

A SURVEY OF THE ANISOPTEROUS ODONATA OF MARKS' SLOUGH
IN MONTGOMERY COUNTY, TENNESSEE, WITH A CHECK LIST OF THE
ANISOPTERA OF TENNESSEE

A Research Paper
Presented to
the Graduate Council of
Austin Peay State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
in Biology

by
James Robert Fletcher
August 1969

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To the Graduate Council:

I am submitting herewith a Research Paper written by James Robert Fletcher entitled "A Survey of the Anisopterous Odonata of Marks' Slough in Montgomery County, Tennessee, with a check list of the Anisoptera of Tennessee". I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Biology.

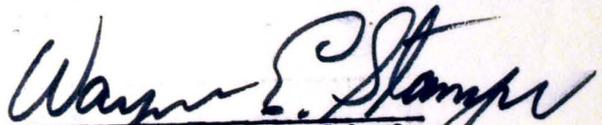
Appreciation is also extended to Dr. Floyd Ford, Professor of Zoology, Austin Peay State University, and to Glenda C. Locke, research assistant of that institution for their verifications of the taxonomic classifications and identifications used therein.

Appreciation is certainly due to my wife, Sylvia, for her patience and kindly help in proof-reading.

Gratitude is expressed to Mr. Arthur Marks for the use of his land and slough, without which this study would not have been possible.


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TABLE OF CONTENTS

| CHAPTER | PAGE |
|------------------------------------|------|
| I. INTRODUCTION..... | 1 |
| II. REVIEW OF THE LITERATURE..... | 3 |
| III. METHODS AND MATERIALS..... | 5 |
| IV. RESULTS..... | 10 |
| V. DISCUSSION AND CONCLUSIONS..... | 19 |
| VI. SUMMARY..... | 21 |
| LITERATURE CITED..... | 22 |

LIST OF TABLES

| TABLE | PAGE |
|---|------|
| I. Anisoptera Collected at Marks' Slough..... | 14 |
| II. A Check List of Tennessee Anisoptera..... | 15 |

LIST OF FIGURES

| FIGURE | DESCRIPTION | PAGE |
|--------|------------------------------------|------|
| I. | Location Map of Marks' Slough..... | 6 |

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INTRODUCTION

The anisopterous Odonata, or dragonflies, are relatively large and often beautifully colored insects. The immature stages are aquatic, and the free flying adults are usually found near water. All stages are predaceous and feed on various insects and other organisms. From man's point of view, they are generally considered beneficial due to this predation.

Very little work has been done in Tennessee on this important segment of our insect fauna. However, practically nothing noteworthy has been done on the Odonata of Montgomery County, Tennessee. Wilson (1912) recorded five species from Montgomery County. These were Gomphus plagiatus Selys, Anax junius Drury, Perithemis tenera Say, Plathemis lydia Drury, and Pachydiplax longipennis Burmeister, which were collected in 1911. No other published records from Montgomery County were found. It is not even known what species are present in the area, their relative abundance, or their major locations. The purpose of this study was to add to the knowledge of the Odonata of Tennessee by determining the abundance and emergence time of the spring species at Marks' Slough, a habitat favorable to Odonata. In addition, incomplete data of flight periods was recorded.

This study was important because it verified several of the major species cited in Tennessee to be in this area and has resulted in the addition of two new species to the list of known

Anisoptera in Tennessee. It, likewise, is a prerequisite to any future research on the species described herein or on the ecology of the study area.

Since the study was concerned with a single area in Montgomery County Tennessee, it by no means represents the state in habitat or fauna. Although the author observed the area approximately every other day from April 16 until July 3, it is possible that some species emerged and left the study area unnoticed. The termination date of this study, July 3, 1969, leaves two major summer months unsurveyed. However, due to the nature of the research assignment, termination of the study was necessary.

No changes or additions to the list of Tennessee Anisoptera took place until Kormondy (1957) in his study of the Wright collection and the Williamson - Kennedy collection discovered several new records for the state and modified the existing list by reclassification of several species. The result was the addition of eight new species. Kormondy (1960) added two new species which brought the total anisopterous fauna to seventy species. No further additions were found in the literature beyond that date.

Several papers have been written on the life histories, ecology, dispersibility, and emergence patterns of various Anisoptera. The author's assistance in the selection of the problem and the design of study. Although this study was somewhat different from

CHAPTER II

REVIEW OF THE LITERATURE

The present status of our knowledge of the anisopterous Odonata of Tennessee is due largely to the excellent work of Edward J. Kormondy and Mike Wright. In a review of the literature Wright (1938a) listed fifty Anisoptera from Tennessee and added two new species from Reelfoot Lake area later that year (Wright, 1938b). Wright (1943) added another species to the list and Wright and Shoup (1945) added three new species from the Obey River area. The following year Wright (1946a) added three new species from the Central Tennessee Area and one species from other sources (Wright, 1946b). Cook (1947) added three new species of Somatochlora from the Great Smoky Mountain National Park. No changes or additions to the list of Tennessee Anisoptera took place until Kormondy (1957) in his study of the Wright collection and the Williamson - Kennedy collection discovered several new records for the state and modified the existing list by reclassification of several species. The result was the addition of eight new species. Kormondy (1960) added two new species which brought the total anisopterous fauna to seventy species. No further additions were found in the literature beyond this date.

Several papers have been written on the life histories, ecology, territoriality, and emergence patterns of various Anisoptera. These were of assistance in the selection of the problem and the methods of study. Although this study was somewhat different from

prior studies, Kormondy and Gower's (1965) paper on life history variations was of interest and assistance.

The slough, a reclaimed swamp on the Arthur Marks Farm, is located approximately eight miles south of Clarksville, Tennessee, near Loop 3 and Mile 139 of the Overland River. The slough is most easily approached by traveling northward on the Tennessee Central/Illinois Central Railroad track approximately one-fourth mile from its overpass over Highway 160 as indicated in Figure I.

The slough is the remnant of a once extensive swamp area which covered over 200 acres, but is now confined to a man-made drainage ditch and a swampy area about 50 meters wide at its widest point, and one-half mile in length. The slough serves as a drain for both the reclaimed pastureland on its west banks and the bottomland on its east banks. A fresh water spring continually feeds the slough with a fairly constant inflow of water which varies in temperature from 12 to 14 degrees centigrade throughout the year. Heavy water causes sporadic flooding of the area during the spring months, increasing the depth to as much as 10 inches above normal levels. A cattle pasture borders the slough on the west and it is used to some extent for watering livestock.

The slough averages one to three feet in depth at the southern end and three to five feet in depth at its northern end. Pool water was one inch higher on April 16 than on July 1. The highest temperature recorded was 24.5 degrees centigrade on July

CHAPTER III

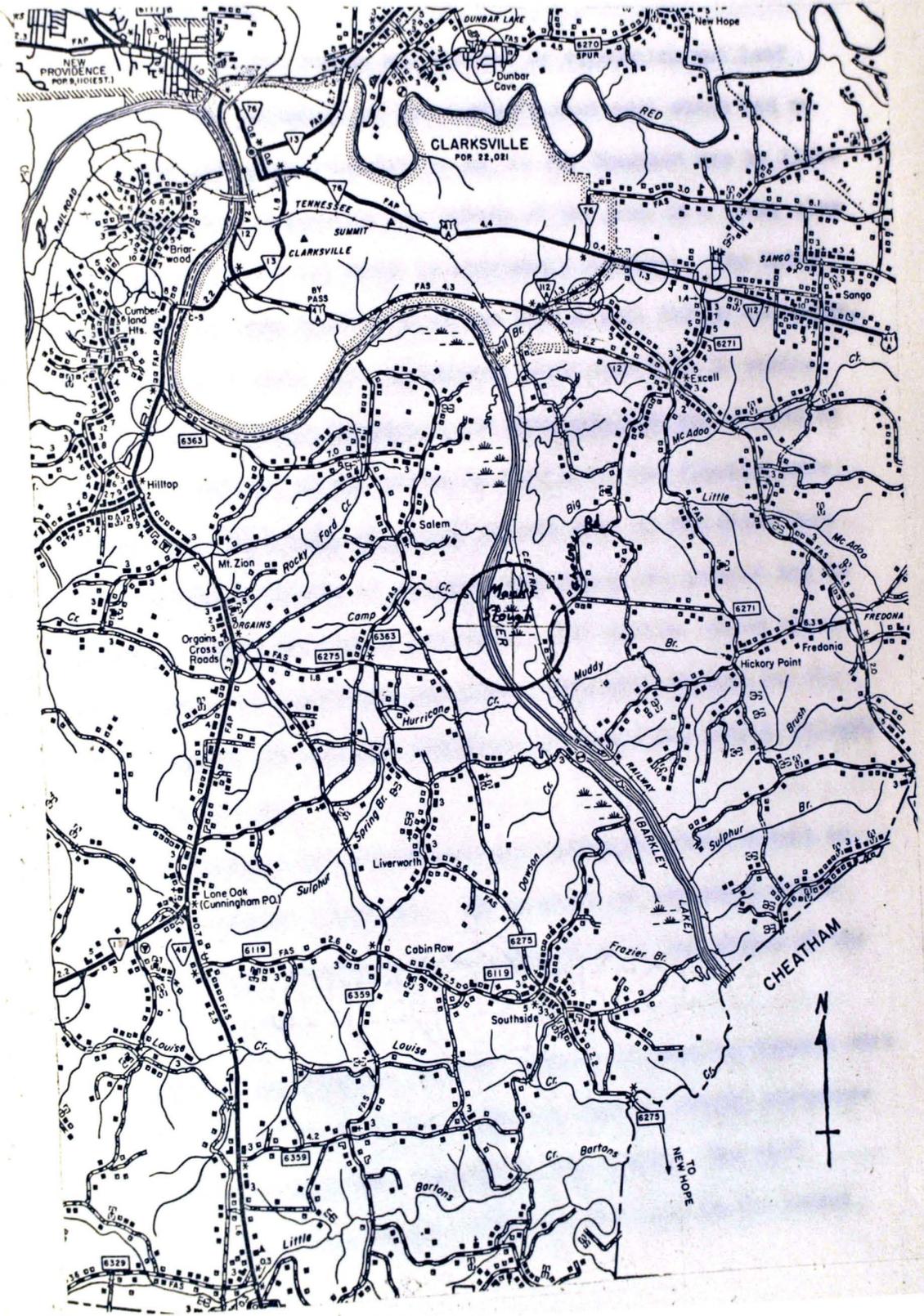
MATERIALS AND METHODS

Description of study area. Marks' Slough, a reclaimed swamp located on the Authur Marks Farm, is located approximately eight miles south of Clarksville, Tennessee, near Lock B and Mile 139 of the Cumberland River. The slough is most easily approached by walking northward up the Tennessee Central/Illinois Central Railroad track approximately one-fourth mile from its overpass over Gholson Road as indicated in Figure I.

The slough is the remnant of a once extensive swamp area which covered over 200 acres, but is now confined to a man-made drainage ditch and a swampy area about 50 meters wide at its widest point, and one-half mile in length. The slough serves as a drain for both the reclaimed pastureland on its west banks and the bottomland forest on its east banks. A fresh water spring continually feeds the marsh with a fairly constant inflow of water which varies in temperature from 12 to 14 degrees centigrade throughout the year. Ground water causes sporadic flooding of the area during the spring months, increasing the depth to as much as 10 inches above normal pool level. A cattle pasture borders the slough on the west and it is used to some extent for watering livestock.

The slough averages one to three feet in depth at the southern end and three to five feet in depth at its northern end. Pool depth was nine inches higher on April 16 than on July 1. The highest water temperature recorded was 24.5 degrees centigrade on July

FIGURE I
LOCATION MAP OF MARK'S SLOUGH



2, whereas the lowest temperature recorded was 15 degrees centigrade on April 16.

The soil on the bottom was covered by vegetation and leaf litter with the exception of the southern-most pool which had no leaf litter and sparse vegetation due to its frequent use by livestock. The soil comprising the bottom of the pool is a loamy clay with a pH of 7.4 to 7.9 which is moderately alkaline. The water maintained the same general pH as the bottom soil during the study. The bottom is a soft, well decomposed black ooze 5 to 30 centimeters thick. Elodea canadensis and Ceratophyllum sp. covered as much as 70 percent of the bottom in some areas and floating mats of duck weed (Spirodela polyrriza) covered most of the water surface. Numerous species of emergent vegetation are present and in general a swamp environment persisted. The uniform bottom type, depth, shore and vegetation provided a favorable habitat for the aquatic nymphs and adequate emergence sites for the adults throughout the study area.

An abundance of invertebrate and vertebrate fauna abound in this well balanced ecosystem. The presence of dragonfly nymphs and an abundant invertebrate food supply led to the choice of the area for the study.

Sampling techniques. Several methods of sampling Odonata were tried in the field and it was found that due to habitat structure certain methods were more successful than others. The most successful collection method was by use of a long-handle insect

net. Of the 202 specimens collected during the study, 196 were by netting. Koen (1937) suggests that a collector's outfit consists of a net, a fly swatter, a shot gun loaded with dirt or sand, and a creel of containers or Lepidoptera papers. In general he is correct. It was found that a long-handled net could be maneuvered fairly quickly for dragonfly capture, and that in a shallow marsh, a pair of hip boots for wading was essential. A collecting bag containing a field notebook, thermometer, kill jar, vials, and envelopes was always carried. In this way insects could be killed, labeled, and preserved in the field, and notes on habitat, time of capture, and activity could be made at time of capture. On several occasions a dip net was used to check the bottom for available food. A camera with a telephoto lens was found to be of assistance in recording dragonflies in flight.

The emergence trap technique, which had been used successfully by C. N. Boehms (personal communication), Kormondy and Gower (1965), and others was found to be unsatisfactory in the Marks' Slough area. Three large emergence traps covering 18 square feet each were erected in three habitat areas along the slough at locations known to have large Odonata nymph populations. Each trap measured three feet by six feet and was two feet high. The traps were constructed with wooden legs and securely anchored to the bottom. The traps were covered by screen wire with at least six inches submerged beneath the surface of the water. Although the traps were checked on every visit to the study area, only eight specimens were collected from them.

All collections and observations were made during daylight hours, at various times from dawn to dusk. Specimens were killed in the field and carried to the laboratory for identification and classification. Specimens were pinned and dried or pressed and dried. Specimens were examined under a dissection microscope and taxonomic classification and identification was verified by Dr. Floyd M. Ford, entomologist at Austin Peay State University. The major key and manual used was Needham and Westfall's (1955) Dragonflies of North America. Classification of the order Odonata used in this paper is according to this source. Other important keys used include Borror and DeLong (1954) An Introduction to the Study of Insects, Pennak (1953) Freshwater Invertebrates of the United States, and Ward and Whipple (1959) Freshwater Biology.

CHAPTER IV

RESULTS

The results of this study are summarized in Tables I and II. Table I lists the Anisoptera collected at Marks' Slough and the dates of collection. This list of species was added to the known species from Tennessee according to Wright (1938a, 1938b, 1943, 1946a, 1946b), Cook (1947), Wilson (1912), Wright and Shoup (1945) and Kormondy (1957, 1960), to compile Table II, A Check List of the Anisoptera of Tennessee.

Twelve species were observed and collected during the study. It is important to note that the specimens examined were adult dragonflies and collected from the restricted habitat previously discussed. There is sufficient cause to assume the list to include a nearly complete inventory of the spring and early summer dragonflies, however, there is not cause to assume that it includes the late summer species as defined by Corbet (1954).

Plathemis lydia Drury was collected from April 26 through July 3. This species was the most abundant species in the area. The males and females were most active in the late morning and early afternoon hours, with the males separated into distinct territorial areas around all pond areas. This species was seldom present in the narrow portions of the slough where the water was less open.

Erythemis simplicicollis Say was collected from June 1 through July 3, and was a second only to Plathemis lydia in

abundance. This species preferred the high Johnson grass marsh areas and the slower moving water areas. Both males and females could be found in the wooded areas adjacent to the slough in the afternoon hours.

Libellula pulchella Drury was collected from May 12 through July 3. This species was third in abundance and preferred the more open waters for mating and the wooded areas for feeding.

Pachydiplax longipennis Burmeister was collected from June 2 through July 3. This species preferred the vegetated waters and avoided the open pools, and exhibited little territoriality but frequented the banks of the quiet vegetated portions of the slough.

Libellula luctuosa Burmeister is a large, beautifully colored species which was collected from June 6 through July 3. This species patrols the small pools as well as the larger open waters. The males exhibit extreme territorial habits and seldom venture away from a specific area of the habitat. No specimens were observed in the wooded area and few patrolled into the pastureland. This species became more abundant toward the later part of June and early July.

Libellula cyanea Fabricius. This species was observed from June 12 through July 3. These dragonflies do not exhibit territoriality to any marked degree, but stay in the high Johnson grass marshes or quiet waters, and frequently rest on emergent vegetation.

This species may emerge in the late summer from pre-emergence studies (Curtis, 1954).

Perithemis domitia Hagen was observed from June 3 through July 3. This species frequented the smaller pools where it could be seen skimming the water or resting on the mats of duck weed. Normally only one male maintained a territory in any one pool area and this species was never seen away from the water area.

Helocordulia selysii Hagen was collected on only two dates May 18 and May 29, and observed near the first small vegetated pool on June 3. This species is a new addition to the list of Tennessee dragonflies and a state record, although his presence is to be expected from its present range.

Epiaschna heros Fabricius. This rather large species was collected and observed from June 12 through July 3, and was noted both in the early morning and late afternoon. This species patrols the entire length of the slough and is the most rapid and high flying dragonfly in the area.

Gomphus townesi Gloyd was collected only on June 20, and was observed on June 20 and 22, in the high grass marsh near the center of the slough. Only one specimen was collected and this appears to be one of the least abundant species. This collection of species is a state record.

Sympetrum rubicundulum Say is a rather rare species in this area and was collected on July 1, from emergent vegetation at the edge of the large open southern pool. It is expected that large numbers of this species may emerge in the late summer from previous emergence studies (Corbet, 1954).

Sympetrum sp. is an interesting species of Sympetrum which could not be keyed to species level from existing keys, but which is distinct from the specimen of Sympetrum rubicundulum. Two males were collected on June 27 and June 29, but no other specimens were observed. This species was also found at the edge of the large, open southern pool.

The above specimens are exhibited in the Austin Peay State University collection in a reference collection of Odonata.

| | |
|----|-------------------|
| 66 | April 26 - July 3 |
| 67 | June 1 - July 3 |
| 68 | May 12 - July 3 |
| 69 | June 2 - July 3 |
| 70 | June 4 - July 3 |
| 71 | June 6 - July 3 |
| 72 | June 10 - July 3 |
| 73 | June 1 - July 3 |
| 74 | May 10 - June 3 |
| 75 | June 12 - July 3 |
| 76 | June 27 - June 29 |
| 77 | June 20 - June 22 |
| 78 | July 3 |

TABLE I

ANISOPTERA COLLECTED AT MARKS' SLOUGH

| Species | Number Collected | Range of Collection Dates in 1969 |
|---------------------------------|------------------|-----------------------------------|
| <u>Plathemis lydia</u> | 66 | April 26 - July 3 |
| <u>Erythemis simplicicollis</u> | 57 | June 1 - July 3 |
| <u>Libellula pulchella</u> | 32 | May 12 - July 3 |
| <u>Pachydiplax longipennis</u> | 19 | June 2 - July 3 |
| <u>Libellula luctosa</u> | 12 | June 6 - July 3 |
| <u>Libellula cyanea</u> | 5 | June 12 - July 3 |
| <u>Perithemis domitia</u> | 3 | June 3 - July 3 |
| <u>Helocordulia selysii</u> | 2 | May 18 - June 3 |
| <u>Epiaeschna heros</u> | 2 | June 12 - July 3 |
| <u>Sympetrum sp.</u> | 2 | June 27 - June 29 |
| <u>Gomphus townesi</u> | 1 | June 20 - June 22 |
| <u>Sympetrum rubicundulum</u> | 1 | July 1 |

TABLE II

A CHECK LIST OF THE TENNESSEE
ANISOPTEROUS ODONATA

Family Petaluridae

Tachoperteryx thoreyi (Hagen)

Family Cordulegasteridae

Cordulegaster diastatops (Selys)Cordulegaster erroneus HagenCordulegaster maculatus SelysCordulegaster obliquus Say

Family Gomphidae

Progomphus obscura RamburHagenius brevistylus RamburOphiogomphus rupinsulensis WalshEreptogomphus designatus HagenGomphus crassus HagenGomphus dilatatus RamburGomphus hybridus WilliamsonGomphus notatus RamburGomphus pallidus RamburGomphus plagiatus SelysGomphus quadricolor WalshGomphus rogersi GloydGomphus scudderi SelysGomphus spiniceps Walsh

Gomphus townesi Gloyd (state record)

Gomphus vastus Walsh

Dromogomphus spinosus Selys

Dromogomphus spoilatus Hagen

Lanthus abistylus Hagen

Family Asechnidae

Boyeria vinosa Say

Boyeria grafiana Williamson

Anax junius Drury

Basiaeschna janata Say

Nasiaeschea pentacantha Rambur

Epiaeschna heros Fabricius

Aeschna constricta Say

Family Macromiidae

Macromia georgia (Selys)

Macromia illinoisensis Walsh

Macromia taeniolata Rambur

Didymops transversa Say

Family Corduliidae

Neurocordulia obsoleta Say

Neurocordulia virginensis Davis

Epicordulia priceps Hagen

Tetragoneuria cynosura (Say)

Somatochlora filosa Hagen

Somatochlora linearis Hagen

Somatochlora tenebrosa Say

Somatochlora williamsoni Walker

Platycordulia xanthosoma Williamson

Helocordulia uhleri (Selys)

Helocordulia selysii Hagen (state record)

Family Libellulidae

Libellula auripennis Burmeister

Libellula cyanea Fabricius

Libellula flavida Rambur

Libellula incesta Hagen

Libellula luctuosa Burmeister

Libellula pulchella Drury

Libellula semifasciata Burmeister

Libellula vibrans Fabricius

Plathemis lydia Drury

Perithemis tenera Say

Perithemis domitia Hagen

Celithemis elisa Hagen

Celithemis eponina Drury

Sympetrum ambiguum Rambur

Sympetrum corruptum Hagen

Sympetrum rubicundulum (Say)

Sympetrum semicinctum Say

- Sympetrum vicinum Hagen
- Leucorhinia intacta Hagen
- Pachydiplax longipennis Burmeister
- Erythemis simplicicollis Say
- Pantala hymensea Say
- Pantala flavescens Fabricius
- Tramea lacerata Hagen
- Tramea onusta Hagen
- Tramea carolina Linneus
- Tramea abdominalis Rambur

DISCUSSION AND CONCLUSIONS

The Marks' Slough area is an excellent habitat for Odonata and contains at least 12 species of Anisoptera. The area may contain one of the largest populations of Odonata in the county due to its stable habitat, large area, and relatively undisturbed condition. There are few natural ponds in the county due to the topography and soil structure of the area. No area contains the abundance of the flora and fauna as that of Marks' Slough making it an ideal ecosystem for the study of Odonata.

Emergence traps were found to be ineffective for trapping Odonata, probably because of the homogenous habitat structure and the abundance of natural emergence sites. The insect net was very successful as a collection tool.

Several species of somewhat divergent ranges were collected. The geographical location of Tennessee is an important factor for the abundant and diverse assemblage of Odonata in the state. This fact is reconciled by Kormondy (1957) in his analysis of the distribution of dragonflies in Tennessee. The capacity for extensive flight significantly increases the possible and probable range of the Anisoptera. The geographical location of Tennessee also increases the possibility of various dragonflies from widely separated areas being found in Tennessee. Kormondy (1957) states that Tennessee marks the northern limit for at least five southern species of Odonata, and that it marks the southern limit for at

least twelve northern species. Likewise, several western and eastern species overlap ranges in Tennessee, and most of the transcontinental species are also found in the state.

The results of this survey are considered good for the short term nature of the study. Although twelve species were found in the area, it is quite possible that other species may also be present. The species collected probably represent most of the spring and early summer species, but due to the termination of the study in early July, several late emerging species may have been missed.

It is significant that two species collected were new records for Tennessee. It is also significant that several species known from Tennessee were cited from Montgomery County in an area heretofore unstudied. All species collected in this study were county records, with the exception of Plathemis lydia and Pachydiplax longipennis which were collected by Wilson (1912).

CHAPTER VI

SUMMARY

Dragonflies of the sub-order Anisoptera were collected in the Marks' Slough area in Montgomery County, Tennessee, during the period April 16, 1969 through July 3, 1969. Twelve species of Anisoptera were collected and observed during the study. The species collected in order of relative abundance were: Plathemis lydia Drury, Erythemis simplicicollis Say, Libellula pulchella Drury, Pachydiplax longipennis Burmeister, Libellula luctuosa Burmeister, Libellula cyanea Fabricius, Perithemis domitia Hagen, Helocordulia selysii Hagen, Epiaeschna heros Fabricius, Sympetrum sp., Gomphus townesi Gloyd, Sympetrum rubicundulum Say.

Two state records were established for Tennessee. These were Helocordulia selysii and Gomphus townesi. A new list of known Anisoptera was compiled and is listed in tabular form. Ten county records were also established for Montgomery County. All species listed with the exception of Plathemis lydia and Pachydiplax longipennis were county records.

Some habitat information was noted and several species were seen to exhibit marked territoriality and habitat selection.

Of the collection methods examined the insect net was found to be superior to the emergence trap. Keys and manuals used were found to be somewhat unprecise in separating specimens at the species level.

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