellula needhami* and pursued certain individuals. One specimen of *heros* was collected carrying a captured *L. needhami*.

Nymphs occurred almost entirely (96%) in lentic water and 51 percent of all collections of nymphs were from swamps. *E. heros* was one of the few members of the limited odonate fauna of swamps.

Earliest and latest dates for adults were February 22 (1949) and October 28 (1950). The October record was exceptional but adults were collected on March 6, 1940, March 23, 1955, March 26, 1949, and 76 percent of all collections were prior to June.

LIBELLULIDAE

26. *Didymops transversa* (Say)

Louisiana Records.—St. Tammany (Bick, et al, 1953).

Collections.—East Feliciana, Grant, Natchitoches, Rapides, St. Tammany, Tangipahoa, Washington (ten collections of nymphs, three of adults).

Didymops transversa was collected from scattered localities in the pinelands of the Florida Parishes and the central part of the state. All nymphs were from flowing streams; eight collections were from small, shallow, sand-bottomed streams, and two from large rivers. *D. transversa* nymphs were associated with *Progomphus obscurus*, *Hagenius brevistylus*, and *Boyeria vinosa*.

Adults were collected on March 12, April 3, and April 10 near swiftly flowing streams in densely wooded areas.

*27. *Macromia georgina* Selys

Collections.—La Salle, Olla, July 29, 1953, 1♂; St. Tammany, St. Tammany, May 12, 1949, 1♂.

Both collections were along creeks in heavily wooded areas in the pinelands. One creek was narrow, shallow, swift, and clear; the other was deeper, more sluggish, and somewhat turbid. Numerous collections of *Macromia* nymphs are not included in this paper because specific identification is not clear to me.

28. *Macromia taeniolata* Rambur

Louisiana Records.—Needham and Westfall (1955). Madison (Montgomery, 1927).

Collections.—Catahoula, Lafayette, Morehouse, Ouachita, St. Tammany, Tangipahoa, Union (eight collections of adults).

M. taeniolata was one of a very few species collected frequently in alluvial areas; it was also present in the pinelands but not in the deltaic plain. There are no obvious habitat differences between the sluggish mud-bottomed streams of the alluvial areas where *taeniolata* was taken and those of the deltaic plain where no species of *Macromia* was seen or collected.

Most collections were along sluggish, mud-bottomed streams but one was along a swiftly flowing, sandy creek and one was from a large pond.

Adults were collected between May 7 and August 11.

*29. *Neurocordulia alabamensis* Hodges

Collections.—*St. Tammany*, Covington, August 10, 1948, 2 nymphs; Talisheek, August 28, 1954, 3 nymphs; *Tangipahoa*, Tangipahoa, August 13, 1948, 2 nymphs; *Washington*, Enon, August 10, 1948, 4 nymphs (four collections of nymphs).

These are the westernmost records for *alabamensis*, previously recorded by Needham and Westfall (1955) from only Alabama, Florida, Georgia, and South Carolina. All Louisiana collections were from the pinelands of the Florida Parishes in clear, flowing creeks with bottoms of sand or of sand and gravel. The nymphs were collected with *Cordulegaster* sp, *Dromogomphus spinosus*, *Hagenius brevistylus*, and *Progomphus obscurus*.

30. *Neurocordulia molesta* Walsh

Louisiana Records.—Needham and Westfall (1955).

Collections.—*Washington*, Angie, June 3, 1950, 1 nymph; *St. Landry*, Washington, June 22, 1948, 1 nymph.

The Angie collection was from the Pearl River in clear, flowing water with a gravel bottom; the other nymph was from the more sluggish, turbid and mud-bottomed Bayou Courtableau.

*31. *Neurocordulia virginienensis* Davis

Collections.—*St. Tammany*, Talisheek, March 12, 1955, 1 nymph.

This nymph was taken with *Dromogomphus spinosus* from a dense patch of *Potomageton* in a shoal area of a small, swift, shallow, sandy, clear water creek in the pinelands. Collecting was frequent at this locality during all seasons but *Neurocordulia* adults were not taken here or elsewhere in Louisiana. Perhaps this is due to the scarcity of collections at twilight when the adults become active.

32. *Epicordulia princeps* (Hagen)

Louisiana Records.—Needham and Westfall (1955). Madison (Montgomery, 1927).

Collections.—Allen, Avoyelles, Catahoula, Claiborne, Jefferson, Madison, Ouachita, Rapides, St. Landry, Union, West Feliciana (six collections of adults, six sight records of adults, one collection of

nymphs).

This species was uncommon and, like *Macromia taeniolata*, was found most often (60%) in alluvial areas. Many years of collecting in the deltaic plain yielded but one nymph from a pond.

Adults were most frequent along large, sluggish streams, with mud bottoms, turbid water, and little or no aquatic vegetation. Wright (1943b) states that *princeps* nymphs always occur on rich mucky bottoms with scanty vegetation and he notes that nymphs were present at one end of a reservoir with a mucky bottom but not at the other end where the bottom was fine sand and gravel.

The flight season was from June 23 to August 19.

33. *Tetragoneuria cynosura* (Say)

Louisiana Records.—Hagen (1875); Calvert (1893); Williamson (1899); Foster and Smith (1901); Martin (1906); Murtkowski (1910); Needham and Heywood (1929); Byers (1930); Needham and Heywood (1929); Byers (1930); Needham and Westfall (1955).

Collections.—De Soto, Jackson, Jefferson, Lincoln, Orleans, Pointe Coupee, Rapides, St. John the Baptist, St. Martin, St. Tammany, Tangipahoa, Washington, Webster, Winn, West Feliciana (37 collections of nymphs, 27 of adults).

T. cynosura was most frequent (74%) in the pinelands but was also found in alluvial and deltaic areas. Nymphs were from lotic (33%) and from varied lentic habitats, including ponds and lakes (33%), borrow pits (22%), and sloughs and swamps (11%). At Bayou Lacombe, Bick, et al (1953) record nymphs as *spinosus*, through typographical error, from stations with practically no flow as well as from others with a definite flow. Nymphs were taken most often (69%) where the bottom was mud and nearly always (92%) among vegetation.

All collections of adults were early in the season between February 17 (1950) and May 3 (1940). The flight season was March 9 to April 8 in 1949, February 17 to April 9 in 1950, and February 21 to March 30 in 1954. Bick (1950) records adults in Mississippi from April to August so it is assumed that they will be taken in Louisiana later than May 3.

34. *Helocordulia uhleri* (Selys)⁴

Louisiana Records.—Needham and Westfall (1955). St. Helena

⁴ After the manuscript of this paper had been put into type I read *Variations in a Local Population of the Dragonfly Helocordulia* (McMahan, E. A. and I. E. Gray, *Ann. Ent. Soc. Amer.*, 50: 62-66, 1957). This caused me to reconsider determinations of *Helocordulia*. A personal communication from Dr. E. J. Kormondy states that legends for male appendages of *uhleri* and of *selysii* (figures 231 and 232) in Needham and Westfall (1955) are reversed and a telegram from Dr. Westfall verifies the reversal. The four males agree with figure 232 which is actually *selysii* and with the McMahan and Gray analysis of *selysii*. However, the immature nymph shows a small but definite spine-like structure dorsally on abdominal segment 6 which indicates that it is *uhleri*. The one female was not available for reexamination.

and St. Tammany (Wright, 1939, 1946b).

Collections.—Lincoln, Ruston, March 30, 1940, 1 ♀ (Louisiana Polytechnic Institute); Rapides, Melder, April 10, 1953, 1 nymph; St. Tammany, Talisheek, March 12, 1955, 4 ♂ (two collections of adults, one of nymphs).

The nymph at Melder was from a clear, shallow, sand-bottomed stream and was the only odonate collected. Adults at Talisheek were from a similar creek where they flew in a straight line four or five feet above the water and were easily captured. *H. uhleri* is usually considered crepuscular but the four adults from Talisheek were collected between 2 and 4 p.m. on a sunny day. Frequent collecting at Talisheek before and after March 12 for many years failed to yield additional specimens.

35. *Somatochlora linearis* (Hagen)

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955). St. Tammany (Wright, 1944; Bick, et al, 1953).

Collections.—Caldwell, Jackson, Lincoln, St. Tammany, Winn (four collections of nymphs, three of adults).

S. linearis occurred in widely scattered localities in the pinelands. All nymphs were from clear, flowing creeks. Adults were collected between June 4 and August 17.

36. *Perithemis tenera* (Say)

Louisiana Records.—Hagen (1861, 1875); Foster and Smith (1901); Calvert (1907); Muttkowski (1910); Needham and Westfall (1955). Madison (Foster, 1915; Montgomery, 1927; Ris, 1930). St. Tammany (Wright, 1937). Tensas (Montgomery, 1927; Ris, 1930).

Collections.—Allen, Ascension, Assumption, Avoyelles, Beauregard, Bossier, Calcasieu, Caldwell, Catahoula, Claiborne, Concordia, De Soto, East Baton Rouge, East Carroll, East Feliciana, Evangeline, Grant, Jefferson, Jefferson Davis, Lafayette, Lafourche, La Salle, Lincoln, Madison, Morehouse, Natchitoches, Orleans, Ouachita, Pointe Coupee, Rapides, Red River, St. Bernard, St. Charles, St. James, St. Martin, St. Mary, St. Tammany, Tangipahoa, Tensas, Union, Vermilion, Vernon, Washington, Webster, West Carroll, West Feliciana, Winn (87 collections of adults 81 sight records of adults, 21 collections of nymphs).

This species was frequent and abundant in all physiographic areas and was collected from 47 of the state's 64 parishes.

Nymphs occurred almost entirely (94%) in lentic water but only 74 percent of the collections of adults were from lentic situations. Most (81%) collections of nymphs were from ponds with mud bottoms and vegetation. Males usually flew low over the water and seldom perched but females perched frequently on low vegetation a short distance from the water.

The long flight season extended from February 1 (1953) to November 6 (1950) yet there was only one collection each in February and March and but two in November. Fifty-two percent of the collections were during July and August. The flight season was April

24 to August 12 in 1948, March 26 to October 24 in 1949, April 16 to October 1 in 1951, February 1 to November 1 in 1953.

*37. *Celithemis amanda* (Hagen)

Collections.—St. Tammany, Florenville, September 9, 1953, 10♂, 1♀.

This is the westernmost record for this Coastal Plain species which is reported by Needham and Westfall (1955) from North Carolina to Mississippi.

The one Louisiana collection was in the pinelands along an old, heavily vegetated roadside borrow pit containing deeply stained acid water. Most individuals perched low on bordering weeds and one was laying eggs. *C. amanda* was collected with *Libellula auripennis*, *L. vibrans*, *Celithemis fasciata*, and *C. ornata*. For many years and during all seasons, collecting was frequent and thorough at this site but specimens of *amanda* were taken only once.

38. *Celithemis elisa* (Hagen)

Louisiana Records.—Foster and Smith (1901).

Collections.—Claiborne, Lincoln, Ouachita, St. Tammany, Washington (ten collections of adults).

C. elisa occurred in widely separated localities in pineland (86%) and in alluvial (14%) areas. Habitat data are available for five collections, four from ponds and one from a borrow pit. Adults flew swiftly over the water, perched infrequently and briefly on low twigs, and were more difficult to capture than other species of the genus.

Seasonal limits for adults were March 9 and September 9.

39. *Celithemis eponina* (Drury)

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955). Orleans (Hagen, 1875; Ris, 1912; Wright, 1937; Penn, 1950). Plaquemines (Wright, 1943a). Tensas (Montgomery, 1927).

Collections.—Allen, Claiborne, East Baton Rouge, Jefferson, Lafayette, Natchitoches, Orleans, Ouachita, St. Tammany, Vermilion, Webster (27 collections of adults, five sight records of adults).

This species was collected in all physiographic areas and often in large numbers. All collections were near lentic water where adults were easily captured as they perched frequently in full sunshine. Wright (1943a) records *eponina* from fresh to almost saline areas in the Central Gulf Coast, but I did not obtain a single specimen of this species from saline areas.

The flight season was from April 21 to September 7.

40. *Celithemis fasciata* Kirby

Louisiana Records.—Foster and Smith (1901); Muttkowski (1910); Williamson (1922); Byers (1930); Needham and Westfall (1955). Orleans (Wright, 1937). St. Tammany (Williamson, 1910).

Collections.—Claiborne, East Baton Rouge, Grant, Ouachita, St. Tammany, Vernon, Washington (six collections of adults, seven sight records of adults).

This species occurred in scattered localities in the pinelands (84%)

and alluvial areas (16%) and was never abundant. Wright (1943a) records *fasciata* in fresh or slightly brackish marshes of the Central Gulf Coast but it was not collected by the writer in any part of the deltaic plain. All collections were from ponds, borrow pits, or lakes where the adults perched less frequently than *eponina* and were more difficult to capture.

Adults were collected from June 29 to September 10.

41. *Celithemis ornata* (Rambur)

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955).

Collections.—St. Tammany (six collections of adults, one collection of last instar nymphal skins).

Both *C. amanda* and *C. ornata* are Coastal Plain species which reach their westernmost limits in the Florida Parishes of Louisiana. All collections were near lentic, heavily vegetated, acid water in the pine-lands. Two collections of adults were along a well established borrow pit, three from a pond, and one from a slough. Most individuals perched low on weeds a few feet above the water; one female had been captured by an *Erythemis simplicicollis*. The exuviae were one foot above water on stems of *Eriocaulon* at the margin of a slough.

Adults were collected from March 12 to September 9.

42. *Macrodiplax balteata* (Hagen)

Louisiana Records.—St. Tammany (Wright, 1939, 1943a).

Wright (1939, 1943a) reports a single collection of *M. balteata* from the State Fish Hatchery at Lacombe in St. Tammany Parish on July 2, 1938 and states (1943a) he is confident that further collections on the Gulf Coast will show this species to be more common than the single collection indicates. I did not collect *balteata* in Louisiana but, through the kindness of Dr. Kormondy, I examined the two males in the University of Michigan Museum of Zoology collected by M. Wright.

*43. *Orthemis ferruginea* Fabricius

Collections.—Allen, Beauregard, Claiborne, Concordia, De Soto, East Baton Rouge, Jefferson, Lafayette, Orleans, St. Tammany, Vernon, West Carroll (ten collections of adults, ten sight records of adults, three collections of nymphs).

Wright (1937, 1943a) reports this species from the Central Gulf Coast but does not specifically mention Louisiana. *Orthemis ferruginea* was taken in widely scattered localities from Claiborne and West Carroll Parishes in the north to Lafayette and St. Tammany in the south yet was never abundant. Collections were most frequent (75%) in the pinelands and much less so in deltaic and in alluvial areas. Nine of the ten collections of adults were near lentic water including ponds, borrow pits, and sloughs. Two collections of nymphs were from ponds, the other from a ditch choked with vegetation.

Adults of this late season species were collected between July 12 (1950) and December 1 (1953). The flight season was August 29

to October 15 in 1949, July 12 to November 2 in 1950, and July 17 to December 1 in 1953.

44. *Ladona deplanata* (Rambur)

Louisiana Records.—Ris (1910); Needham and Westfall (1955).

Collections.—Lincoln, Rapides, St. Tammany, Union (16 collections of adults, three of nymphs).

L. deplanata occurred in the pinelands at widely separated localities. All collections were near lentic water, including sloughs, ponds, and borrow pits.

Adults were taken early in the season, from February 21 to May 5. This range is one of the briefest for any odonate in Louisiana. In spite of frequent collecting throughout the year in the southeastern part of St. Tammany Parish where *deplanata* was common during early spring, adults were not taken there at any other time of the year. During the 1955 season, adults reached a peak of abundance on April 3 at a heavily vegetated acid pond. Here, they flew swiftly approximately three feet above the water and often perched on the ground not more than 20 feet from the water's edge. On March 12 at this pond two last instar exuviae were collected.

45. *Libellula auripennis* Burmeister

Louisiana Records.—Needham and Westfall (1955). Acadia, Livingston, St. Tammany (all by Westfall, 1943). There are numerous other records of *auripennis* from Louisiana prior to the recognition of *needhami* as a distinct species by Westfall (1943). Because most of these include *needhami* they are not listed.

Collections.—Claiborne, Orleans, St. Tammany, Vernon (seven collections of adults).

This species was collected from a few scattered localities and was neither frequent nor abundant anywhere in the state. The penes of hundreds of the golden wing *Libellula* from the New Orleans area were studied and only one specimen was *auripennis*. It was never taken from the coastal marshes where at the height of the season *needhami* occurred in large swarms.

Six collections were from pinelands; one from the deltaic plain. All were near lentic water and three of the seven collections were from sloughs.

Adults were collected between June 29 and September 9.

46. *Libellula axilena* Westwood

Louisiana Records.—Hagen (1875); Calvert (1893); Foster and Smith (1901); Muttkowski (1910); Kennedy 1922a); Needham and Heywood (1929); Byers (1930); Needham and Westfall (1955). Orleans and St. Tammany (Wright, 1939).

Collections.—St. Tammany, Washington (11 collections of adults).

L. axilena is a Coastal Plain species which reaches its western limit in the Florida Parishes. All collections were from the pinelands of the eastern halves of St. Tammany and Washington Parishes in the southeastern part of the state. In this area the ranges of *axilena*, *incesta*, and *vibrans* overlap and *axilena* and *vibrans* were taken at

the same spot on three occasions. *L. axilena* was one of the few species whose range in Louisiana was restricted. It has not crossed the wide alluvial plain of the Mississippi into the pinelands of central and northern Louisiana. In spite of the fact that *axilena* was common in a pineland area at the eastern end of Lake Pontchartrain, it has not crossed the four miles of slightly brackish marsh at the eastern edge of the Lake to enter the deltaic plain near New Orleans. *L. axilena* was not taken in this part of the deltaic plain during 20 years of frequent collecting. For this reason I doubt the validity of the Wright (1939) record from New Orleans.

Most collections were associated with lentic or with very sluggish water and half were from pineland sloughs where *axilena* perched on the branches of small gum trees. This species was more difficult to capture than either *vibrans* or *incesta*. Byers (1930) states that *axilena* is shy and difficult to capture and that it is found deep in hardwood forests, in small open glades, usually near black gum swamps.

The flight season was from May 23 to September 9.

*47. *Libellula flavida* Rambur

Collections.—East Feliciana, Jackson, July 8, 1953, 1 ♀; Lincoln, Dubach, June 26, 1951, 1 ♀ (Louisiana Polytechnic Institute); Sabine, Negreet, July 8, 1953, 1 ♂; Tangipahoa, Robert, September 6, 1950, 1 ♀; Union, Marion, June 24, 1950, 1 ♂, 2 ♀; Randolph, July 1, 1950, 1 ♀ (six collections of adults).

L. flavida was scarce and occurred in widely scattered localities in the pinelands. Habitat notes are available only for the individual from Jackson which perched low on weeds along a small creek in an exposed portion of a densely wooded beech-magnolia area.

48. *Libellula incesta* Hagen

Louisiana Records.—Needham and Westfall (1955). Madison (Montgomery, 1927).

Collections.—Allen, Ascension, Avoyelles, Beauregard, Bossier, Caddo, Calcasieu, Catahoula, Claiborne, Evangeline, East Feliciana, Grant, Jackson, Lafayette, La Salle, Lincoln, Morehouse, Natchitoches, Ouachita, Rapides, Sabine, St. Helena, St. Tammany, Union, Vernon, Washington, Webster, West Carroll, West Feliciana, Winn (67 collections of adults).

L. incesta was frequent and abundant north of the deltaic plain, in pinelands (76%) and in alluvial areas (24%). The southernmost Louisiana records from Slidell, Gonzales, Lafayette and Sulfur coincide with the northern limits of the deltaic plain. North of these points *incesta* occurred with *vibrans*, south of these points *vibrans* was present but neither *incesta* nor *axilena*, and in the eastern halves of St. Tammany and Washington Parishes all three species were present.

L. incesta was taken with equal frequency along sluggish streams and at varied lentic habitats. During July and August, almost any pineland habitat provided many specimens. Most collections were in full sunlight but Wright (1943a) considers *incesta* a shade loving

species. Adults perched low and often returned to the same spot but they were more difficult to capture than the sluggish *vibrans*.

Adults were collected between May 17 (1937) and September 11 (1952). The flight season was June 5 to August 6 in 1948, May 29 to August 30 in 1949, June 18 to September 11 in 1952, and June 23 to September 10 in 1953.

*49. *Libellula luctuosa* Burmeister

Collections.—Bossier, Ninock, August 10, 1954, 2♀; Ouachita, Monroe, August 16, 1953, 1♂.

This distinctive and easily captured species was seen and collected at only two localities in northern Louisiana, and was neither seen nor collected southward. I am confident that *luctuosa* occurs sporadically in the northernmost parts of the state and that it is absent southward.

Although *luctuosa* occurs in parts of Mexico and in most of eastern United States including northern Mississippi, it is absent in the southern part of that state (Bick, 1950) and in Florida (Needham and Westfall, 1955). Since the only record from the Gulf Coast is that of Williamson (1914a) from Bay City, Texas, it seems that *luctuosa* is absent or rare in a wide coastal band across the Gulf States. Factors responsible for this restriction are not clear but absences in coastal parts of the Gulf States were noted for other widely distributed eastern species such as *Libellula cyanea*, *Argia violacea*, and *Enallagma basidens*.

50. *Libellula needhami* Westfall

Louisiana Records.—Needham and Westfall (1955). Acadia, Calcasieu, Cameron, East Baton Rouge, St. Tammany (all by Westfall, 1943). Jefferson (Westfall, 1943; Behre, 1950). Orleans (Westfall, 1943; Bick, 1949; Penn, 1950).

Collections.—Acadia, Assumption, Bossier, Calcasieu, Cameron, East Baton Rouge, Iberia, Jefferson, Lafayette, Lafourche, Orleans, Ouachita, Plaquemines, St. Bernard, St. Charles, St. Mary, St. Tammany, Tangipahoa, Terrebonne, Vermilion (76 collections of adults).

L. needhami was present in every physiographic area but was frequent in the southern part of the State and very scarce north of Baton Rouge. Westfall (1943), considering the general distribution of *needhami* and *auripennis*, states that the latter extends farther inland. In Louisiana, both species were rare north of Baton Rouge, but *auripennis* was also rare in the deltaic plain, an area where *needhami* was both frequent and abundant.

Wright (1943a) states that because of the tremendous concentration of individuals, *L. needhami* forms the most conspicuous component of the fauna of the lower Mississippi delta and that adults congregate in vast swarms and penetrate into New Orleans in clouds. I was equally impressed with the great numbers of this species in the deltaic plain during July and August. Large numbers often perched on shrubbery at night at the well lighted Pontchartrain Beach in New Orleans. Just outside the city limits of New Orleans, by using a flashlight for one half hour each night, Bick (1949) collected twenty

apparently sleeping individuals on May 4, and eighteen on May 24. In July a swarm of approximately 700 individuals was seen at the edge of an extensive swamp. Adults were also present in large numbers in the brackish marshes. Most roads through the marshes are bordered by dense stands of *Phragmites* and on any sunny day in July or August individuals of *needhami* perched on the top of nearly every cane.

Nearly all (97%) collections were associated with lentic water which was most often (42%) ponds, and less frequently borrow pits, fresh and brackish marshes, swamps, and rice fields.

Adults were collected between April 24 (1948) and September 10 (1952). The flight season was April 24 to August 6 in 1948, April 30 to September 3 in 1949, May 1 to September 10 in 1952, and July 3 to September 7 in 1953.

51. *Libellula pulchella* Drury

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955). Orleans (Ris, 1910). West side of Lake Pontchartrain (Wright, 1943a).

Collections.—Catahoula, East Baton Rouge, Lincoln, Ouachita, St. Tammany, Tangipahoa, Washington, West Carroll (seven collections of adults, three sight records of adults).

This transcontinental species was neither frequent nor abundant and neither Wright (1943a) nor the writer collected the distinctive nymph in Louisiana. Adults were taken in pinelands, alluvial areas, and in the deltaic plain. All collections were near lentic water which included ponds, sloughs, and borrow pits. Numerous adults were noted only once as they flew high and constantly over a large pineland pond.

Adults were taken in Louisiana late in the season, between August 29 and November 7, and oviposition was noted as late as September 10, but since Needham and Westfall (1955) record adults in Ohio as early as May 9, earlier collections in Louisiana are anticipated.

52. *Libellula semifasciata* Burmeister

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955). St. Tammany (Wright, 1939, 1943a; Bick, et al, 1953).

Collections.—Allen, Claiborne, Lincoln, St. Tammany, Washington (15 collections of adults, one reared nymph on which the writer's (1951a) description is based, one additional reared nymph).

This species was collected from a few scattered localities in the pinelands. In shaded portions of a pineland slough at Hickory in St. Tammany Parish, adults were often numerous and were easily captured as they frequently perched on dry clumps of grass or on twigs of small gum trees. Both reared nymphs were from the deeply stained acid water of this heavily vegetated slough.

Adults were collected between March 6 and July 26, but 10 of the 14 collections were in March and April. Eggs were attached to a female taken on March 26 and egg laying was noted on April 25. Needham and Heywood (1929) state that *semifasciata* is the earliest of the genus to be abroad in the spring and that it appears in the

north before May. Needham and Westfall (1955) record adults from April 1 in South Carolina to August 16 in New England. Kennedy (1922a) states that the primitiveness of *semifasciata* seems confirmed by its spring and early summer season and perhaps by its retiring habit of life in woods-swamps. In Louisiana, adults were always collected early in the season and always in shaded situations.

53. *Libellula vibrans* Fabricius

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955). Madison (Foster, 1915; Montgomery, 1927; Glick, 1939). Orleans (Ris, 1910; Ferguson, 1942; Penn, 1950). Plaquemines (Wright, 1943a).

Collections.—Allen, Avoyelles, Bossier, Calcasieu, Catahoula, Concordia, East Baton Rouge, East Feliciana, Evangeline, Grant, Iberia, Jefferson, Jefferson Davis, Lafayette, Lafourche, La Salle, Lincoln, Livingston, Morehouse, Orleans, Ouachita, Rapides, Sabine, St. Bernard, St. Charles, St. John the Baptist, St. Helena, St. Landry, St. Mary, St. Tammany, Tangipahoa, Terrebonne, Vernon, Washington (133 collections of adults).

Unlike *L. axilena* and *incesta* whose ranges in Louisiana were limited, *vibrans* occurred throughout the State and was one of the most frequent and abundant odonates, particularly in the deltaic plain where the other two species were absent. *L. vibrans* was one of a very few species abundant in swamps of the deltaic plain. Most (67%) collections were near lentic water including ponds, swamps, and borrow pits.

Wright (1943a) considers *vibrans* the most sluggish of the libellulids and states that it was only occasional in open areas. *L. vibrans* was very sluggish; but although it occurred most often in the shade, collections were frequent in exposed situations.

Adults were collected between March 26 (1949) and September 11 (1952). The flight season was April 15 to August 16 in 1948, March 26 to August 30 in 1949, May 4 to August 15 in 1950, May 4 to September 11 in 1952, April 3 to September 9 in 1953, and April 18 to August 30 in 1954. Adults appeared late in March, approximately two months earlier than the late May appearance of *axilena* and *incesta*. Since adults of the three species were present until the first week of September, the flight season for *vibrans* was approximately two months longer than for *axilena* and *incesta*.

54. *Plathemis lydia* (Drury)

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955). Lafayette (Liner, 1949). Madison (Foster, 1915; Montgomery, 1927). Orleans (Hagen, 1875). Tensas (Montgomery, 1927).

Collections.—Allen, Beauregard, Bienville, Bossier, Catahoula, Claiborne, Concordia, De Soto, East Baton Rouge, East Carroll, East Feliciana, Evangeline, Grant, Jackson, Lafayette, La Salle, Lincoln, Madison, Natchitoches, Ouachita, Rapides, Red River, Richland, St. Tammany, Tangipahoa, Tensas, Washington, Webster, West Carroll, West

Feliciania (41 collections of adults, 37 sight records of adults, 13 collections of nymphs).

P. lydia was widely distributed in all parts of the state except the deltaic plain. Hagen (1875) reports *lydia* from New Orleans but because this distinctive species was neither seen nor collected during 20 years of frequent and thorough collecting in the New Orleans area, I doubt its presence there or anywhere in the deltaic plain. I cannot at present explain the absence of *lydia*, as well as other species, from this extensive area which provides many apparently suitable habitats.

Collections were most frequent (69%) in the pinelands. Adults were taken almost equally near lotic and near lentic water but 11 of the 13 collections of nymphs were from lentic water. Males were more abundant at all sites than females. Individuals of both sexes perched frequently on the ground or on fallen logs but were captured with difficulty.

Adults were collected between March 3 (1951) and November 24 (1939). The flight season was March 15 to August 16 in 1948, May 29 to October 21 in 1949, March 3 to October 1 in 1951, March 28 to September 10 in 1953, and April 3 to August 10 in 1954. Many teneral were collected as late as August 20.

55. *Erythrodiplax berenice* (Drury)

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955). Cameron (Hine, 1904). Jefferson (Borror, 1942; Behre, 1950). Orleans (Penn, 1950). Plaquemines (Borror, 1942; Wright, 1943a). St. Tammany (Borror, 1942; Wright, 1943a). Terrebonne (Borror, 1942).

Collections.—Jefferson, Orleans, Lafourche, Plaquemines, St. Bernard, St. Tammany, Terrebonne (22 collections of adults, one of nymphs).

Wright (1943a) states that adults were restricted to brackish and salt marshes where they were abundant and that they increase in numbers with increasing salinity, but he did not collect the nymphs. I also found *berenice* adults abundant in and restricted to brackish and salt marshes of the deltaic plain but collected a single nymph in Louisiana from the salt marshes at Buras.

The flight season was from April 11 to November 4.

56. *Erythrodiplax connata minuscula* (Rambur)

Louisiana Records.—Needham and Westfall (1955). St. Tammany (Borror, 1942; Wright, 1943a). Terrebonne (Borror, 1942).

Collections.—Allen, Assumption, Bienville, Calcasieu, Claiborne, East Baton Rouge, Jefferson Davis, Lincoln, Natchitoches, Orleans, Ouachita, Rapides, St. Tammany, Washington (37 collections of adults, five of nymphs).

E. c. minuscula was much more widely distributed than *berenice* and occurred in scattered localities in all physiographic areas. Thirty-seven collections were from pinelands, three from the prairie, and one each from alluvial and from deltaic areas. Wright (1943a) considers *minuscula* rare in the marshes of the Central Gulf Coast and

in the present study no adults and but a single nymph were obtained from the entire deltaic plain. In the Slidell area of St. Tammany Parish where pinelands are adjacent to brackish marshes, *minuscula* was regularly collected in the pinelands but never in the marshes, whereas the reverse was true for *berenice*. The five collections of nymphs were from sloughs or borrow pits.

Adults were collected from April 9 (1950) to November 18 (1953). The flight season was May 12 to October 15 in 1949, April 9 to November 5 in 1950, and May 23 to October 26 in 1954.

57. *Erythrodiplax umbrata* (L.)

Louisiana Records.—Needham and Westfall (1955). St. Tammany (Foster and Smith, 1901).

Collections.—Jefferson, Grand Isle, September 27, 1953, 1♂, 1♀. These individuals flew over a small area of standing water along a road about 50 yards from the open Gulf.

58. *Sympetrum ambiguum* (Rambur)

Louisiana Records.—Foster and Smith (1901).

Collections.—East Baton Rouge, Richland, St. Tammany (ten collections of adults, one of nymphs).

S. ambiguum was most frequent in shaded swamps and sloughs in the pinelands. Adults were collected between June 27 and November 27 but 77 percent of the collections were in November. Pairs in tandem were taken on November 15. Wright (1943a) reports *ambiguum* as a late summer species in the Central Gulf Coast, rarely found other than in shaded areas.

59. *Tarnetrum corruptum* (Hagen)

Louisiana Records.—Banks (1892); Williamson (1899); Foster and Smith (1901); Calvert (1907); Muttkowski (1910); Needham and Heywood (1929); Byers (1930); Needham and Westfall (1955). Orleans (Wright, 1946c).

Collections.—East Baton Rouge, East Feliciana, Jefferson, Lafayette, Lincoln, Natchitoches, Orleans, Plaquemines, St. Charles, St. Tammany, Tangipahoa, Terrebonne (36 collections of adults, three of nymphs).

This species occurred in scattered localities throughout the state but was most frequent in the deltaic plain, an area where *S. ambiguum* was absent. All collections were near or in lentic water.

The seasonal occurrence was unusual inasmuch as adults were collected as early as March 23 and as late as December 10 but not between May 1 and September 14. One of the 36 collections of adults was in March, five in April, two in September, 14 in October, 11 in November, and three in December. In contrast, Wright (1943a) states that adults appeared in April and lasted throughout the summer.

60. *Erythemis simplicicollis* Say

Louisiana Records.—Hagen (1875); Foster and Smith (1901); Needham and Westfall (1955). Cameron (Hine, 1906). Jefferson (Behre, 1950). Madison (Foster, 1915; Montgomery, 1927). Orleans (Bick, 1941; Wright, 1944; Penn, 1950). Plaquemines (Wright, 1943a). St. Bernard (Hinman, 1933). St. Tammany (Bick, et al,

1953). Tensas (Montgomery, 1927).

Collections.—Acadia, Allen, Ascension, Avoyelles, Beauregard, Bienville, Bossier, Caddo, Calcasieu, Caldwell, Catahoula, Claiborne, De Soto, East Baton Rouge, Evangeline, Franklin, Grant, Iberia, Iberville, Jackson, Jefferson, Jefferson Davis, Lafayette, Lafourche, La Salle, Lincoln, Livingston, Madison, Morehouse, Natchitoches, Orleans, Ouachita, Plaquemines, Pointe Coupee, Rapides, Sabine, St. Bernard, St. Charles, St. Helena, St. James, St. Landry, St. Martin, St. Mary, St. Tammany, Tangipahoa, Tensas, Terrebonne, Vermilion, Vernon, Washington, Webster, West Baton Rouge, West Carroll, West Feliciana, Winn (146 collections of adults, 103 sight records of adults, 151 collections of nymphs).

E. simplicicollis was the second most frequent and abundant odonate in the state and with *Pachydiplax longipennis* was common in all physiographic areas and was represented in 55 of the state's 64 parishes. Wright (1943a) considers these two species similar in habits and abundance and states that at times *Erythemis* almost reached the abundance of *L. needhami*. Although numbers of individuals were not recorded, the writer's opinion is that *P. longipennis* was more abundant than *E. simplicicollis* at nearly every site and that neither rivaled the number of *L. needhami* in the deltaic plain during mid-summer.

Seventy-four percent of all collections of adults and 89 percent of the nymphs were associated with lentic water which included ponds, lakes, borrow pits, fresh water marshes, swamps, and sloughs. Twenty-six percent of the collections of adults and 11 of nymphs were from lotic waters. These percentages from lotic waters, like those for *Pachydiplax*, are much greater than is commonly assumed. Nearly all collections of nymphs were associated with mud and with dense vegetation.

Adults were collected between February 18 (1950) and November 18 (1953). The flight season was February 28 to November 7 in 1948, March 8 to October 24 in 1949. February 18 to November 2 in 1950, March 1 to October 1 in 1951, and March 10 to November 18 in 1953. Bick (1941) states that the flight season extends from March 4 to November 2 and records oviposition on April 10 and on September 24. The present more extensive data require little modification of the earlier statement.

61. *Cannacria gravida* (Calvert)

Louisiana Records.—Needham and Westfall (1955). Cameron (Hine, 1906). Jefferson (Behre, 1950). Orleans (Foster and Smith, 1901). Plaquemines (Wright, 1943a). St. Bernard and St. Tammany (Foster and Smith, 1901). Tensas (Montgomery, 1927).

Collections.—Allen, East Baton Rouge, Jefferson, Lafayette, Lafourche, Natchitoches, Orleans, Ouachita, Plaquemines, Pointe Coupee, St. Bernard, St. Charles, St. Tammany, Terrebonne, Vermilion (32 collections of adults, 12 sight records of adults, four collections of nymphs).

Wright (1943a) lists *gravid*a as one of the five most common species in the Central Gulf Coast in all types of marshes but predominant in brackish marshes. I, too, found *gravid*a abundant in brackish areas and collected it only in the deltaic plain prior to 1953. I considered it restricted to that part of the state until 1953 when it was collected occasionally in all other physiographic areas as far north as Natchitoches and Ouachita Parishes.

*C. gravid*a was taken most often (86%) in the deltaic plain and was by no means restricted to marshes since 71 percent of the collections of adults were from ponds and all nymphs were either from ponds or borrow pits.

The flight season was from April 27 (1954) to October 24 (1949). The season was May 6 to August 17 in 1948, June 10 to October 24 in 1949, May 15 to September 7 in 1952, May 16 to October 16 in 1953, and April 27 to October 15 in 1954.

At the edge of a lagoon in City Park in New Orleans on September 5, individuals of *gravid*a were observed in tandem and laying eggs. The male clasped the female and they flew low over the water for about 15 seconds. Then the female broke away and flew low over the water, rapidly dipping her abdomen among submerged *Ceratophyllum*. During egg laying the male circled above her and at times disrupted her flight, but she eluded him and continued oviposition for at least three minutes. Then they paired again, the female broke away and again oviposited. Three such periods of pairing and ovipositing were observed. While ovipositing, the female never soared or dove but flew parallel to the shore in one direction. After three minutes she circled back and repeated the egg laying in the same direction.

62. *Pachydiplax longipennis* (Burmeister)

Louisiana Records.—Hagen (1875); Foster and Smith (1901); Needham and Westfall (1955). Cameron (Hine, 1906). Jefferson (Behre, 1950). Lincoln (Ferguson, 1942). Madison (Foster, 1915; Glick, 1939; Montgomery, 1927). Orleans (Shufeldt, 1884; Ris, 1911; Bick, 1949; Penn, 1950). Plaquemines (Wright, 1943a). St. Tammany (Bick, et al, 1953).

Collections.—Penn (1951) reported *longipennis* from the parishes marked with an asterisk. Allen,* Ascension,* Assumption,* Avoyelles,* Beauregard,* Bossier,* Caddo,* Calcasieu,* Cameron,* Catahoula,* Claiborne,* De Soto,* East Baton Rouge,* East Feliciana,* Evangeline,* Franklin,* Grant,* Iberia,* Iberville,* Jackson,* Jefferson,* Jefferson Davis,* Lafayette,* Lafourche,* La Salle,* Lincoln,* Livingston,* Madison,* Natchitoches,* Orleans,* Ouachita,* Plaquemines,* Rapides,* Richland,* Sabine,* St. Bernard,* St. Charles,* St. Helena,* St. John the Baptist,* St. Landry,* St. Martin,* St. Mary,* St. Tammany,* Tangipahoa,* Tensas,* Terrebonne,* Union,* Vermilion,* Vernon,* Washington,* Webster,* West Baton Rouge,* West Carroll,* West Feliciana,* Winn (215 collections of adults, 147 collections of nymphs, 141 sight records of adults).

Pachydiplax longipennis was the most frequent and abundant odonate in Louisiana. It occurred in the greatest number of collections, is represented by the largest number of individuals, and, along with *Erythemis simplicicollis*, was present in 55 of the state's 64 parishes in all physiographic areas. There was scarcely a collecting spot where five or six individuals were not encountered at any given time, but *longipennis* was noted only once in a swarm.

Most (66%) collections of adults were associated with a variety of lentic habitats, primarily ponds, but a surprisingly large percentage (34%) was along flowing streams. Eighteen percent of all collections of nymphs were from streams. Because *longipennis* is so generally reported as strictly lentic, these percentages from lotic waters are significant. Almost all collections of nymphs were from habitats with mud bottoms and abundant vegetation.

The long flight season extended from March 9 (1949) to December 2 (1948). The season was March 18 to December 2 in 1948, March 9 to October 24 in 1949, March 24 to November 2 in 1950, March 26 to October 27 in 1952, March 22 to November 18 in 1953, and March 13 to October 26 in 1954. Ovipositing was recorded as late as December 2 and teneral were taken on September 10.

63. *Miathyria marcella* (Selys)

Louisiana Records.—Orleans and St. Tammany (Bick, et al, 1950).

Collections.—*East Baton Rouge*, Baton Rouge, June 14, 1950, 1 ♀; October 2, 1950, 1 ♀; October 10, 1950, 1 ♀; October 14, 1950, 1 ♀; exact date unknown, 1950, 1 ♀; October 1953, 1 ♂, 1 ♀ (all in collection of Louisiana State University); *Orleans*, New Orleans, October 27, 1950, 1 ♀; *St. Tammany*, Hickory, September 29, 1950, 1 ♂; Indian Village, October 22, 1955, 1 ♂, 1 ♀; *West Feliciana*, St. Francisville, July 9, 1953, 1 ♀ (10 collections of adults).

Bick, et al (1950) judge that this neotropical species is well established along the Gulf Coast and subsequent collecting verified this for Louisiana. *Miathyria marcella* occurred in pineland, alluvial and deltaic areas in southern Louisiana north to St. Francisville which is about 96 air miles from the Gulf. Six collections were obtained by the writer; five were near lentic water and one was near a shallow, clear, swiftly flowing, sandy creek.

Adults were collected between June 14 (1950) and October 27 (1950) and since nine of the ten collections were in October, *marcella* is primarily a late season form.

64. *Tramea carolina* (L.)

Louisiana Records.—Foster and Smith (1901); Muttkowski (1910); Needham and Heywood (1929); Needham and Westfall (1955). Cameron (Hine, 1904). Lincoln (Ferguson, 1942). Madison (Foster, 1915). Plaquemines (Wright, 1943a).

Collections.—Allen, Beauregard, Caddo, Caldwell, East Baton Rouge, Grant, Jackson, Jefferson Davis, Lafayette, Livingston, Natchitoches, Orleans, St. Charles, St. John the Baptist, St. Helena, St. Tammany,

Tangipahoa, Terrebonne, Washington, Winn (49 collections of adults, 15 of nymphs).

Tramea carolina was collected from all physiographic areas and was more widely distributed and abundant than *onusta*. Eighty-three percent of the collections of adults were associated with lentic water. Adults were from a variety of habitats including vacant lots in New Orleans, pineland sloughs, and brackish marshes. Like *onusta*, *carolina* was very abundant in prairie rice fields. Byers (1930) also reports *carolina* as common in fields in Florida. Nymphs were from lentic or from sluggish water, nearly always among vegetation.

The flight season extended from February 24 to November 15 but 59 percent of the collections were between August and October. On September 27, 1953, along the beaches at Grand Isle in the Gulf, ten individuals were captured and hundreds were seen among a huge swarm of *Anax junius* and lesser numbers of *Pachydiplax longipennis* in the greatest concentration of odonates I have ever seen.

65. *Tramea lacerata* Hagen

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955). Cameron (Hine, 1906). Lincoln (Ferguson, 1942). Orleans (Penn, 1950; Bick, 1951b). Madison and Tensas (Montgomery, 1927).

Collections.—Allen, Avoyelles, Beauregard, Calcasieu, Claiborne, Evangeline, Jefferson, Jefferson Davis, Lafayette, Lafourche, Lincoln, Natchitoches, Orleans, Ouachita, Plaquemines, Rapides, St. Charles, St. Mary, St. Tammany, Tensas, Terrebonne, Union, Vermilion, Washington, Webster, West Feliciana (28 collections of adults, 33 sight records of adults, one reared nymph).

Tramea lacerata was widely distributed and was collected in all physiographic areas but was never as abundant as *carolina*. Ninety percent of the collections of adults were near exposed lentic water which was most often ponds or lakes. The reared nymph was from a pond with abundant vegetation.

Adults were collected between March 30 and November 5, but 58 of the 61 collections were between July 1 and October 31.

66. *Tramea onusta* Hagen

Louisiana Records.—Foster and Smith (1901); Needham and Westfall (1955); Cameron (Hine, 1906). Madison (Montgomery, 1927).

Collections.—Allen, Beauregard, Caddo, Calcasieu, Cameron, Iberia, Lafayette, St. Mary, St. Tammany, Vermilion, Winn (13 collections of adults).

T. onusta was more localized than either *carolina* or *lacerata* and was taken in the prairie more frequently than either of these species. Unlike all other Louisiana odonates, most (69%) collections were from the southwestern part of the state and there was but a single collection east of the Mississippi. In contrast, 73 percent of the collections of *carolina* were east of the Mississippi and but 22 percent were from the southwestern parishes. This corresponds with unpub-

lished observations in eastern Oklahoma where during five summers there were numerous collections of *onusta* and only two of *carolina*. I surmise that *onusta* is more common than *carolina* west of the Mississippi and that the reverse is true for the eastern states. In spite of difference in frequency, both were taken together at three separate localities in the Louisiana prairie.

The flight season of *onusta* was from March 31 to September 10.

67. *Pantala flavescens* (Fabricius)

Louisiana Records.—Needham and Westfall (1955). Cameron (Hine, 1904). Madison (Montgomery, 1927).

Collections.—Allen, Avoyelles, Assumption, Beauregard, Bossier, Calcasieu, Caldwell, Cameron, Catahoula, Claiborne, Concordia, East Baton Rouge, East Carroll, East Feliciana, Franklin, Grant, Iberia, Jackson, Jefferson, Jefferson Davis, Lafayette, Lafourche, La Salle, Lincoln, Morehouse, Natchitoches, Orleans, Ouachita, Plaquemines, Pointe Coupee, Rapides, St. Charles, St. James, St. Landry, St. Martin, St. Mary, St. Tammany, Tangipahoa, Tensas, Terrebonne, Union, Vermilion, West Carroll, West Feliciana, Winn (71 collections of adults, 67 sight records of adults).

Collections were from 45 of the state's 64 parishes and in every physiographic area. *P. flavescens* was outranked in number of parishes by only *Pachydiplax longipennis*, *Erythemis simplicicollis*, and *Perithemis tenera* but unlike these, *flavescens* often occurred in large swarms. These swarms, always in open areas in full sunlight, were noted in the pine barrens at considerable distance from water, above rice fields in the prairie, over sugar cane fields in the deltaic unit, in lesser numbers near brackish marshes, and in the city of New Orleans. *P. flavescens* and the three species of *Tramea* were at times the most abundant odonates in the prairie.

Adults were recorded between April 13 (1954) and December 5 (1949). The season was June 23 to November 1 in 1948, August 4 to December 5 in 1949, July 8 to November 13 in 1953, and April 13 to October 26 in 1954. The April 13 record was unusually early. All swarms occurred in July and August and adults were common in New Orleans throughout October. Oviposition was observed as late as November 15.

68. *Pantala hymeneae* (Say)

Louisiana Records.—Needham and Westfall (1955). Cameron (Hine, 1906). Madison (Montgomery, 1927).

Collections.—Caddo, Caldwell, Grant, Jackson, Lafayette, Lafourche, Ouachita, Pointe Coupee, St. Tammany, Union (five collections of adults, six sight records of adults).

P. hymeneae occurred in scattered localities in all physiographic areas but was less frequent and abundant than *flavescens*. Adults of *P. hymeneae*, unlike those of *flavescens*, were never noted in swarms and were seldom far from water. One or two individuals of *hymeneae* were observed on several occasions among swarms of *flavescens*.

Adults of *hymeneae* were collected between June 6 and September 9.

AGRIONIDAE

69. *Agrion dimidiatum* (Burmeister)

Louisiana Records.—Foster and Smith (1901).

Collections.—Beauregard, Rapides, St. Helena, St. Tammany, Union, Washington (27 collections of adults).

Wright (1946d) considers *maculatum* common along the Gulf Coast but reports only three collections of *dimidiatum* over a four year period. *Agrion dimidiatum* was not as frequent as *maculatum*, but the author does not consider *dimidiatum* as limited in Louisiana as the Wright comparison indicates.

A. dimidiatum was collected from widely scattered localities in the pinelands, always along small, swift, clear, shaded creeks. *A. maculatum* occurred in the same type of habitat, but since the two species were seldom taken together (never by Wright, 1946d, and three times by the writer), there must be minor differences in habitat requirements which were not detected.

Adults were collected between March 1, (1953, 1954) and September 10 (1952, 1953). Other early dates were March 19, 1949, and March 12, 1955. Adults were often associated with *Argia moesta*, *A. tibialis*, *A. fumipennis* and *A. sedula*.

70. *Agrion maculatum* Beauvois

Louisiana Records.—Foster and Smith (1901); Wright (1943a).

Collections.—Beauregard, Bossier, Claiborne, East Baton Rouge, East Feliciana, Jackson, La Salle, Lincoln, Natchitoches, Ouachita, Rapides, St. Tammany, Tangipahoa, Washington, Winn (46 collections of adults).

Agrion maculatum was more common and more widely distributed than *dimidiatum*. Both occurred along small, swiftly flowing, clear, shaded creeks in the pinelands. At times, *maculatum* was the sole odonate present along very small, heavily shaded, and almost dry creeks. *A. maculatum* was collected with a large number of species but most frequently with *Argia tibialis*.

Adults were collected between March 1 (1954) and October 25 (1940). The flight season was May 9 to October 25 in 1940, May 7 to October 2 in 1948, March 29 to August 6 in 1949, March 28 to September 10 in 1953, and March 1 to October 6 in 1954.

71. *Hetaerina americana* (Fabricius)

Louisiana Records.—Foster and Smith (1901).

Collections.—East Baton Rouge, East Feliciana, St. Helena, Tangipahoa, Washington (nine collections of adults).

H. americana is common throughout the United States but in Louisiana was collected only in the Florida Parishes. This area, as well as the rest of the pinelands of the state, provides many apparently suitable habitats where *americana* was not found. The nine collections obtained during years of effort in Louisiana contrasts with an equal number obtained in southern Oklahoma during eight weeks.

Adults were most frequent along swift, wide, sunlit, sand or gravel

bottomed streams where they often perched on twigs or fallen logs well out in the stream. *H. americana* occurred along wider and more exposed streams than either species of *Agrion*. Williamson (1923) states that *americana* frequents streams 15 feet or more in width.

Adults were collected between April 3 and October 2 and were often taken with *Argia moesta*.

72. *Hetaerina titia* (Drury)

Louisiana Records.—Foster and Smith (1901). Madison (Montgomery, 1927). St. Tammany (Wright, 1943a).

Collections.—Allen, East Baton Rouge, East Feliciana, Evangeline, Rapides, St. Helena, St. Tammany, Tangipahoa, Vernon, Washington (20 collections of adults).

H. titia was present in 20 collections from scattered localities in the pinelands of the southern half of the state whereas *americana* was limited to nine collections in the Florida Parishes.

All collections were from pinelands, mostly along swift, shallow streams with clear water and with sand or gravel bottoms. Well defined habitat differences between *titia* and *americana* could not be detected yet the two were collected together only twice. Wilson (1928) considers *titia* almost identical with *americana* in habitat and the writer shares Wilson's opinion that *titia* was more difficult to capture. Williamson (1923, 1932) considers *titia* more of a shade dweller than *americana*, otherwise he finds it difficult to explain the abundance of one and the absence of the other on some streams.

Adults of *titia* were collected later in the season (June 24 to November 15) than those of *americana* (April 3 to October 2). In contrast, both Williamson (1932) for Missouri and Montgomery (1947) for Indiana give later records for *americana* than for *titia*.

LESTIDAE

73. *Lestes disjunctus australis* Walker

Louisiana Records.—Walker (1953). Terrebonne (Walker, 1952).

Collections.—Ascension, East Baton Rouge, Lincoln, Ouachita, Sabine, St. Tammany (26 collections of adults).

This species was widespread in the pinelands but abundant in few localities. Adults were equally frequent in sloughs and around ponds. *L. d. australis* was most often in sunlight whereas *L. vigilax* was always in the deep shade of black gum sloughs or woods.

Walker (1952) reports adults from March 8 to November 21 in Florida. In Louisiana the flight season was longer, February 19 to December 16, but adults were not collected during April, May, June, and July at localities where they were common in early spring and in late autumn. This indicates a possibility of two emergence peaks in Louisiana.

*74. *Lestes inaequalis* Walsh

Collections.—Webster, Sibley, August 18, 1953, 1♀.

This collection from northwestern Louisiana is a significant extension of the range of this species which Walker (1953) records

south to Oklahoma, Tennessee, and North Carolina. The female perched low on matted roots and vegetative debris above deeply stained water of an extensive swampy area where the underbrush was dense and the entire area heavily shaded. *Enallagma geminatum* and *E. signatum* were also collected at this locality.

*75. *Lestes vigilax* Hagen

Collections.—Bossier, Claiborne, Lincoln, St. Tammany, Tangipahoa (13 collections of adults).

This species was widespread but neither frequent nor abundant. Adults were always in dense shade in acid, pineland sloughs or ponds, never in the numerous alluvial or deltaic swamps of the Mississippi drainage. At one locality, a thick stand of shrubs provided complete cover and was so dense that walking was impossible. Here, numerous individuals perched on trunks, twigs, and moss, just above the saturated soil, and were captured by crawling and using a very unorthodox swing of the net. Only once, at twilight, was *L. vigilax* seen flying from the shade out into the open. These observations agree with Byers' (1930) notes, "Appears in March and is usually associated with the luxuriant mass of low vegetation found around the mucky edges of black gum swamps in heavily wooded areas. Shuns sunlight and companionship, usually occurring alone, in areas singularly free from other Odonata".

The flight season was from April 25 to October 19.

COENAGRIONIDAE

76. *Argia apicalis* (Say)

Louisiana Records.—Banks (1892). Madison and Tensas (Montgomery, 1927).

Collections.—Ascension, Avoyelles, Beauregard, Bienville, Catahoula, East Baton Rouge, East Feliciana, Grant, Lafayette, La Salle, Lincoln, Madison, Natchitoches, St. Helena, Tangipahoa, Tensas, Washington, West Feliciana (31 collections of adults).

This widely distributed species was most often (53%) in pinelands but was one of the few species frequent (43%) in alluvial areas. *Argia apicalis* and *A. tibialis* were the only members of the genus collected in the prairie, and no species of *Argia* was collected in the deltaic plain. *A. apicalis* occurred most often (66%) along streams which were either swift or sluggish.

The limits of the flight season were April 17 (1954) and November 24 (1951). Other early and late dates were April 24, 1951, November 15, 1936, October 2, 1948, October 19, 1950, October 4, 1953, October 20, 1954.

*77. *Argia bipunctulata* (Hagen)

Collections.—Caldwell, Columbia, August 4, 1948, 2♂; De Soto, Keachie, August 2, 1949, 1♂; Lincoln, Ruston, May 20, 1938, 1♀; May 5, 1940, 1♂ (Louisiana Polytechnic Institute) (four collections of adults).

All collections were from northern parishes, three from the pine-

lands and one from an alluvial area.

78. *Argia fumipennis* (Burmeister)

Louisiana Records.—Foster and Smith (1901); Wright (1943a).

Collections.—East Baton Rouge, East Feliciana, St. Helena, St. Tammany, Tangipahoa, Washington (20 collections of adults).

This Coastal Plain species reaches its western limit in the Florida Parishes. The wide Mississippi alluvial plain is apparently a barrier to its westward extension.

A. fumipennis was always in pinelands, most often (89%) in the shade along small, swiftly flowing, sandy creeks with acid water. Associates were recorded for eight collections and seven of these included either *Agrion dimidiatum* or *maculatum*. Unlike these species which were always at the creeks, *fumipennis* was found twice, without associates, more than 200 yards from water.

The limits of the flight season were March 28 (1953) and October 4 (1948). Other early and late records are April 26, 1939, April 21, 1951, April 25, 1954, April 3, 1955; September 8, 1950, September 10, 1953.

79. *Argia moesta* (Hagen)

Louisiana Records.—Foster and Smith (1901).

Collections.—Allen, Beauregard, Claiborne, East Baton Rouge, East Feliciana, Grant, La Salle, Livingston, Morehouse, Rapides, St. Helena, St. Tammany, Tangipahoa, Vernon, Washington, Winn (45 collections of adults).

Williamson (1932) states that *moesta* is a river species, but Borror (1944) and Walker (1941, 1953) note that it occurs along rocky shores of lakes as well as along streams. Kennedy (1922) reports *moesta* abundant along the rocky, wave-swept shores of the Bass Islands in Lake Erie. None of the 45 Louisiana collections of adults were from lentic water; all were from pineland streams. However, fresh water lakes in Louisiana are rarely wind-swept and turbulent. Apparently moving water of either streams or wave-washed lakes is required by *moesta*.

Wright (1943a) states that *A. moesta* occurs in the same areas as *A. fumipennis*. The present study records both species along flowing water in the pinelands, but *fumipennis* was restricted to small, very swift creeks whereas *moesta* was found along both small, swift creeks and large, slow streams. The two were collected together only twice. *A. moesta* was taken most often with *Argia tibialis* and *A. sedula*.

The flight season was from April 3 (1955) to September 11 (1952). Other early and late records are April 29, 1948, April 3, 1954, and September 10, 1953.

80. *Argia sedula* (Hagen)

Louisiana Records.—Madison and Tensas (Montgomery, 1927).

Collections.—East Baton Rouge, East Feliciana, La Salle, Livingston, St. Helena, St. Tammany, Tangipahoa, Washington, West Feliciana (26 collections of adults).

Argia sedula occurred along small, swift, sandy creeks in the pine-

lands. It was less widely distributed and less abundant locally than either *Argia moesta* or *A. tibialis* with which it was frequently associated.

The flight season was from April 17 to September 10.

81. *Argia tibialis* (Rambur)

Louisiana Records.—Foster and Smith (1901). Madison (Montgomery, 1927). St. Tammany (Wright, 1943a).

Collections.—Allen, Ascension, Beauregard, Bossier, Caddo, Catahoula, Claiborne, De Soto, East Baton Rouge, East Feliciana, Evangeline, Jackson, Jefferson Davis, Grant, La Salle, Lincoln, Livingston, Madison, Morehouse, Natchitoches, Rapides, St. Helena, St. Landry, St. Tammany, Tangipahoa, Union, Vernon, Washington, Webster, West Carroll, Winn (83 collections of adults).

A. tibialis, the most frequent and widely distributed species of *Argia* in Louisiana, was absent in the deltaic plain. It occurred most often (87%) in the pinelands, seldom (11%) in alluvial areas, and rarely (2%) in the prairie.

This species was collected from a wider range of habitats than any other *Argia*. In the pinelands, *A. tibialis* occurred along swift creeks (73%), along sluggish streams (9%), and near sloughs, swamps, or ponds (5%). In alluvial areas it was taken near sluggish streams (9%) and at an oxbow lake. There was one collection from a sluggish stream in the prairie. The wide range of habitats is reflected in the list of associates which included both lentic and lotic species: *Agrion maculatum*, *Argia moesta*, *Libellula incesta*, *Erythemis simplicicollis*, *Pachydiplax longipennis* and *Ischnura posita*.

Adults were collected between March 13 (1954) and September 16 (1948). The flight season was April 29 to September 16 in 1948, March 26 to August 30 in 1949, and April 10 to September 10 in 1953.

82. *Argia violacea* (Hagen)

Louisiana Records.—Foster and Smith (1901).

Collections.—Claiborne, Homer, August 17, 1953, 1♂; Vernon, Cravens, July 17, 1953, 5♂.

A. violacea, a common and widespread eastern United States species reported as far south as Guatemala, was present in but two of the writer's collections. Both were from ponds. The pond at Homer was small, shaded, and in a wooded area; the one at Cravens was large, exposed and in barren, cut-over pineland. Other writers (Williamson, 1932; Wright, 1946a; Walker, 1953) record *violacea* from streams.

*83. *Nehalennia integricollis* Calvert

Collections.—Seven collections of adults were obtained from three different sites all within a 20 mile radius in St. Tammany Parish: St. Joe, July 12, 1953, 6♂, 3♀; July 26, 1953, 2♂; May 23, 1954, 12♂, 3♀; August 30, 1954, 2♂, 3♀. Slidell, May 25, 1954, 3♂, 1♀. Florenville, August 31, 1953, 2♂; September 10, 1953, 3♂, 2♀.

N. integricollis is recorded from just three states, New Jersey

(Calvert, 1913; Beatty, 1946); Florida (Byers, 1930; Wright, 1943c); and Oklahoma (Pritchard, 1935). In Louisiana, it was collected from a single area in the pinelands and occurred among abundant low vegetation growing in deeply stained, shallow, acid water. Four collections were from a slough, two along a roadside borrow pit, and one at the edge of a pond. *N. integricollis* was collected with *Enallagma concisum* and *Ischnura kellicotti* at Florenville but, unlike these species, did not perch on the abundant lily pads.

The flight season was from April 25 to September 10.

*84. *Teleallagma daeckii* (Calvert)

Collections.—*St. Tammany*, Slidell, April 25, 1954, 2♂; *St. Joe*, May 23, 1954, 1♂.

This species is recorded from New Jersey to Florida (Needham and Heywood, 1929), from southeastern Oklahoma (Pritchard, 1935), and from Indiana (Montgomery, 1951). There are no published records from any Gulf State west of Florida.

Both collections were in the pinelands within a three mile radius, one from a pond, the other from a slough. At the margins of these deeply stained, acid waters *T. daeckii* flew low among dense vegetation and was collected with *Erythrodiplax connata minuscula*, *Nehalennia integricollis* and *Lestes vigilax*.

*85. *Enallagma basidens* Calvert

Collections.—*Natchitoches*, Natchitoches, October 5, 1954, 1♂, 1♀, (Northwestern State College); *Tensas*, Lake Bruin, August 15, 1953, 3♂, 1 tandem pair.

E. basidens occurs in eastern United States from Texas and Kansas to New York and South Carolina but is not reported from any Gulf State east of Texas. Montgomery (1942) states that when first found in Indiana in 1929, *basidens* had been reported from Kansas and Texas, and that subsequent to 1929 it has increased in Indiana and spread through many states to the Atlantic Coast. Because many years of collecting in Louisiana yielded but three recent records from the northern part of the State, I believe that *basidens* has recently entered Louisiana.

At Lake Bruin, a large oxbow of the Mississippi with abundant marginal vegetation, *basidens* was taken with *Argia apicalis*, *Enallagma vesperum*, *E. signatum* and *Ischnura posita*.

86. *Enallagma civile* (Hagen)

Louisiana Records.—Madison and Tensas (Montgomery, 1927).

Collections.—Caldwell, East Baton Rouge, Jackson, Jefferson, La Salle, Lincoln, Natchitoches, Ouachita, Webster, West Feliciana (22 collections of adults).

E. civile was widely distributed yet neither frequent nor abundant.

The five collections obtained by the writer were from diverse situations. The three pineland collections included one along a moderately flowing stream and two adjacent to ponds. One collection was from an alluvial pond and one from a brackish marsh about 50 yards

from the open waters of the Gulf at Grand Isle. Wright (1943a) does not record *civile* from the Gulf Coast marshes, but Walker (1953) reports it from several stations on Cape Breton Island near the ocean, and Osburn (1906) states that it breeds to some extent in brackish water.

The flight season was from April 4 to November 8.

87. *Enallagma concisum* Williamson

Louisiana Records.—St. Tammany (Wright, 1943a).

Collections.—Jefferson, Grand Isle, September 27, 1953, 1 ♂; St. Tammany, Florenville, August 31, 1953, 10 ♂, 7 ♀, 1 tandem pair; September 10, 1953, 4 ♂, 2 ♀; Slidell, March 6, 1955, 1 ♂; St. Joe, March 12, 1955, 1 ♂ (five collections of adults).

This species, recorded from Georgia (Williamson, 1934), Florida (Byers, 1930; Westfall, 1941), and Louisiana (Wright, 1943a), was restricted to southeastern Louisiana, and the record from Grand Isle is the westernmost for the species.

Collections were from two different kinds of habitats. The Grand Isle specimen was taken with *E. civile* as both flew low among grass in a brackish marsh about 50 yards from the Gulf. These are the only species of *Enallagma* which I found in brackish areas in Louisiana. Other collections were from pinelands. Both Florenville collections were at the margin of a borrow pit of stained, acid water covered with pads of *Nuphar*. Here *E. concisum* was associated with *Nehalennia integricollis*, *Enallagma dubium* and *Ischnura kellicotti*. The Slidell and St. Joe specimens were from margins of heavily vegetated acid ponds and were associated with *Enallagma signatum*, *Ischnura posita*, *I. ramburi* and *Anomalagrion hastatum*. Individuals of *concisum* were taken both from *Nuphar* pads and among marginal vegetation, both at dusk and in full sunlight.

88. *Enallagma divagans* Selys

Louisiana Records.—Foster and Smith (1901).

Collections.—Natchitoches, St. Helena, St. Tammany, Tangipahoa (11 collections of adults).

This species was collected from pinelands in the eastern and central parts of the state. Nine of the 11 collections were along small, swift creeks; two were from lentic waters. Williamson (1932) reports *divagans* from glacial lakes, pools in spring fed brooks, and from sloughs along steep hills.

E. divagans was one of the few early season species and was not collected later than May. Specimens were taken between March 14 and May 7, but not later in the season in spite of repeated collecting at the same localities. Teneral were numerous on April 10 and 17. In Indiana, Montgomery (1942) records *divagans* from May to early July.

At the creeks, *divagans* was associated with *Agrion dimidiatum*, *Argia fumipennis* and *A. tibialis*; at a pond with *Argia apicalis*, *Enallagma traviatum*, *E. signatum* and *Ischnura posita*.

*89. *Enallagma dobium* Root

Collections.—*St. Tammany*, Florenville, September 10, 1953, 2♂; Hickory, May 23, 1954, 1♂; Folsom, September 10, 1953, 2♂.

E. dubium is reported previously from only Georgia (Root, 1924; Williamson, 1934), Florida (Byers, 1930; Westfall, 1941), Mississippi (Wright, 1943a), and southeastern Oklahoma (Pritchard, 1935).

The three Louisiana collections were from lentic, stained, acid water in the pinelands; two from borrow pits, one from a slough. *E. dubium* did not perch on the *Nuphar* pads abundant at one site but on small dead twigs in the water or on marginal vegetation. Associated species were *Enallagma concisum*, *Nehalennia integricollis* and *Anomalagrion bastatum*.

90. *Enallagma durum* Hagen

Louisiana Records.—Banks (1892); Calvert (1893); Foster and Smith (1901); Muttkowski (1910); Needham and Heywood (1929); Byers (1930). Madison (Foster, 1915). Jefferson (Behre, 1950).

Collections.—*Orleans*, New Orleans, June 9, 1923, 1♀, T. H. Hubbell, (University of Michigan, Museum of Zoology); *Orleans*, New Orleans, April 25, 1954, 2♂, 1♀; April 27, 1954, 1♀; May 10, 1954, 2♂, 2♀ (four collections of adults).

Although frequently reported from Louisiana and considered widespread and common in the Central Gulf Coast by Wright (1943a), *durum* was not collected in Louisiana by the writer until 1954 when it was found within the city limits of New Orleans. All specimens were from artificial ponds and were taken with *Ischnura ramburi* and *I. posita*. Wright (1943a) finds *durum* abundant in brackish areas of the Central Gulf Coast but the writer's collections were from fresh water habitats.

91. *Enallagma exsulans* (Hagen)

Louisiana Records.—Walker (1953). Madison (Montgomery, 1927).

Collections.—*Madison*, Tendal, August 16, 1953, 5♂, 3♀; *Washington*, Franklinton, September 10, 1953, 3♂.

E. exsulans is recorded throughout eastern United States west to North Dakota and Texas but was scarce in Louisiana and restricted to the eastern part of the state. In the pinelands at Franklinton, *exsulans* hovered over the deeper holes in a swift, clear, sand-bottomed stream and was collected with *Agrion maculatum*, *A. dimidiatum* and *Argia tibialis*. At Tendal, in an alluvial area, *exsulans* was among dense stands of *Zizaniopsis* and *Cephalanthus* at the margin of the sluggish Tensas River and was collected with *Argia apicalis*, *A. tibialis* and *Ischnura posita*.

92. *Enallagma geminatum* Kellicott

Louisiana Records.—Needham and Heywood (1929); Byers (1930). Madison and Tensas (Montgomery, 1927).

Collections.—*Webster*, Sibley, August 18, 1953, 2♂, 1♀.

This collection was from a densely shaded swamp where *geminatum* either perched on lily pads or hovered low over the darkly stained

water. *Lestes inaequalis* and *Enallagma signatum* were also collected at this habitat.

93. *Enallagma signatum* (Hagen)

Louisiana Records.—Calvert (1893); Williamson (1899); Foster and Smith (1901); Muttkowski (1910). Cameron (Hine, 1906). Madison and Tensas (Montgomery, 1927).

Collections.—Ascension, Caldwell, Catahoula, Claiborne, East Baton Rouge, Evangeline, Jefferson, Lafourche, Lincoln, Madison, Natchitoches, Orleans, Rapides, St. Martin, St. Tammany, Tangipahoa, Tensas, Webster, West Feliciana (34 collections of adults).

Enallagma signatum and *E. durum* were the sole members of the genus collected in the deltaic plain. *E. signatum* was the most frequent and widespread *Enallagma* in the state and occurred from the Arkansas border to New Orleans, in pinelands (50%), alluvial areas (25%) and in the deltaic plain (25%). Most (72%) collections were from lentic habitats including ponds, lakes, and sloughs but 20 percent were along swift, pineland streams and eight percent along sluggish streams. Walker (1953) also records *signatum* from both lentic and loric habitats.

The limits of the flight season were February 13 (1954) and October 3 (1954). *E. signatum* was also taken in February, 1955, and in March, 1938, 1948, 1950, and 1953 but only once in October. Numerous pairs in tandem were noted on March 5, 1955.

*94. *Enallagma traviatum* Selys

Collections.—Tangipahoa, Amite, April 17, 1954, 8♂, 2♀, all teneral.

These specimens were taken with *Argia apicalis*, *Enallagma divagans*, *E. signatum* and *Ischnura posita* among dense shrubs and vines adjacent to a deep, clear pond in the pine woods.

*95. *Enallagma vesperum* Calvert

Collections.—Claiborne, Summerfield, August 17, 1953, 1♀; Tensas, Lake Bruin, August 15, 1953, 3♂, 2♀. All specimens were teneral. These identifications are tentative pending clarification of the *vesperum-laurenti* difficulty. Mrs. L. K. Gloyd concurs with the determination until more material is available.

The Lake Bruin individuals perched on dense vegetation at the margin of this large oxbow lake and were collected with *Enallagma basidens* and *E. signatum*. The Summerfield collection was from a large artificial pond in an extensive wet area in the pinelands. Walker (1953) states that *vesperum* is semi-crepuscular and flies in the late afternoon and evening. Both Louisiana collections were on sunny days at approximately 3 p.m.

*96. *Enallagma weewa* Byers

Collections.—St. Tammany, Abita Springs, August 31, 1953, 1♂; September 9, 1953, 5♂, 2 tandem pairs; September 10, 1953, 7♂; Talisheek, April 25, 1954, 1♂, 1 tandem pair (four collections of adults).

These Louisiana collections are the westernmost for this species recorded along the Atlantic Coast from New Jersey (Montgomery, 1933; Beatty, 1946) to Florida (Westfall, 1941) and on the Gulf Coast from only Gulf County, Florida (Byers, 1930).

All Louisiana collections were from pinelands along small, shallow, swiftly flowing streams with partly sandy bottoms and very darkly stained acid water. *E. weewa* hovered low over pools and was difficult to see because the dark bodies offered little contrast with the almost black water. Westfall (1941) records this species as abundant at similar habitats in Florida.

In New Jersey, Montgomery (1933) collected 88 males and only one female and Beatty (1946) collected 96 males but no uncoupled females. Uncoupled females were not taken in Louisiana.

The long flight season in Louisiana lasted from April 25 to September 9.

*97. *Ischnura kellicotti* Williamson

Collections.—Claiborne, Randolph, August 17, 1953, 1 ♀; Ouachita, Calhoun, April 1, 1950, 1 ♀; Lincoln, Ruston, October 1, 1954, 2 ♂, (Louisiana Polytechnic Institute); St. Tammany, Florenville, August 31, 1953, 6 ♀ (four collections of adults).

The only previous record of *kellicotti* from any Gulf State is that of Westfall (1941) for Florida.

Habitat data are available for the widely separated Florenville and Randolph localities; both habitats were similar lentic, acid, pineland waters with abundant pads of *Nuphar*. Individuals perched on the pads and were collected by scooping up both pads and water in the air net. Williamson (1899, 1914a) discusses this method of collecting *kellicotti*. At Florenville *kellicotti* was taken with *Enallagma concisum*; at Randolph with *E. signatum*.

98. *Ischnura posita* (Hagen)

Louisiana Records.—Foster and Smith (1901). Madison (Foster, 1915; Montgomery, 1927). Plaquemines (Wright, 1943a). Tensas (Montgomery, 1927).

Collections.—Acadia, Ascension, Caldwell, Catahoula, Claiborne, East Baton Rouge, East Feliciana, Evangeline, Franklin, Grant, Jackson, Jefferson, Lafayette, Lafourche, La Salle, Lincoln, Livingston, Madison, Morehouse, Natchitoches, Orleans, Ouachita, Rapides, Richland, Sabine, St. Charles, St. Martin, St. Tammany, Tangipahoa, Tensas, Terrebonne, Vernon, Washington, Webster, West Feliciana (112 collections of adults).

With the exception of *I. ramburi*, *posita* was the most common damselfly in Louisiana and was recorded from 36 of the state's 64 parishes. *I. posita* occurred from Webster parish in the northwest to Terrebonne, near the Gulf, but was less frequent than *ramburi* in the southern half of the state and particularly so in the New Orleans area.

I. posita was in all physiographic areas, pinelands (60%), deltaic (23%), alluvial (16%), and prairie (1%). It occurred at both lentic (61%) and lotic (39%) habitats. Lentic habitats were most

often well vegetated ponds and lotic ones mostly swift pineland streams. Walker (1953) reports *posita* from both lentic and lotic situations in Canada.

The limits of the flight season were February 13 (1954) and November 30 (1954). These dates were not exceptional for *posita* was taken on February 17, 1949, February 18, 1950, February 15, 1955, November 1, 1949, November 20, 1952.

A total of 184 males and 248 females were collected but pairs in randem were never observed. Walker (1953) states that he has no data on mating or oviposition. On March 12, 1955, I watched a female oviposit on a small succulent plant, at the edge of a pineland pond. Unaccompanied by the male she clasped the stem with her legs about six inches above the water surface with head upward and abdomen arched. For a minute she gently probed the stem with her ovipositor, remained motionless in the same position for four minutes, and then flew away and was captured.

99. *Ischnura prognatha* Hagen

Louisiana Records.—Cameron (Hine, 1906). Orleans (Wright, 1943a).

Collections.—Jefferson, Orleans, St. Tammany, Tangipahoa (14 collections of adults).

This species was infrequent and was limited to southeastern Louisiana. I did not collect *prognatha* in Louisiana prior to 1953 and even though five collections were from my own yard, none was obtained there until 1954.

Fifty-seven percent of the collections were from the deltaic unit, 43 percent from pinelands. Most collections were from lentic situations but five were at least a mile from the nearest water. Byers (1930) states that *prognatha* shuns sunlight and companionship; 12 of the 14 collections were in shade and *prognatha* occurred alone on seven occasions.

Adults were collected between February 15 and September 9.

100. *Ischnura ramburi* Selys

Louisiana Records.—Banks (1892); Calvert (1893, 1902); Foster and Smith (1901). Cameron (Hine, 1904). *Madison* (Foster, 1915; Montgomery, 1927). *Plaquemines* (Wright, 1943a). *Tensas* (Montgomery, 1927).

Collections.—Allen, Ascension, Avoyelles, Beauregard, Bienville, Bossier, Calcasieu, Cameron, Claiborne, East Baton Rouge, East Carroll, East Feliciana, Franklin, Iberia, Jackson, Jefferson, Jefferson Davis, Lafayette, Lafourche, Lincoln, Livingston, Natchitoches, Orleans, Ouachita, Plaquemines, Rapides, St. Mary, St. Tammany, Tangipahoa, Tensas, Terrebonne, Vermilion, West Feliciana (153 collections of adults).

This species was the most common damselfly in Louisiana and was rivaled only by *I. posita*. *I. ramburi* was collected in 33 of the state's 64 parishes from Webster in the northwest to Grand Isle in the Gulf. Ninety-four percent of the collections of *ramburi* were

from the southern half of the state, whereas 61 percent of the collections of *posita* were from this area, and in the New Orleans area there were twice as many collections of *ramburi* as of *posita*. This contrast reflects the continental distribution of the two species. *I. posita* is nearctic and is found throughout eastern United States and Canada; *ramburi* is tropical and in the United States occurs primarily in the southern states.

I. ramburi was in every physiographic area but, unlike *posita*, was much less common (34%) in the pinelands and much more frequent in the deltaic plain (46%) and in the prairie (10%). Seventy-six percent of all collections were at the margins of lentic waters which were most often heavily vegetated ponds.

Adults were collected between January 2 (1949) and December 2 (1948). *I. ramburi* is the only zygopteran collected in Louisiana during every month of the year. The flight season was January 2 to October 4 in 1949, February 18 to November 7 in 1950, March 10 to November 11 in 1953, February 20 to November 30 in 1954.

101. *Anomalagrion bastatum* (Say)

Louisiana Records.—Banks (1892); Williamson (1899); Calvert (1893); Walker (1953). Cameron (Hine, 1904). Madison and Tensas (Montgomery, 1927). Plaquemines (Wright, 1943a).

Collections.—Allen, Caldwell, Claiborne, East Baton Rouge, Franklin, Grant, Iberia, Jackson, Jefferson, Lafayette, La Salle, Lincoln, Madison, Morehouse, Natchitoches, Ouachita, Orleans, Rapides, Richland, St. Helena, St. Martin, St. Tammany, Sabine, Tangipahoa, Vernon, Vermilion, Washington, Webster, Winn (99 collections of adults).

A. bastatum was outranked in frequency by *I. ramburi* and *I. posita*. Both *bastatum* and *posita* were much more frequent in the pinelands (each 60%) than in the deltaic plain (each 23%) whereas the reverse was true for *ramburi*.

Most (87%) collections were near lentic water which included ponds, borrow pits, sloughs, swamps, fresh and brackish marshes. (Wright (1943a) collected adults from the salt marshes of Louisiana and Alabama but does not accept it as a true salt marsh form. Several collections were approximately one mile from water. *I. ramburi* was collected once carrying a partly eaten *bastatum*.

Adults were taken between February 17 (1949) and November 18 (1953). The flight season was March 3 to October 2 in 1948, February 17 to November 7 in 1949, February 18 to September 8 in 1950, and March 28 to November 18 in 1953.

RECORDS OF SPECIES NOT SEEN BY THE WRITER

Most species included here were first recorded in an unpublished manuscript by Foster and Smith (1901) from "Lower Louisiana", an area in the southeastern part of the state embracing Orleans, Jefferson, St. Bernard, St. Tammany and Tangipahoa parishes. The writer collected more frequently in this part of the state than any other, yet

many species listed by Foster and Smith were not collected. While serving with the Louisiana State University Sugar Experiment Station, the Federal Horticultural Board, and the Louisiana State Department of Agriculture, Mr. Edward Foster collected dragonflies in "Lower Louisiana" for many years, corresponded with E. B. Williamson from 1899 to 1923, and sent at least some specimens to Williamson. The Foster letters to Williamson are available at the University of Michigan but none of Foster's specimens could be located there. Wright (1939) suggests that the odonates in the Louisiana State Museum, all but one without data, are probably Foster's specimens.

1. *Gomphus (Arigomphus) lentulus* Needham

Recorded from Louisiana by Needham and Westfall (1955). Westfall (personal communication) states that this record was based on a reared female in the Cornell University collection taken at Des Allemands (St. Charles Parish) on June 6, 1937 and that the specimens can no longer be located. Dr. Westfall, who did not see the specimens, suggests that the original determination was probably in error and that the specimens are possibly *submedianus*.

2. *Gomphus (Arigomphus) pallidus* Rambur

Recorded from New Orleans by Hagen (1875) as *Gomphus pilipes* Selys. Williamson (1899) lists *pallidus* from Louisiana and records one male from New Orleans (1914b). Foster and Smith (1901) include *pallidus* from "Lower Louisiana". On April 9, 1917, Foster sent to Williamson several jars of specimens which were broken in transit and at least some of the specimens damaged. On the back of an April 7, 1917 letter from Foster to Williamson is a list of determinations of these specimens in Williamson's handwriting; included in a vertical column are [sic] "Gom. abbreviatus," "minutus," "pallidus(?)." Needham and Westfall (1955) record *pallidus* from Illinois, Indiana, Louisiana, Massachusetts, Michigan, Mississippi, Oklahoma, and Texas. Records of *pallidus* from Louisiana are probably valid but I doubt that it now occurs in New Orleans for no species of *Gomphus* was taken in the city during 20 years of collecting.

3. *Gomphus (Gomphurus) dilatatus* Rambur

Recorded by Foster and Smith (1901) from "Lower Louisiana". On June 24, 1922, Foster wrote Williamson, "The *Gomphus* you noted in the bottle of fragments we ran down to *dilatatus*. That I distinctly remember and it is recorded on my list as from Amite River, May 28, 1899." Calvert (1921) states, "After this paper had been put into type Mr. Williamson sent me a male and a female *Gomphus* labelled 'Amite River, L[ouisian]a, 5.28.99, Ed. Foster. Fragments received in bottle years ago.'" Calvert then states that in some characteristics these two specimens resemble *lineatifrons* but that in most features they resemble *dilatatus*. Calvert (1923) lists fragments of *dilatatus* from Amite River, Louisiana. Needham and Westfall (1955) record *dilatatus* from Alabama, Florida, Georgia, Louisiana, and South Carolina.

4. *Gomphus (Gomphus) minutus* Rambur

Reported from "Lower Louisiana" by Foster and Smith (1901). Foster's specimens were studied and determined as *minutus* by Williamson in 1917 as mentioned for *pallidus*. The range given by Needham and Westfall (1955) is primarily southern and includes Florida, Georgia, Louisiana and Mississippi.

5. *Gomphus (Gomphus) spicatus* Hagen

Recorded from "Lower Louisiana" by Foster and Smith (1901). This species is not mentioned in the correspondence between Foster and Williamson. Louisiana is far south of the southernmost states, Illinois, Indiana and Ohio, listed by Needham and Westfall (1955). I judge that the Foster and Smith record is based on a misidentification.

6. *Gomphus (Hylogomphus) abbreviatus* Hagen

Recorded from "Lower Louisiana" by Foster and Smith (1901). Foster's specimens, though probably damaged, were studied and determined as *abbreviatus* by Williamson in 1917 as has been mentioned for *pallidus*. *G. abbreviatus* is recorded south to Ohio and South Carolina but not from Louisiana by Needham and Westfall (1955).

7. *Anax amazili* (Burmeister)

Calvert (1927) reports Ris' 1918 record of two females from New Orleans and Calvert (1934) gives the range as Louisiana to Rio de Janeiro and the Galapagos. *A. amazili* is listed for Louisiana by Needham and Heywood (1929) and by Needham and Westfall (1955).

8. *Neurocordulia obsoleta* (Say)

Byers (1937) states that Burmeister's 1839 New Orleans record places this species in the far south and out of its continuous range. All Louisiana records are apparently based on the Burmeister record: Hagen (1875), Calvert (1893), Williamson (1899), Muttkowski (1910), Needham and Heywood (1929), Byers (1930), Needham and Westfall (1955). If the Burmeister specimen was *obsoleta*, I surmise that it was actually collected in the nearby pinelands of St. Tammany Parish and not in New Orleans proper. All *Neurocordulia* nymphs collected by the writer were from flowing creeks in the pinelands; none were from the lentic waters of the New Orleans area.

9. *Tetragoneuria spinigera* Selys

Recorded from Louisiana by Foster and Smith (1901). Wright (1937) states that specimens of *T. spinigera*, without locality data, are in the Louisiana State Museum. These specimens cannot be safely assigned to Louisiana because northern species such as *Leucorrhinia intacta* are also in the museum without data. Louisiana is included in the Needham and Westfall (1955) list but is far south of the other states in their list. Dr. E. J. Kormondy (personal communication) states, "There is no question in my mind that *spinigera* does not occur that far south."

10. *Tetragoneuria stella* Williamson

Williamson (1911), in describing *T. stella* states, "It is interesting to note that Dr. Ris found *stella* in the de Selys collection under the

label *cynosura*. One of these specimens is from Louisiana (Morrison)." *T. stella* is listed from Louisiana by Muttkowski (1915), Byers (1930), and Davis (1933). Needham and Westfall (1955) record it from Florida, Georgia, and Louisiana.

11. *Nannothemis bella* Uhler

Recorded from Louisiana by Foster and Smith (1901) and by Needham and Westfall (1955). Wright (1937) states that this species is in the Louisiana State Museum without data. Westfall (1952) reports *bella* from Lucedale (George County), Mississippi, which is approximately 75 miles east of the Louisiana-Mississippi state line.

12. *Libellula cyanea* Fabricius

The sight record of Foster (1915) from Mound in Madison Parish is the only Louisiana record of this species. Bick (1950) records *cyanea* from Coahoma County, Mississippi, approximately 95 miles north of Mound. I surmise that this species occurs in northern Louisiana.

13. *Ladona exusta* (Say)

Foster and Smith (1901) record *exusta* from "Lower Louisiana". Wright (1937) states that specimens of *exusta* without data are in the Louisiana State Museum. The range of *exusta* in Needham and Westfall (1955) is primarily northern; that of *deplanata* primarily southern. The writer did not collect *exusta* in Louisiana but found *deplanata* common in St. Tammany Parish in "Lower Louisiana". For these reasons, I believe that Louisiana records of *exusta* should be referred to *deplanata*.

14. *Lestes forcipatus* Rambur

Recorded by Foster and Smith (1901) from "Lower Louisiana" and by Foster (1915) from Mound, Louisiana. Walker's 1952 description of *L. disjunctus australis* differentiates it from *forcipatus*, and on page 66 he states, "The general distribution of *L. d. australis* is thus the eastern United States, from Pennsylvania, northern Ohio and Indiana, Iowa, Nebraska and Kansas, south to Florida and west to Texas and Oklahoma." On page 70 he states, "The distributional range of *L. forcipatus* thus centers around the Great Lakes and the St. Lawrence River and from this region it extends northward to the Hudson Bay watershed in Quebec and Ontario, westward to middle Saskatchewan, and southward to Tennessee and Missouri." It seems that Louisiana records of *forcipatus* should be referred to *disjunctus australis*.

15. *Lestes rectangularis* Say

Recorded from "Lower Louisiana" by Foster and Smith (1901). Walker (1953) records *rectangularis* from Nova Scotia to western Ontario and North Dakota to Connecticut, South Carolina, Florida, and Alabama, and west to Kansas and Oklahoma. Based on this distribution, *rectangularis* probably does occur in Louisiana.

16. *Lestes unguiculatus* Hagen

Hine (1906) lists this species from the Gulf Biologic Station in Cameron Parish and states that the determination was by E. B. Williamson. The occurrence of *unguiculatus* in the coastal marshes of Louisiana is considerably farther south than the range given by Walker (1953), Nova Scotia to British Columbia, south to New Jersey, Tennessee, Missouri, Oklahoma, and California.

17. *Lestes vidua* Hagen

Hagen (1861) describes *vidua* from a New Orleans collection. Both Williamson and Foster were apparently concerned about this record for in a 1922 letter to Williamson, Foster writes, "In regard to *Lestes vidua* my notes fail to show that we collected this species, the only record being the original of Hagen, who seems to have described it from the Pfeiffer collection, the whereabouts of which I do not know." Muttkowski (1910) and Wright (1943a) record this species from New Orleans, and Banks (1892), Needham and Heywood (1929), and Byers (1930) list it from Louisiana. The only other records of *vidua* known to the author are from Florida (Byers, 1930) and South Carolina (Montgomery, 1940).

18. *Enallagma aspersum* (Hagen)

Recorded from "Lower Louisiana" by Foster and Smith (1901). Louisiana is a considerable distance south of the range of *aspersum*, recorded by Walker (1953) from South Carolina, Tennessee, and Oklahoma, north to Maine, New Hampshire, and southern Canada.

19. *Enallagma pollutum* (Hagen)

Reported from "Lower Louisiana" by Foster and Smith (1901) in a handwritten addition to their typed manuscript. This note was probably prior to Calvert's (1919) description of *vesperum*. The only other records of *pollutum* known to the writer are from Florida (Byers, 1930; Westfall, 1941).

20. *Enallagma praevarum* (Hagen)

Calvert (1902) mentions Selys' 1876 record of *praevarum* from New Orleans; Banks (1892), Muttkowski (1910), and Needham and Heywood (1929) list it from Louisiana. Montgomery (1942) states that *praevarum* is a western species. There are no records east of Kansas and Oklahoma (Bird, 1932), other than those which seem to be based on the 1876 listing from New Orleans by Selys, therefore I seriously doubt the validity of all records of *praevarum* from Louisiana.

21. *Nehalennia irene* Hagen

Recorded from "Lower Louisiana" by Foster and Smith (1901) and from Madison Parish by Foster (1915), probably before they were aware of Calvert's (1913) description of *integricollis*. Montgomery (1944) gives the range of *irene* as transcontinental in Canada, and in eastern United States as far south as South Carolina. Walker (1953) reports *irene* south only to northern Ohio, Indiana, and Illinois. The writer found *integricollis* locally abundant in St. Tammany

Parish but did not collect *irene* anywhere in Louisiana. For these reasons I doubt the validity of Louisiana records of *irene*.

22. *Nehalennia pallidula* Calvert

Reported from Grand Isle in Jefferson Parish by Behre (1950). Mr. George Beatty informs me in correspondence that he has one female in his collection from Grand Isle, Louisiana.

23. *Ischnura verticalis* Say

Recorded from Louisiana by Calvert (1893), Williamson (1899), and Foster and Smith (1901), and from Madison Parish by Foster (1915). Walker (1953) reports *verticalis* south to South Carolina, Tennessee, and Texas.

GEOGRAPHIC DISTRIBUTION

North American distribution patterns of the 101 species seen by the writer were determined primarily from Needham and Heywood (1929), Montgomery (1942, 1947, 1948), Walker (1953), and Needham and Westfall (1955). Based on area of primary occurrence each species was placed in one of these categories: Eastern, Coastal Plain, Tropical and Eastern, Transcontinental, Tropical and Transcontinental.

Eastern species (59) extend from the Atlantic Coast to a line from North Dakota south through Texas with very few records west of this line. A few included here occur also in Mexico and many are recorded from Canada. These species are *Progomphus obscurus*, *Tachopteryx thoreyi*, *Cordulegaster maculatus*, *Ophiogomphus mainensis*, *Hagenius brevistylus*, *Erpetogomphus designatus*, *Dromopomphus spinosus*, *D. spoliatus*, *Gomphus amnicola*, *G. lividus*, *G. plagiatus*, *G. submedianus*, *Gomphaeschna antilope*, *G. furcillata*, *Basiaeschna janata*, *Boyeria vinosa*, *Nasiaeschna pentacantha*, *Epiaeschna heros*, *Macromia georgina*, *M. taeniolata*, *Didymops transversa*, *Neurocordulia molesta*, *N. virginensis*, *Epicordulia princeps*, *Tetragoneuria cynosura*, *Helocordulia uhleri*, *Somatoclora linearis*, *Perithemis tenera*, *Celithemis elisa*, *C. eponina*, *C. fasciata*, *Libellula auripennis*, *L. flavida*, *L. incesta*, *L. luctuosa*, *L. semifasciata*, *L. vibrans*, *Erythrodiplax c. minuscula*, *Sympetrum ambiguum*, *Cannacria gravida*, *Tramea carolina*, *Agrion dimidiatum*, *A. maculatum*, *Lestes d. australis*, *L. inaequalis*, *L. vigilax*, *Argia apicalis*, *A. bipunctulata*, *A. tibialis*, *Enallagma basidens*, *E. divagans*, *E. exsulans*, *E. geminatum*, *E. signatum*, *E. travium*, *E. vesperum*, *Ischnura kellicotti*, *I. posita* and *I. prognatha*.

Coastal Plain species (17) occur primarily in the area designated as Coastal Plain by Fenneman (1930) and extend along the Atlantic and Gulf Coasts from New Jersey to Texas. A few of these species have been recorded beyond the limits of the Coastal Plain: *L. deplanata* and *T. daeckii* are recorded from Indiana, *L. needhami* from Cuba and Mexico, and *E. berenice* from the Bahamas and Mexico. Coastal Plain species are *Cordulegaster fasciatus*, *Gomphus flavocaudatus*, *G. hodgesi*, *Neurocordulia alabamensis*, *Celithemis amanda*, *C. ornata*, *Ladona deplanata*, *Libellula axilena*, *L. needhami*, *Ery-*

throdiplox berenice, *Argia fumipennis*, *Teleallagma daeckii*, *Enallagma concisum*, *E. dubium*, *E. durum*, *E. weewa* and *Nebalennia integricollis*.

Tropical and Eastern species (10) occur in the tropics south of Mexico as well as in Eastern North America. Some are widely distributed in eastern United States, others are restricted to the Gulf Coast. Species in this category are *Aphylla williamsoni*, *Anax longipes*, *Coryphaeschna ingens*, *Macrodiplax balteata* (Antilles, but not south of Mexico), *Erythrodiplox umbrata*, *Miathyria marcella*, *Hetaerina titia*, *Argia violacea*, *Ischnura ramburi* and *Anomalagrion hastatum*.

Transcontinental species (5) cross the United States and/or Canada and may or may not be reported from Mexico. Species included here are *Libellula pulchella*, *Plathemis lydia*, *Tramea lacerata*, *Argia moesta* and *A. sedula*.

Tropical and Transcontinental species (10) occur in the tropics south of Mexico and also cross the United States and/or Canada; some occur also in other regions of the world. These species are *Anax junius*, *Tarnetrum corruptum*, *Orthemis ferruginea*, *Pachydiplax longipennis*, *Erythemis simplicicollis*, *Pantala flavescens*, *P. hymeneae*, *Tramea onusta*, *Hetaerina americana* and *Enallagma civile*.

Fifty-nine species are listed under Eastern but those in all other categories occur at least somewhere in Eastern United States hence all Louisiana species were shared with this area. None was restricted to Louisiana and none was western.

Fourteen species reach their western limits in Louisiana: *Cordulegaster fasciatus*, *Aphylla williamsoni*, *Gomphaeschna antilope*, *Coryphaeschna ingens*, *Enallagma concisum*, *Ophiogomphus mainensis*, *Gomphus flavocaudatus*, *G. hodgei*, *Neurocordulia alabamensis*, *Celithemis amanda*, *C. ornata*, *Libellula axilena*, *Argia fumipennis* and *Enallagma weewa*. The last eight do not extend west of the Florida Parishes.

Nineteen of the 101 Louisiana species occur also in the tropics south of Mexico; 23 of the 126 species recorded from Oklahoma (Bick, unpublished) are tropical. Eight of the 46 genera collected in Louisiana are listed by Tillyard (1917) as entogenic to Neotropica alone whereas 11 of the 48 genera recorded from Oklahoma are in this category. Because southern Louisiana is semitropical one might anticipate that a greater number of tropical species and genera would be present in Louisiana than in Oklahoma. However, there are apparently two main routes of migration of South American species into the United States: (1) via Central America, Mexico, and Texas; (2) via Central America and the West Indies to Florida. Oklahoma is at the head of the first route but Louisiana is distant from either route.

Eleven species were restricted within the state; 90 were in a geographic sense statewide. This does not mean that 90 species were collected in every parish or even in every physiographic area but

rather than United States and Louisiana records suggest that these will be found eventually throughout the state wherever the habitat is suitable. Because all of the state is within the range of an overwhelmingly eastern fauna, an east-west statewide distribution of most species would be anticipated.

Further, a north-south statewide distribution for most species would be expected because of the slight north-south variation in climate. The average annual rainfall decreases from 60 inches in the southeast to 46 inches in the northwest; even the minimum is sufficient for a mesophytic flora and fauna. Insufficient rainfall is certainly not a critical factor limiting odonate distribution in Louisiana. Byers (1930) considers average January temperatures as the factor that controls odonate distribution and accounts for their zonation in Florida. The average January temperature in north and south Florida differs by 17 degrees. In Louisiana, average annual temperatures vary from 64° F in the north to 70° F in the south, and average January temperatures also differ by but six degrees, 48° in the north and 54° in the south. This six degree temperature difference in Louisiana could scarcely be a major factor in odonate distribution. The minor role of temperature was shown by the few species limited in a north-south direction. *Aphylla williamsoni* and *Miathyria marcella*, tropical species which did not extend north of 31° latitude in Louisiana, were limited perhaps by the slightly colder temperatures of northern Louisiana. *Lestes inaequalis*, found only in the northern part of the state, is northern in United States distribution and was limited possibly by the warmer temperatures of southern Louisiana.

The other eight species restricted within the state did not extend beyond the western limits of the Florida Parishes: *Gomphus flavo-caudatus*, *G. hodgesi*, *Neurocordulia alabamensis*, *Celithemis amanda*, *C. ornata*, *Libellula axilena*, *Argia fumipennis* and *Enallagma weewa*. Viosca (1926) lists several cold blooded vertebrates common to the Atlantic and the East Gulf Coastal Plains which occur at least as far west as the Florida Parishes but whose extension westward is limited by the broad Mississippi alluvial plain. The above odonates occur primarily in the Coastal Plain and in Louisiana primarily in the pine-lands. Because climate and habitats are similar in the pinelands of the western part of the State and in the Florida Parishes, the 50-mile wide alluvial plain seems to be a barrier to the extension of at least eight species. I consider it the only physical feature causing geographical restrictions of odonates in Louisiana.

PHYSIOGRAPHY AND SPECIES COMPOSITION

Odonate distribution could not be correlated with small physiographic units as the Bentley Terrace, the Red River Alluvial Cone, etc., but there was some correlation between major physiographic areas (fig. 2) and certain groups of species.

Table 2 gives the percentage of the total collections of each species in each physiographic area. Species are arranged in a sequence depending on their frequencies in each area. Since species present in

TABLE 2.
THE PERCENTAGE OF THE TOTAL NUMBER OF COLLECTIONS OF EACH
SPECIES (PRESENT IN FIVE OR MORE COLLECTIONS) FOR
EACH PHYSIOGRAPHIC AREA

	Total No. Collections	Pineland	Alluvial	Deltaic	Prairie
<i>Progomphus obscurus</i>	62	100			
<i>Hagentus brevistylus</i>	19	100			
<i>Dromogomphus spoliatus</i>	10	100			
<i>Gomphus flavocaudatus</i>	14	100			
<i>Boyeria vinosa</i>	37	100			
<i>Didymops transversa</i>	13	100			
<i>Somatochlora linearis</i>	7	100			
<i>Celithemis ornata</i>	7	100			
<i>Ladona delpianata</i>	19	100			
<i>Libellula arilena</i>	11	100			
<i>Libellula flarida</i>	6	100			
<i>Libellula semifasciata</i>	17	100			
<i>Agriion dimidiatum</i>	27	100			
<i>Agriion maculatum</i>	46	100			
<i>Hetaerina americana</i>	9	100			
<i>Hetaerina tithia</i>	20	100			
<i>Lestes vigilax</i>	13	100			
<i>Argia fumipennis</i>	20	100			
<i>Argia morsta</i>	45	100			
<i>Argia sedula</i>	26	100			
<i>Nehalennia intergricollis</i>	7	100			
<i>Enallagma divagans</i>	11	100			
<i>Lestes d. australis</i>	26	97	3		
<i>Argia tibialis</i>	83	87	11	0	2
<i>Celithemis elisa</i>	10	86	14	0	0
<i>Dromogomphus spinosus</i>	19	85	10	5	0
<i>Libellula auripennis</i>	7	85	0	15	0
<i>Erythrodiplax c. minuscula</i>	42	85	3	3	8
<i>Celithemis fasciata</i>	13	84	16	0	0
<i>Enallagma concisum</i>	5	80	0	20	0
<i>Orthemis ferruginea</i>	23	75	10	15	0
<i>Tetragoneuria cynosura</i>	64	74	5	21	0
<i>Libellula inesta</i>	67	76	24	0	0
<i>Plathemis lydia</i>	91	69	31	0	0
<i>Sympetrum ambiguum</i>	11	60	40	0	0
<i>Enallagma civile</i>	22	55	40	5	0
<i>Argia apicalis</i>	31	53	43	0	4
<i>Enallagma signatum</i>	34	50	25	25	0
<i>Macromia taeniolata</i>	8	50	50	0	0
<i>Epicordulia princeps</i>	13	30	60	10	0
<i>Minthyria marcella</i>	10	33	50	17	0
<i>Libellula pulchella</i>	10	37	50	13	0
<i>Gomphus plagiatus</i>	6	17	83	0	0
<i>Tarnetrum corruptum</i>	39	26	24	50	0
<i>Nastieschna pentacantha</i>	44	39	7	54	0
<i>Ischnura prognatha</i>	14	43	0	37	0
<i>Coryphaeschna ingens</i>	39	42	0	58	0
<i>Gomphaeschna furcillata</i>	5	20	20	60	0
<i>Libellula needhami</i>	76	15	6	77	2
<i>Aphylla williamsoni</i>	12	14	7	78	0
<i>Cannacra gravis</i>	48	2	10	86	2
<i>Erythrodiplax berenice</i>	23	0	0	100	0
<i>Anax junius</i>	200	37	3	56	3
<i>Epiaeschna heros</i>	66	60	19	19	2
<i>Perithemis tenera</i>	189	49	20	29	2
<i>Libellula vibrans</i>	133	52	11	34	2
<i>Erythemis simplicicollis</i>	400	45	19	34	1
<i>Pachydiplax longipennis</i>	503	45	11	39	4
<i>Ischnura posita</i>	112	60	16	23	1
<i>Anomalagrion hastatum</i>	99	60	10	23	7
<i>Pantala flavescens</i>	138	48	22	21	8
<i>Tramea carolina</i>	64	47	9	34	9
<i>Celithemis eponina</i>	32	31	22	38	9
<i>Pantala hymeneus</i>	11	40	30	20	10
<i>Ischnura ramburi</i>	153	34	19	46	10
<i>Tramea lacerata</i>	62	32	18	40	10
<i>Tramea onusta</i>	13	46	8	23	23

less than five collections are excluded from the table, the following discussion is based on the remaining 67 unless otherwise stated.

Fifteen species were recorded from all physiographic areas and 11 of these, *Anax junius*, *Perithemis tenera*, *Libellula vibrans*, *Erythemis simplicicollis*, *Pachydiplax longipennis*, *Ischnura posita*, *Anomalagrion hastatum*, *Pantala flavescens*, *Tramea carolina*, *Tramea lacerata* and *Ischnura ramburi*, were frequent and abundant in all areas.

Most species were associated primarily or entirely with one physiographic area, 38 with pinelands, nine with deltaic, five with alluvial. The greatest number of species occurred in the pinelands and 22 were restricted to this area. When species present in less than five collections are considered, a total of 96 was taken in pinelands whereas the number from deltaic, alluvial, and prairie combined was 54. *Gomphus submedianus*, *Gomphaeschna antilope*, *Erythrodiplax berenice*, *Erythrodiplax umbrata* and *Enallagma durum* were the only species not collected in pinelands. No species was restricted to prairie or to alluvial areas; only *Erythrodiplax berenice* was restricted to the deltaic plain.

Prairie, alluvial, and deltaic areas presented little variation in habitat and shared many species; collecting in any one was representative of the three. Collections from these areas nearly always lacked surprises, but almost every trip to the pinelands added species or important distribution notes. The pineland fauna contrasted markedly with that of the other three areas. Because collecting was more frequent in pineland and deltaic areas, the species composition of the major physiographic areas may be reduced to a contrast between pineland and deltaic faunas.

Thirty-two species absent in the deltaic plain are listed in Table 2. The dropping out of species in this area is more striking when species present in less than five collections are considered. Sixty two of the 101 species were absent in the deltaic plain, 24 of the state's 46 genera were absent, but no genus was restricted to this area. The very minor temperature differences between deltaic and adjoining areas could hardly be responsible for the absence of so many species and genera.

Four species, *Libellula incesta*, *Plathemis lydia*, *Argia apicalis* and *Argia tibialis*, well illustrate absences in the deltaic plain. They were widespread and frequent throughout most of the state and were taken from both lentic and lotic habitats, yet were absent in the deltaic plain. A common misconception is that the deltaic plain consists solely of brackish marsh which precludes the occurrence of fresh water species. There are large brackish areas, but there are also numerous fresh marshes, ponds, and borrow pits which these four species and others seemingly could utilize but did not.

A comparison of the distribution of two closely related species, *Libellula vibrans* and *L. incesta* further emphasizes absences in the deltaic plain. The former was widely distributed throughout the state and was abundant in the deltaic plain; the latter was also wide-

spread but was never taken in that area. Since the two species are similar in so many respects, no tenable hypothesis can be offered to account for the exclusion of *incesta* from the deltaic plain.

Three important conclusions regarding Louisiana distribution are given by Foster and Smith (1901) and repeated by Wright (1939): (1) the Odonata of the low lying deltaic lands in which there are no rapid or clear streams are limited as regards the number of species and genera but are remarkably rich in individuals; (2) all the deltaic species are distributed over higher lands, while numerous genera never seek the bottoms; (3) no species of the subfamily Gomphinae was ever seen on deltaic soil.

As a test of these conclusions I compared the total number of species in St. Tammany (pineland) with Orleans, Jefferson, and St. Charles (deltaic) parishes combined. Collecting in these contrasting areas was approximately equal and they correspond closely to those studied by Foster and Smith. Sixty-five species were found in St. Tammany, 30 in Orleans, Jefferson, and St. Charles combined. Forty-two species were in the St. Tammany area but not the deltaic, whereas six were collected in the three deltaic parishes but not in St. Tammany. *Aphylla williamsoni* was the only gomphine collected in the deltaic plain. These comparisons definitely support Foster and Smith's conclusions.

Viosca (1944) points out the association of the frog, *Acris crepitans*, with alkaline water and of *Acris gryllus* with acid water in Louisiana. There is a great difference in pH between the acid waters of the Florida Parishes and the alkaline waters of the deltaic plain. It could be assumed that this pH difference accounts for the differences in species of odonates present in the two areas. However this assumption is not valid as illustrated by the occurrence of the following lentic and/or lotic species in wide pH ranges. *Progomphus obscurus*, *Hagenius bravistylus*, *Boyeria vinosa*, *Libellula incesta*, *Platthemis lydia*, *Argia apicalis* and *Argia tibialis* were frequently taken in pinelands of the Florida Parishes at pH 5.0 and in southern Oklahoma at values as high as 8.2. They were never found in the deltaic plain where pH values average 8.0. I therefore do not consider pH a factor responsible for the contrast in species composition between the pinelands and the deltaic plain.

Topography seems to be the most important factor responsible for the contrast in species composition between pinelands and deltaic plain. All waters in the deltaic areas are lentic or very sluggish with mud bottoms. There are lentic waters such as ponds and sloughs in the pinelands, but there are also swiftly flowing creeks, wide shallow rivers, springs, and even a small waterfall, each with sand, gravel, clay, or mixed bottoms. Varying topography and the resulting variety of habitats in the pinelands seems to account for the large number of lotic species there which are absent in the deltaic plain. On the other hand, neither topography nor pH can account for the many lentic species present in the pinelands but absent in the deltaic plain.

Kennedy (1922b) states that the more primitive forms are adapted

to well aerated water and are true stream species. Observations in Louisiana were similar to those of Kennedy in that most genera characteristic of lotic water are placed low in phylogeny by systematists. Moreover a greater proportion of more recently evolved genera occurred in the most recent land in the state, the deltaic plain, where all habitats are essentially lentic. For example, *Aphylla* was the only genus in the primitive families Petaluridae, Cordulegasteridae and Gomphidae present in the deltaic plain; seven genera in these families, characteristic of lotic water and present elsewhere in the state, were absent. The more primitive Zygoptera, Agrionidae and Lestidae, were entirely absent in the deltaic plain. There are 14 genera of the highly evolved Libellulinae in Louisiana; ten of these were present and four absent in the deltaic plain. The fauna of the deltaic area was predominantly libelluline because of numbers of genera and of individuals in this group. There was a greater proportion of recent than of primitive genera in the lentic and geologically recent waters of southern Louisiana.

HABITAT AND SPECIES COMPOSITION

Most species could easily be divided into those characteristic of lentic and those characteristic of lotic waters. However I could not prepare a different list of species for each minor habitat within the lentic or the lotic series, because these habitats were similar in physical characteristics and species composition. For example, it was impossible to give contrasting species lists for ponds, lakes, or swamps and contrasting lists for creeks, rivers, etc.

In the pinelands where both lentic and lotic habitats are present, two contrasting lists of common species can be given. The following were sufficiently frequent to be considered characteristic of clear, running, pineland streams: *Progomphus obscurus*, *Hagenius brevistylus*, *Dromogomphus* spp., *Boyeria vinosa*, *Agrion dimidiatum*, *Agrion maculatum*, *Hetaerina titia*, *Argia fumipennis*, *Argia moesta*, *Argia sedula* and *Argia tibialis*.

Exposed lentic habitats in the pinelands shared the following species: *Tetragoneuria cynosura*, *Orthemis ferruginea*, *Ladona deplanata*, *Plathemus lydia*, *Libellula incesta*, *Erythrodiplax c. minuscula* and *Lestes d. australis*. *Libellula axilena*, *Libellula semifasciata*, *Lestes vigilax* and *Nehalennia intergricollis*, though local and not frequent, were characteristic of shaded sloughs in pinelands.

Since no species was associated primarily with prairie and none was closely associated with the alluvial area, species lists are not given for habitats in these areas. The deltaic plain does not have a characteristic fauna except for the three species common in brackish situations, *Erythrodiplax berenice*, *Cannacria grvida* and *Libellula needhami*.

SEASONAL DISTRIBUTION

There was a long flight season for most species in Louisiana because of the mild climate. Two species, *Anax junius* and *Ischnura ramburi*, were collected as adults during every month of the year and

many common forms were abundant from March to October. There was, however, a definite seasonal succession in the percentage of the total number of species flying during each month. These percentages closely parallel mean monthly temperatures (Table 1): January (4%), February (20%), March (50%), April (80%), May (80%), June (92%), July (94%), August (92%), September (86%), Octo-

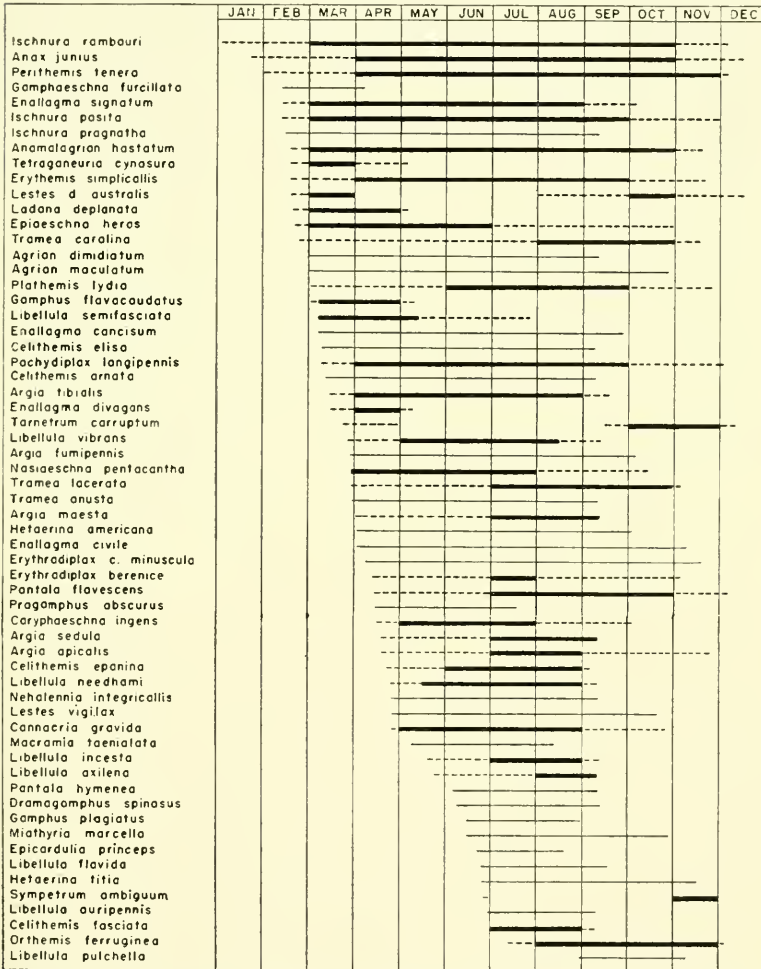


Figure 3. Limits of the flight season for species present in five or more collections. For many species, the periods of greatest frequency and/or abundance could be detected. These periods are shown by thickened lines and the extremes of the flight season by dotted lines. Other species showed little variation in frequency or abundance and this is indicated by thinner unbroken lines.

ber (52%), November (36%), December (10%).

Figure 3 shows seasonal succession of adults of species present in five or more collections. The sequence for the more common species in the New Orleans area was as follows. The season began in January with the occasional appearance of *Ischnura ramburi* and *Anax junius*. In February *Perithemis tenera*, *Erythemis simplicicollis*, *Enallagma signatum* and *Ischnura posita* appeared. March was the earliest month when any species was considered common and *Pachydiplax longipennis* and *Libellula vibrans* were added. April added *Libellula needhami*, *Cannacria gravida* and *Celithemis eponina*; by the close of this month all common species were flying and nearly all were abundant. In July *Tramea carolina*, *T. lacerata* and *Pantala flavescens* became abundant. The season waned in September; by the end of the month *Libellula vibrans* and *L. needhami* were no longer found and *Pachydiplax longipennis* and *Erythemis simplicicollis* were scarce. Many forms dropped out in October but *Pantala flavescens* was still frequent. After October no species was abundant, but *Ischnura ramburi*, *Anax junius*, *Ischnura posita*, *Erythemis simplicicollis*, *Tramea carolina*, *Pachydiplax longipennis* and *Pantala flavescens* were still present in November. *I. ramburi*, *A. junius*, *P. longipennis* and *P. flavescens* were the only species taken in December.

The seasonal range for most species was long but a few were more sharply limited. *Gomphaeschna furcillata*, *Gomphus flavocaudatus*, *Tetragoneuria cynosura*, *Ladona deplanata* and *Enallagma divagans* were not collected later than May 7. *Epicordulia princeps*, *Hetaerina titia*, *Sympetrum ambiguum*, *Celithemis fasciata*, *Orthemis ferruginea*, *Libellula pulchella* and *Miathyria marcella* were late season species not collected earlier than June 30. *Tramea carolina*, *T. lacerata* and *Pantala flavescens* appeared in March but were very scarce until July. *Lestes d. australis* and *Tarnetrum corruptum* were common in April and October but were not collected during May, June, and July suggesting the possibility of two emergence peaks.

Species which appeared early in the season were also found very late. For example, the adults of most species taken in February were also taken in November, whereas most species which first appeared in late April or May were not collected later than September. If a brief adult life of several months is assumed, it seems that species which transform in early spring when temperatures are low also transform during the low autumn temperatures and are therefore present as adults for a long period of the year.

Kennedy (1928) states that there is a tendency for primitive species to be early season forms. Byers (1930) states that, in general, neotropical species of restricted range become dominant in the fall months and that those with wider ranges emerge earlier and last longer. These relationships could not be verified in this study.

SUMMARY

Each of Louisiana's 64 parishes was sampled during 20 years of collecting. One-hundred-and-one species were collected or seen by

the writer and 30 of these are recorded from Louisiana for the first time.

Twenty-three species recorded in the literature from Louisiana were neither collected nor seen by the writer. The validity of these records is discussed.

Each of the 101 species seen by the writer is discussed in regard to distribution, physiography, habitat, and seasonal occurrence. Frequency percentage figures are often used to present comparisons of species composition in relation to physiography and habitat.

Based on area of primary occurrence, 59 species were Eastern, 17 Coastal Plain, 10 Tropical and Eastern, five Transcontinental, and 10 Tropical and Transcontinental. All categories include Eastern United States, hence all Louisiana species were shared with this area. None was restricted to Louisiana and none was western.

Within the state, 90 species were in a geographical sense statewide. Insufficient rainfall is not a factor limiting distribution in the state. The small average annual and January temperature differences between northern and southern Louisiana preclude temperature as a major factor limiting distribution. The minor role of temperature was shown by the fact that only three species were limited in a north-south direction.

Eight species extended no farther west than the Florida Parishes. The 50-mile wide alluvial plain of the Mississippi prevents their westward extension and is apparently the only major physical barrier causing geographical restrictions in Louisiana.

Louisiana was divided into four large physiographic-vegetation areas: pinelands, alluvial, deltaic, and prairie. Of 67 species present in five or more collections, 15 occurred in each of these four areas, 38 were associated primarily or entirely with pinelands, nine with deltaic, and five with alluvial. None was found primarily in the prairie.

The total number of species from deltaic, alluvial, and prairie areas combined was 54. These areas, with only sluggish or static water, presented but little variation in habitat and shared many species. In contrast, 96 species were collected in the pinelands. The more varied topography and the greater variety of lentic and lotic habitats probably accounted for the large number of species in the pinelands.

Many species, common elsewhere in the state, were absent from the deltaic plain; 24 genera and 62 species were absent from this area. Most primitive genera in the state were absent in the deltaic plain and a greater proportion of recently evolved genera were present in the lentic waters of the geologically recent deltaic plain.

Most species could be grouped easily into those characteristic of lentic and those characteristic of lotic waters. However I could not prepare a contrasting list of species for each minor habitat within the lentic or lotic series because those habitats were similar in physical characteristics and species composition.

The flight season was long as a result of the mild climate but there

was a definite seasonal succession in the percentage of the total number of species flying during each month.

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ABSTRACT

Each of Louisiana's 64 parishes was sampled during 20 years of collecting. One-hundred-and-one species were recorded, 30 of which are new state records. Each species is discussed in relation to distribution, physiography, habitat, and seasonal occurrence. All species were shared with eastern United States; none was restricted to Louisiana and none was western. Ninety species were in a geographical sense statewide, three were restricted in a north-south direction, and eight did not extend west of the Florida Parishes. Rainfall and temperature differences between north and south Louisiana are not sufficient to be considered controlling factors. The Mississippi alluvial plain apparently is the only physical barrier causing geographical restrictions in the state. The state was divided into four physiographic-vegetation areas. Of 67 common species, 15 occurred in each of the four areas but 38 were associated primarily or entirely with pinelands, nine with deltiac, five with alluvial, and none was primarily in the prairie. Fifty-four species were collected in, and but one was restricted to, alluvial, deltiac, and prairie areas which lacked distinctive faunas. In contrast, 96 species were collected in the pinelands. Varying topog-

raphy and the resulting variety of habitats probably accounted for the large number of species in the pinelands. Twenty-four genera, mostly phylogenetically primitive, and 62 species were absent in the lentic waters of the geologically recent deltaic plain but were present elsewhere in the state. A greater proportion of recently evolved genera were present in the deltaic plain. Species characteristic of lentic and of lotic waters are given but those closely associated with each minor habitat within the lentic or lotic series could not be listed because these habitats were similar in physical characteristics and species composition. The flight season was long but there was a seasonal succession in the percentage of the total number flying during each month.