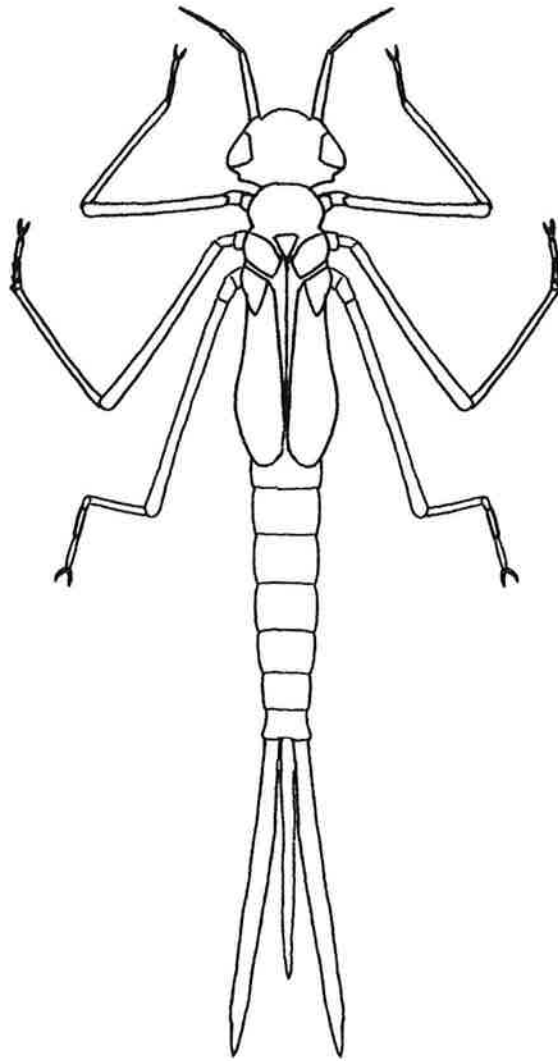


Identification Manual for the Damselfly Nymphs (Zygoptera) of Florida

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Department of Environmental Protection
Division of Water Resource Management
Tallahassee

This project and the preparation of this report was funded by a Section 319 Nonpoint Source Management Program Implementation grant from the U.S. Environmental Protection Agency through an agreement with the Nonpoint Source Management Section of the Florida Department of Environmental Protection.

18 June 2010

IDENTIFICATION MANUAL FOR THE DAMSELFLY LARVAE (ZYGOPTERA) OF
FLORIDA

by

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Introduction

The order Odonata is represented in North America by two suborders, the Anisoptera (Dragonflies) and the Zygoptera (Damselflies). This manuscript will concentrate on the larvae of the Zygoptera of Florida and will enable the reader to determine, with suitable specimens, the identification of known species in the state of Florida.

The number of described species of Zygoptera in North America is about 134 species with about 45 of those found in Florida. Zygoptera larvae occupy a great diversity of aquatic habitats although in general they are most abundant in lowland streams and ponds. They have become so specialized that different species can occupy a wide range of habitats, and a diversity of microhabitats, within a single body of water. Although both dragonfly and damselfly larvae can be recognized by certain features (in particular the prehensile and extensible labium, folded beneath the head when at rest), they show great diversity of form and behavior. The diversity reflects the needs of respiration, foraging, and survival in the biotic and physical environment (Corbet, 1999).

One of the most notable characteristics of the Zygoptera larvae is their method for capturing prey. Whether operating from ambush or hunting mode, all Odonata capture prey by the sudden hydraulically powered protraction of the prehensile labium (Fig. 1-2), a feature unique to the Odonata. The labium is composed of two parts, the prementum and postmentum, previously called the mentum and submentum respectively. They are hinged together by an elbowlike joint and are also hinged at the base of the postmentum to the underside of the head. The labium is folded under the head when not in use. When used, the labium is thrust forward very quickly, and two moveable palpal lobes seize prey. The prementum and palpal lobes vary in form in appearance among families and genera and are very important taxonomically. The larvae are further characterized by having chewing type mouthparts, compound eyes, two pairs of wingpads on the dorsal surface of the thorax which are directly caudad, three pairs of thoracic legs with two to three segmented tarsi, and a ten-segmented abdomen (Fig. 3 and 4). Older larvae have visible gonapophyses visible on abdominal segment nine (Fig. 5).

Zygoptera have three leaf-like gills at the end of the tenth segment (Fig. 6). The gill shape, coloration, and tracheation pattern are important for identification and are used for most taxonomic keys. Coenagrionidae gills will often have a nodus, a point on the edge of the gill where a change in the marginal setae occurs, often also marked by a marginal notch and sometimes by a distinct change in color and/or cuticular thickness across the entire gill width (Fig 7) (Westfall and May, 2006). Gills are easily lost and often regenerate; however the regenerated gills may look quite different from the original ones, making proper identification of the insect more difficult.

At the base and between the median and each lateral gill lies the cercus (Fig. 6). The cercus may have characteristic shapes that at least vaguely reflect the shape of the adult appendage, hence they may be useful in identification of some species (Westfall and May, 2006).

Damselfly larvae in Florida fall into two rather general behavioral groups: claspers, and sprawlers (Table 1). Claspers (sometimes known as climbers), are often found in vegetation and on the stems of aquatic plants. Sprawlers tend to be more legged and move sluggishly. Certain species of the genus *Argia* are the only Florida damselflies that are sprawlers.

Collection and Preservation

Larvae can be collected using a “dip-net” or any suitable seine-like net, scoop, etc. The net can be swept into aquatic plants, submersed roots, leaf packs, snags, mud, muck, sand, and silt. Nymphs should be preserved in 75-85% ethyl alcohol; if it is stronger it hardens the bodies too much and makes them brittle. Vial labels should note the location, date, habitat information, and name of collector. Alcohol should be replaced in the vials after a few weeks if several nymphs are stored per vial (Tennessen, 2010).

Rearing of the Larvae

Rearing larvae can help confirm the identification of a specimen by having an adult/larvae association. By using later instar larvae, you will have a lower mortality rate and lower upkeep of the larvae. When transporting larvae from the field, they can be kept alive and in containers containing wet leaves or other vegetable matter and a small amount of water. Larvae can be kept in small cups or an aquarium with a stick or screen to allow them to crawl out of the water and emerge. Larvae are cannibalistic so it is best if they are kept separate from each other. The size of the larvae at the time of collections determines what their prey items will be. Since they are opportunistic predators, any live prey that is small enough for the larvae to handle, is probably okay. FDEP staff have fed the larvae a combination of *Hyalella azteca* and small fish fry with fairly good results. Chironomidae larvae also make excellent prey (Tennessen, 2010). Shortly before emergence, the larvae will withdraw the flesh from the labium and the crinkled adult wings are often visible through the exoskeleton at this time. When the adult emerges, it should not be touched until the wings have dried and the first signs of color pattern start showing. At that time, it can be placed in an envelope and allowed to harden overnight. It can then either be frozen or placed in acetone to preserve the specimen. Specimens can be kept in cellophane or mylar envelopes, or like larvae, preserved and stored in 75-85% ethyl alcohol. Adults and exuviae should be preserved together. For further information about the preservation and identification of adults I would advise the use of the literature in the Appendix, most notably Damselflies of North American (2006).

Use of Keys

The following keys are in part an adaptation of earlier works. Westfall and May (2006) is generally followed at all taxonomic levels. Walker and Corbet (1975), Brigham, Brigham, and Gnilka (1982), and Daigle (1992) are used to supplement certain portions of the keys. The description at the genus level reiterate characters used in the key couplets and provide additional characters for verification.

The keys in this guide are in the standard dichotomous format normally used for such documents. Most couplets are accompanied by figure(s) illustrating the characters referred to in the text of that couplet and the sources for those figures are given in Appendix I. Arrows are provided in some cases to focus the user's attention to the specific part of interest in that figure.

To identify a specimen using a dichotomous key, the user starts at the first couplet of the key, determines which half of the couplet most closely represents the specimen, and proceeds to the next number indicated. This procedure continues until a taxonomic determination is reached. Because the proportions and the relative lengths of various parts of the larvae, as well as the number of setae, vary in different instars of a given species or genus, and because these differences are known from only a few species, the following key is, of necessity, based on larvae of the last few instars. Do not identify a specimen beyond your expertise or the condition of the specimen.

In putting this key together, I have hopefully made it easier for FDEP biologists and other interested individuals to identify the larvae of Florida damselflies. However, there are several other keys and guides that are listed in the Appendix that can and should be utilized to assist in the determination of the larvae. Since taxonomy changes quickly, go to the literature and search for revisions of the taxa that you have identified. There may be additional information that could confirm or deny your identifications. Finally it is very important for taxonomists to also consult specialists for verification of identifications.

Range Maps

Range maps are another avenue of identification. They must be used with caution because the ranges of some species are incomplete and ranges can expand or retract over time (Louton, 1982). Range maps were created by extracting information on Odonata distribution from certain publications cited on the reference page and the Florida Department of Environmental Protection's Statewide Biological Database (SBIO). The range maps are based on specific collection data, and in many cases actual ranges of species may include additional counties in Florida.

Acknowledgements

This guide is a product of the collective effort of friends and colleagues. My thanks go to Devan Cobb, Dana Denson, Ken Espy, Julie Espy, Shannon Gerardi, Mike Heyn, Peggy Morgan, Todd Risk and Tom Shipp for their encouragement and support and especially to Devan for her patience as the contract manager of this project. I would like to thank Dana Denson, Mike Heyn, Ken Tennessen, the Florida Department of Environmental Tallahassee Laboratory, and the Florida State Collection of Arthropods (FSCA) for allowing me the use of their insect collections. Finally I would like to thank Dana Denson, Michael Heyn, Todd Risk and Ken Tennessen for their review of this manuscript.

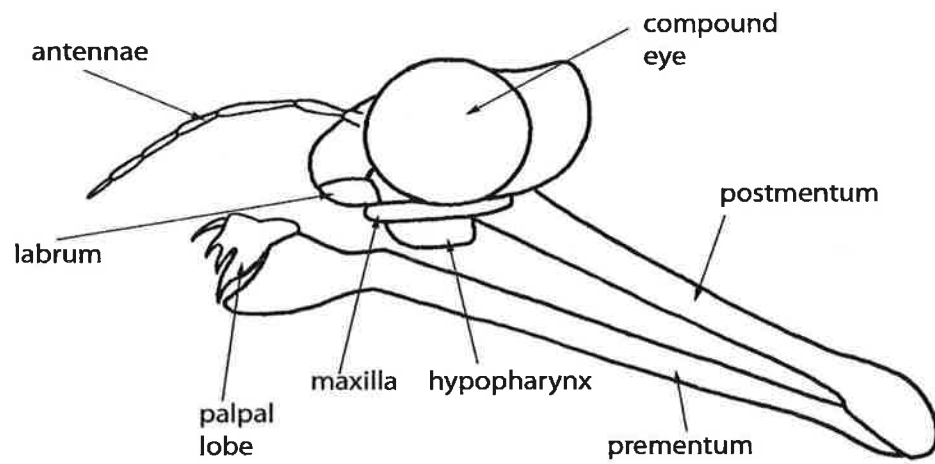


Fig. 1. Lateral view of head of *Lestes* sp.

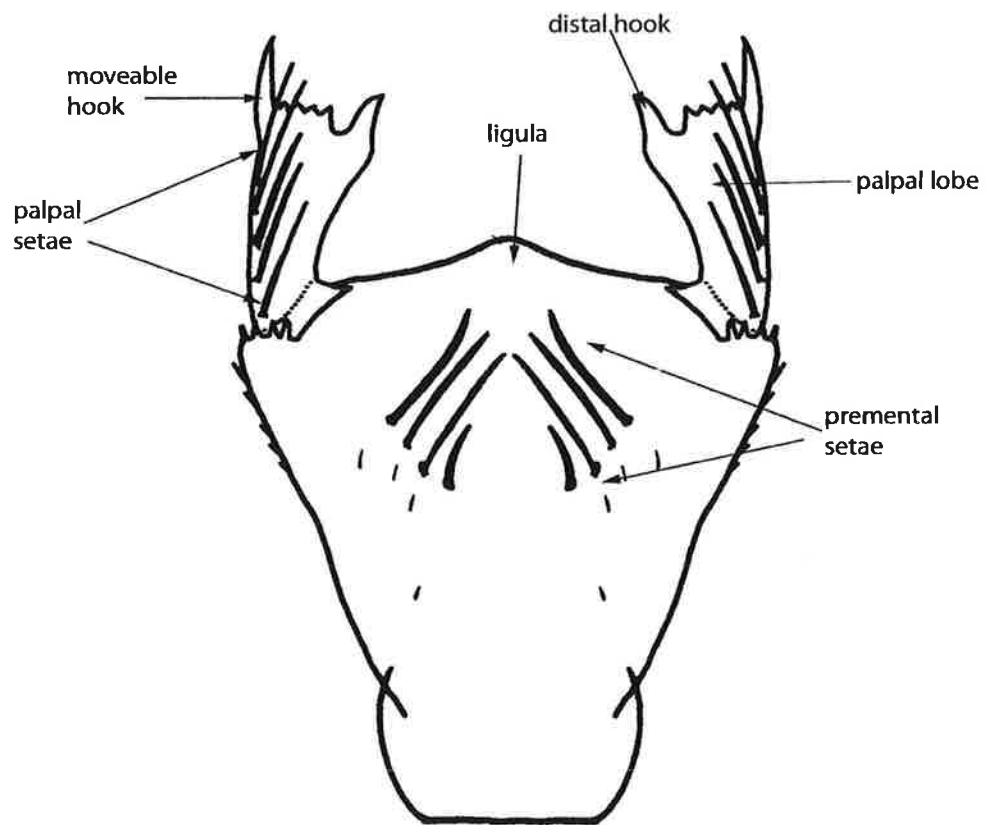


Fig. 2. Dorsal view of prementum and palpal lobe of *Ischnura* sp.

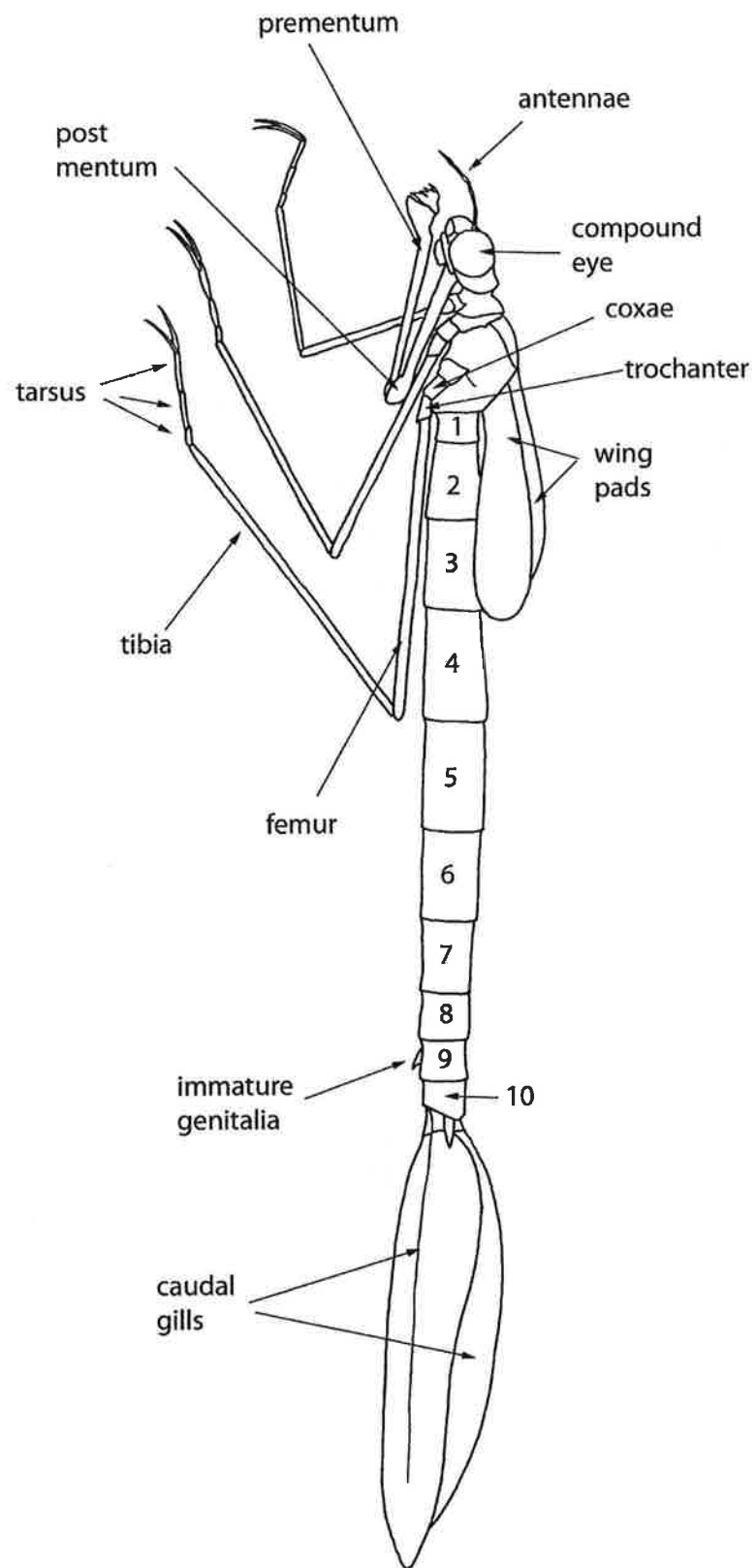


Fig. 3. Lateral view of *Lestes* sp.

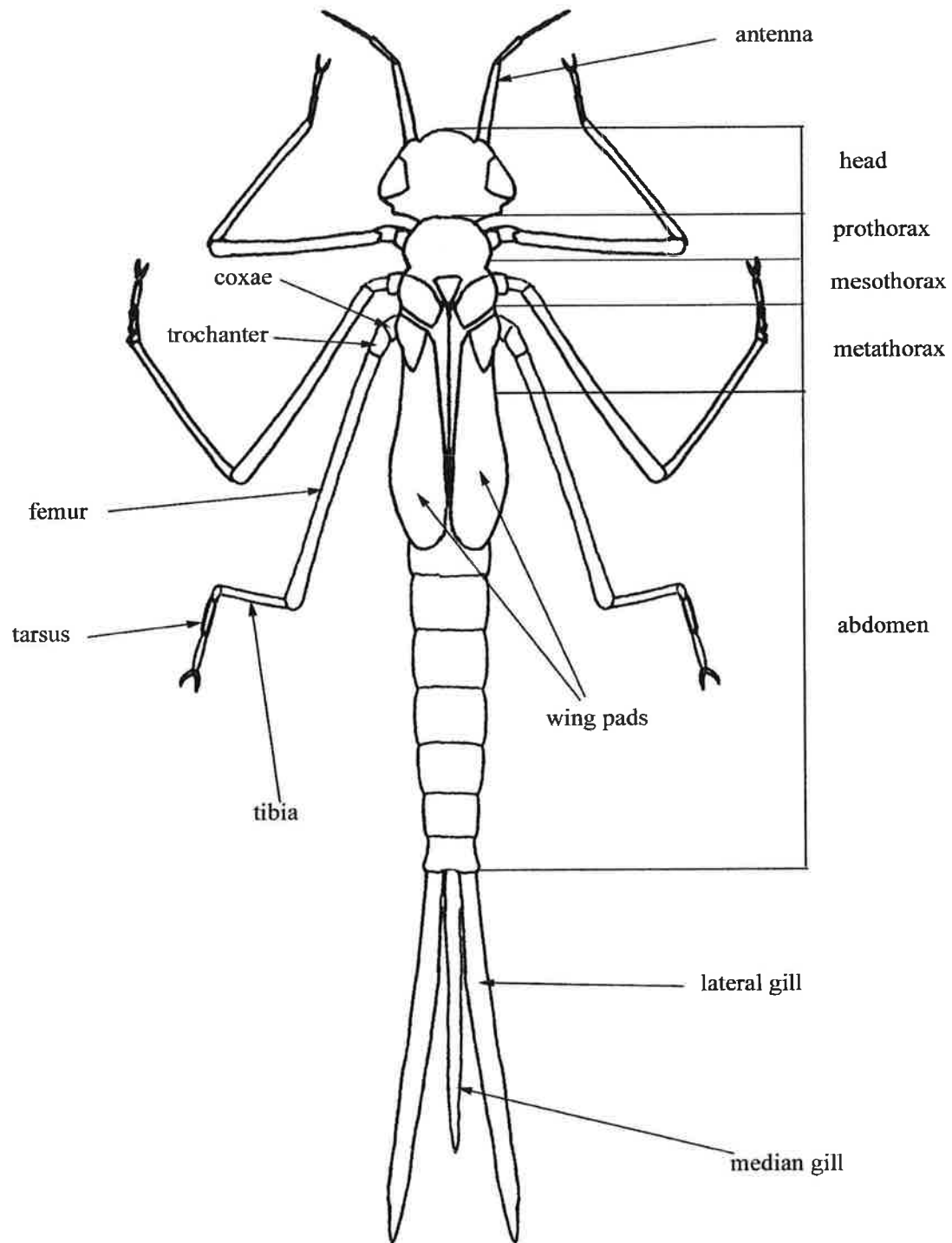


Fig. 4. Dorsal view of Calopteryx maculata (modified from Westfall and May, 2006)

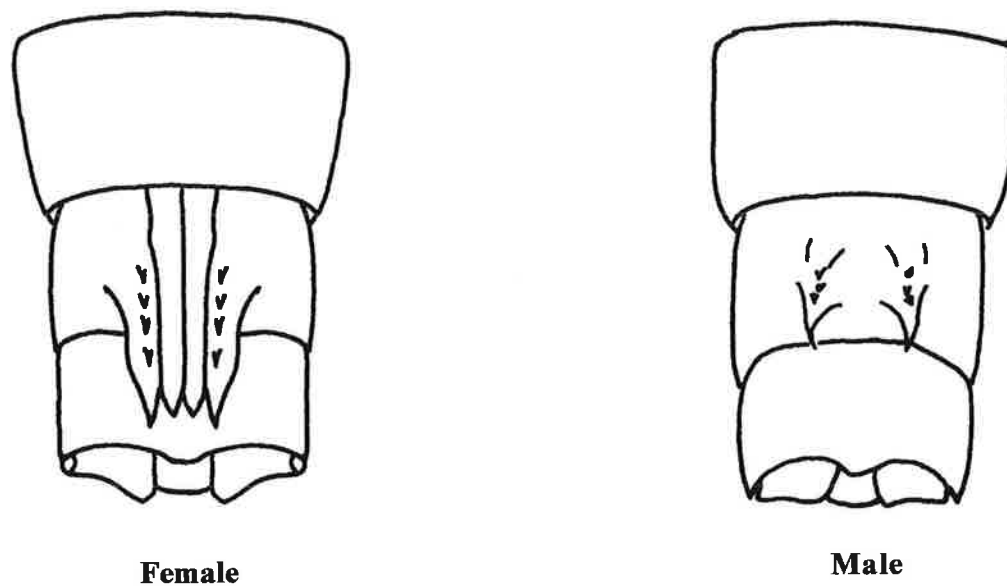


Fig. 5. Ventral view of distal end of abdominal segments eight, nine and ten of female and male coenagrionid larvae showing developing gonapophyses (redrawn from Westfall and May, 2006).

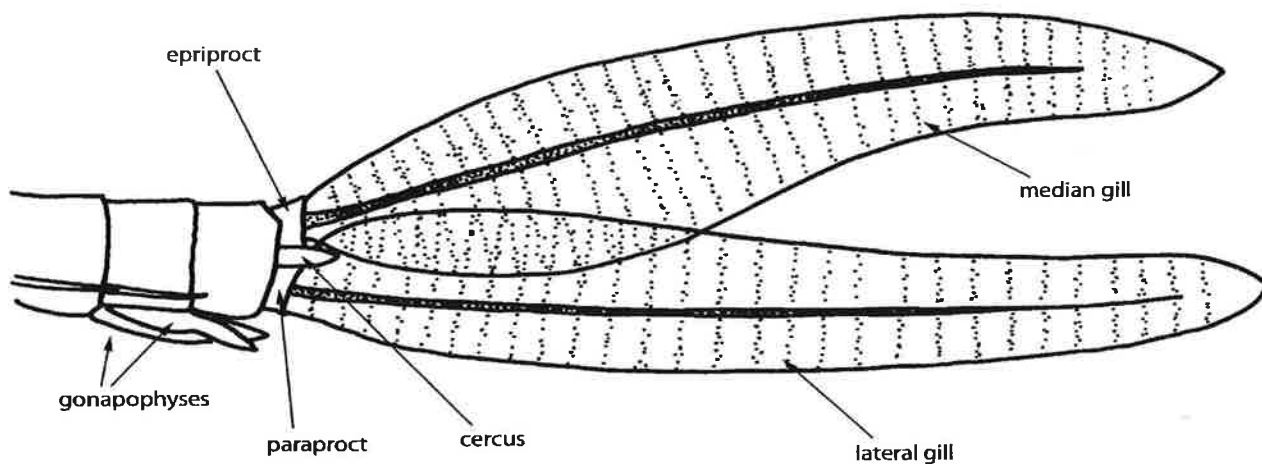


Fig. 6. Lateral view of abdominal segments 8-10 and caudal gills of a female *Lestes vidua*.

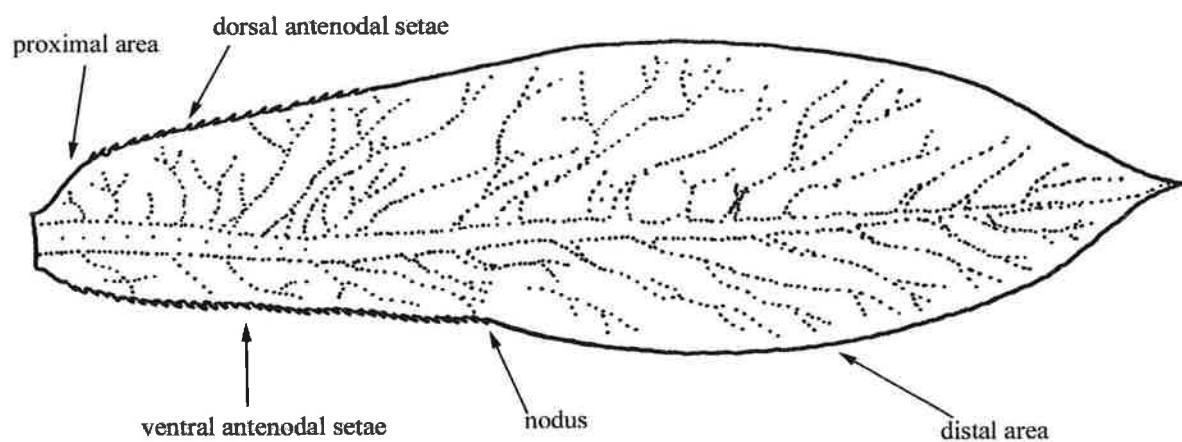


Fig. 7. Lateral gill of Ischnura sp.

Table 1. Summary of ecological data for the Zygoptera genera (immatures only) occurring in Florida (modified from Westfall, and Tennesen 1996).

Taxa	Habit ¹	Substrate ²	General Habitat ³	
			Lotic	Lentic
CALOPTERYGIDAE				
<i>Calopteryx</i>	Claspers	detritus, debris, riparian and aquatic plants	depositional, erosional	-
<i>Hetaerina</i>	Claspers	detritus, debris, riparian and aquatic plants	depositional, erosional	-
COENAGRIONIDAE				
<i>Argia</i>	Claspers, Sprawlers	coarse sediment, debris, aquatic plants	depositional, erosional	littoral, erosional
<i>Enallagma</i>	Claspers	detritus, riparian and aquatic plants	depositional	most including brackish and alkaline water
<i>Ischnura</i>	Claspers	riparian and aquatic plants	depositional	most
<i>Nehalennia</i>	Claspers	aquatic plants	-	most
<i>Telebasis</i>	Claspers	aquatic plants	depositional	most
LESTIDAE				
<i>Lestes</i>	Claspers, swimmers	aquatic plants	depositional	most

¹ Habits are defined as follows:

clasper - living upon aquatic plants or detrital debris, modified to climb upon stems;

sprawler - living upon the surface of floating leaves of vascular macrophytes, sediments, or detritus.

swimmer - swimming, often only to move from one attachment site to another

² Substrates are defined as follows:

detritus - leaf litter and other coarse particulate organic matter;

debris - large organic matter (logs and branches);

sediments - inorganic particulate matter [coarse (cobbles, pebbles, or gravel) or fine (sand or silt)];

aquatic plants - non-microscopic aquatic plants.

³ General habitats defined as follows:

lotic - running water [depositional (pools, slackwater, and margins) or erosional (riffles)];

lentic - standing water [littoral (shallow shore area) or erosional (wave-swept shore area with coarse sediment)].

KEY TO FAMILIES FOR THE MATURE LARVA OF THE DAMSELFLIES OF FLORIDA

1) First antennal segment greatly elongate, as long, or almost as long as combined length of remaining segments (Fig. 8); prementum with deep median cleft (Fig. 9); lateral caudal gills broad and float dorsally (Fig. 10); triangular in cross section . . . **Calopterygidae** (page 13)

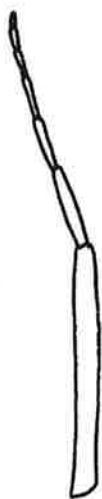


Fig. 8

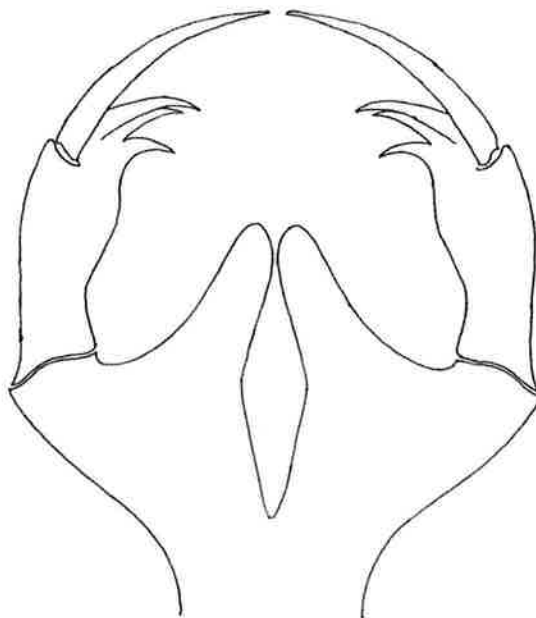


Fig. 9

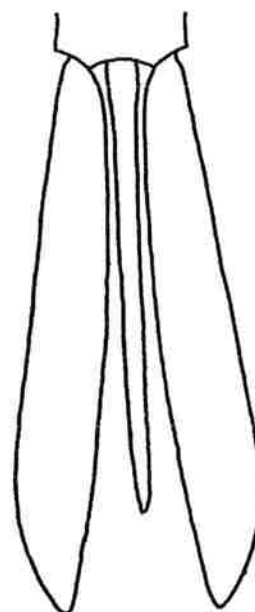


Fig. 10

1') First antennal segment not so elongate, distinctly less than combined length of remaining segments (Fig. 11); prementum with small closed cleft or none (Figs. 12); lateral caudal gills flat or somewhat inflated (Fig. 13) 2

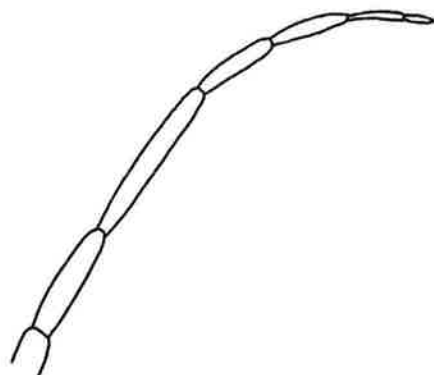


Fig. 11

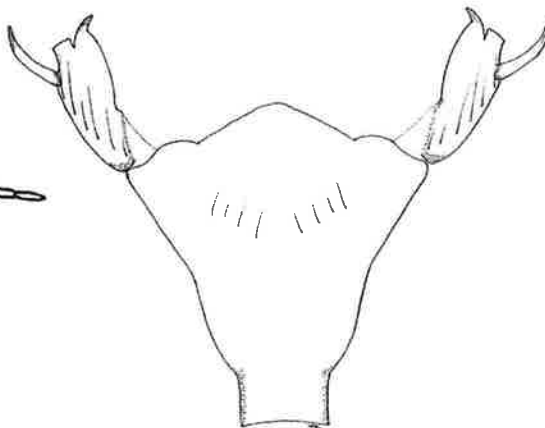


Fig. 12

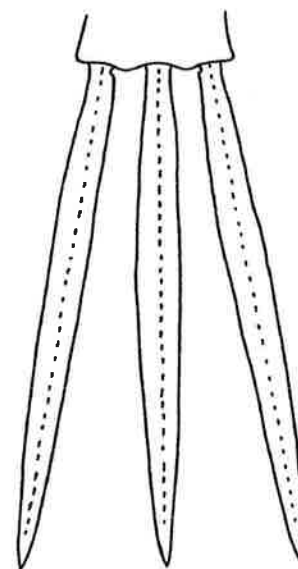


Fig. 13

2) Proximal half of prementum distinctly petiolate, spoon-shaped, the narrow proximal part as long as or longer than expanded distal part (Fig. 14); movable hook of each palpal lobe with 2 or 3 setae; gill tips rounded (Fig. 15) . . . **Lestidae** (page 18)

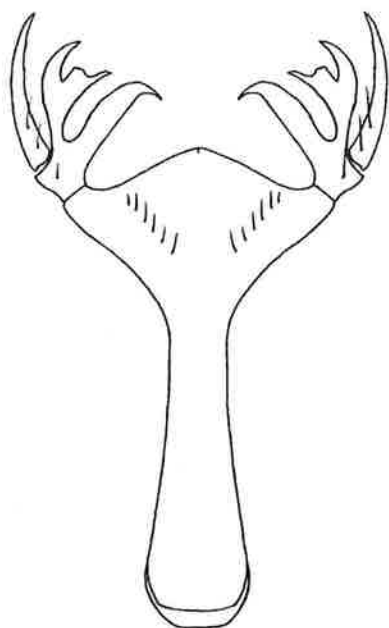


Fig. 14

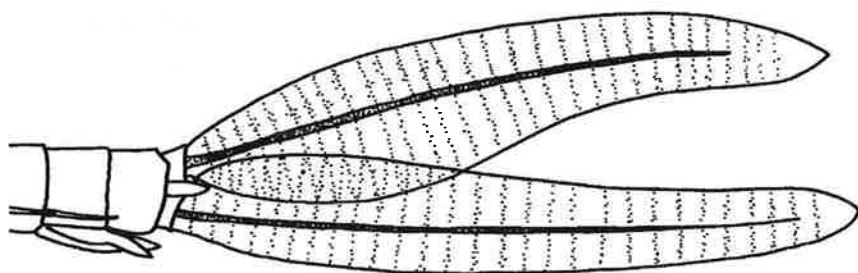


Fig. 15

2') Proximal half of prementum not distinctly petiolate, more triangular (Fig. 16); movable hook of each palpal lobe with no setae; gill tips usually pointed (Fig. 17) . . . **Coenagrionidae** (page 23)

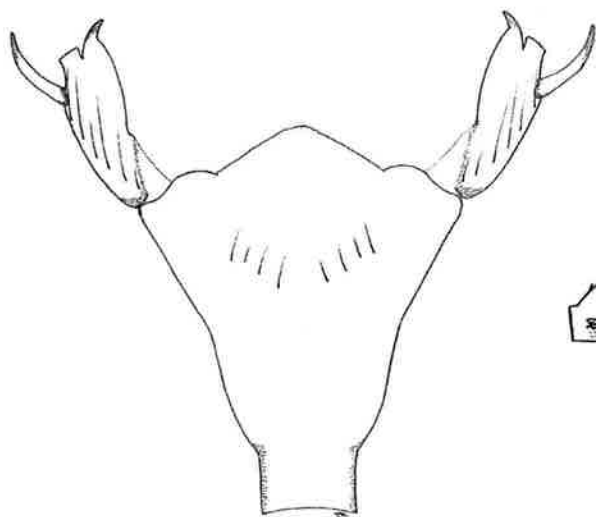


Fig. 16

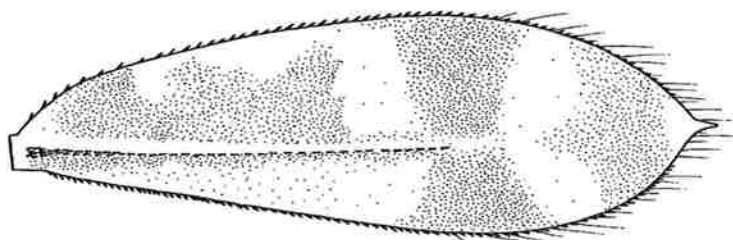


Fig. 17

Family Calopterygidae

Regional diagnosis: First antennal segment greatly elongate, as long as the combined remaining segments; prementum with deep median cleft; lateral caudal gills triangular in cross section

Florida genera: *Calopteryx*, *Hetaerina*

Key to Florida Genera of Calopterygidae

1) Prementum cleft nearly halfway to its base (Fig. 18); posterolateral margins of abdominal segments 9 and 10 without spines; lateral gills flat or not strongly triquetral in cross section . . . *Calopteryx* spp. (page 14)

1') Prementum cleft only to base of palpal lobes (Fig. 19); posterolateral margins of abdominal segments 9 and 10 with small distinct spines; lateral caudal gills strongly triquetral in cross section . . . *Hetaerina* spp. (page 16)

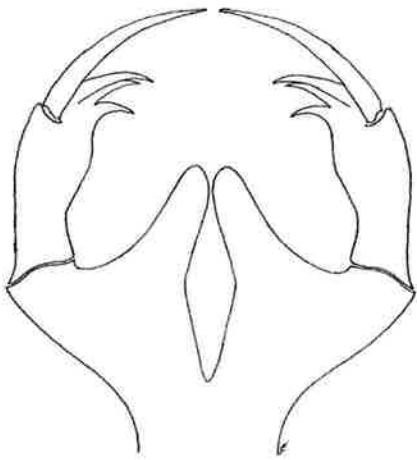


Fig. 18.

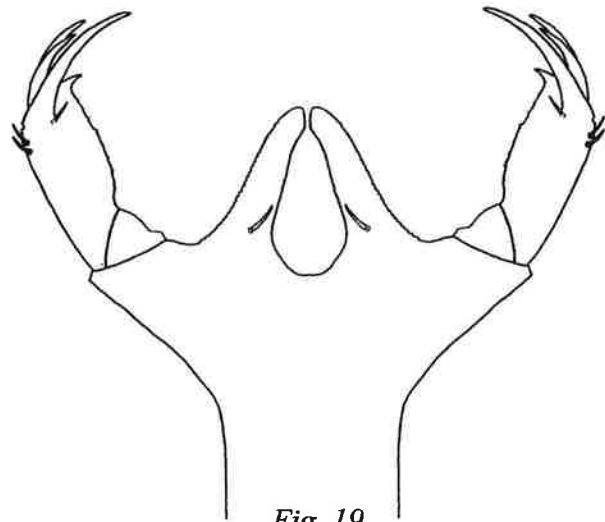


Fig. 19.

Genus *Calopteryx* Leach 1815
Syn.: *Agrion* Fabricius, *Sylphis* Hagen in Selys

Regional diagnosis: First antennal segment greatly elongate, as long as the combined length of the remaining segments; prementum with deep median cleft; lateral caudal gills triangular in cross section; prementum cleft nearly halfway to its base; posterolateral margins of abdominal segments 9 and 10 without spines; lateral gills flat or not strongly triquetral in cross section

Florida species: *C. dimidiata* Burmeister Syn.: *apicalis* Burmeister, *cognata* Rambur ,
C. maculata (Beauvois) Syn.: *floridana* Huggins, *holosericea* Burmeister, *materna* Say, *opaca* Say,
papilionaria Rambur

Remarks: The larvae live in streams among roots and stems in the current. They are long-legged, stiff, and move very little (Westfall, et al, 1996).

Key to Florida species of *Calopteryx*

1) Median gill with stout spines and many long hairlike setae along margins (Fig. 20); stout spines on posterior portion of lateral carinae of abdominal segments 9 and 10 . . . *Calopteryx dimidiata*

1') Median gill without stout spines, only thin short setae and few long hairlike setae along margins (Fig. 21); no stout spines on posterior portion of lateral carinae of abdominal segments 9 and 10 . . . *Calopteryx maculata*

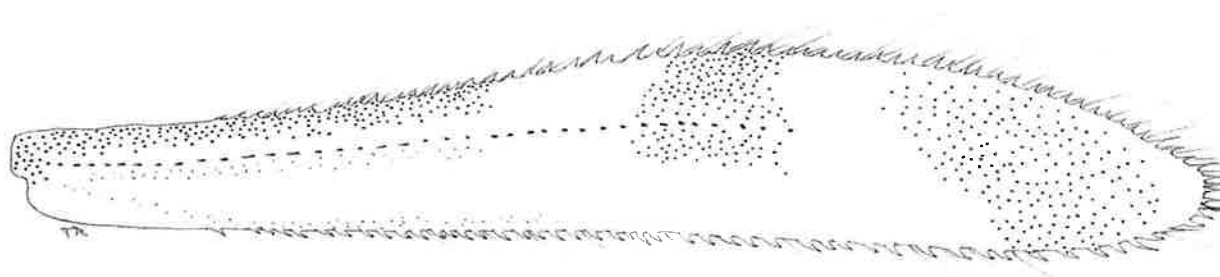


Fig. 20

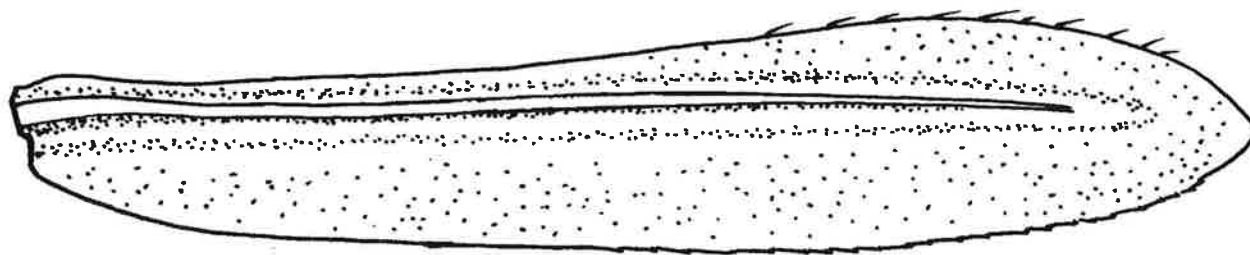
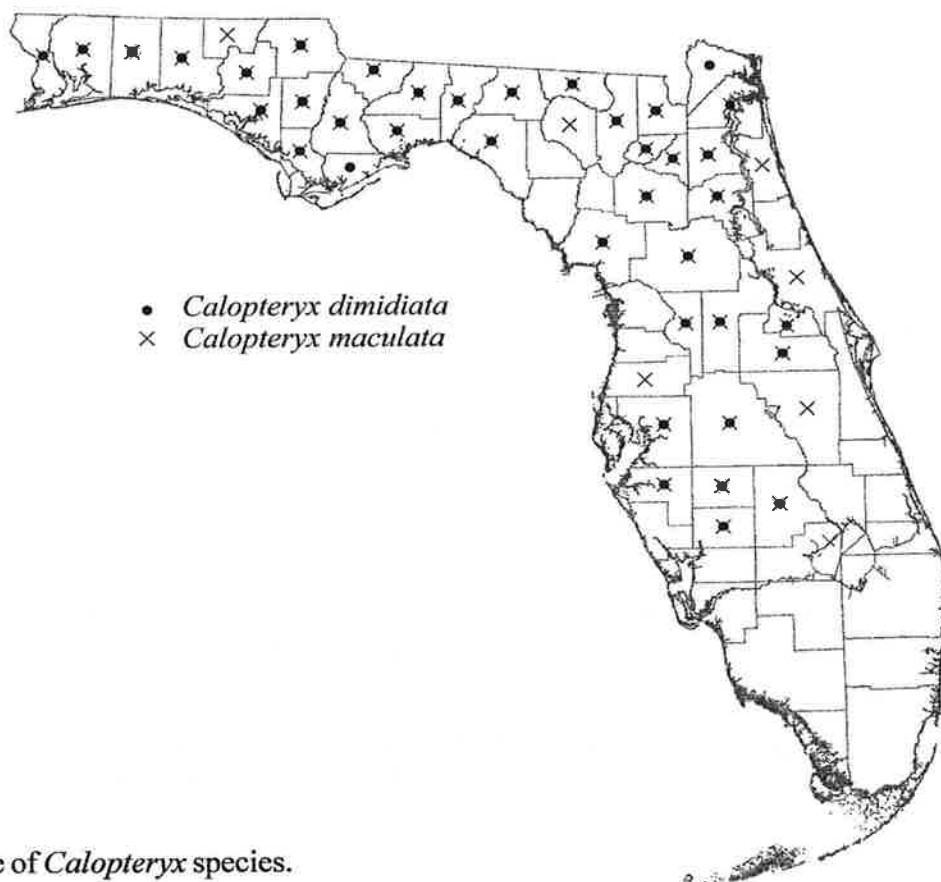


Fig. 21



Map 1. Range of *Calopteryx* species.

Genus *Hetaerina* Hagen in Selys 1853

Regional diagnosis: First antennal segment greatly elongate, as long as the combined length of the remaining segments; prementum cleft only to base of palpal lobes posterolateral margins of abdominal segments 9 and 10 with small distinct spines; lateral caudal gills strongly triquetral in cross section

Florida species: *H. americana* (Fabricius) Syn.: *basalis* (Say), *californica* Hagen, *pseudamericana* Walsh, *scelerata* Walsh, *texana* Walsh

H. titia (Drury) Syn.: *bipartita* Selys, *limbata* Selys, *rupamnensis* Walsh, *rupinsulensis* Walsh, *tricolor* (Burmeister)

Key to Florida species of *Hetaerina*

1) Lateral spines present on abdominal segment 8; gills distinctly banded (Fig. 22) *Hetaerina titia*

1') Lateral spines not present on abdominal segment 8; gills not distinctly banded, distinct markings if any, restricted to margins *Hetaerina americana*

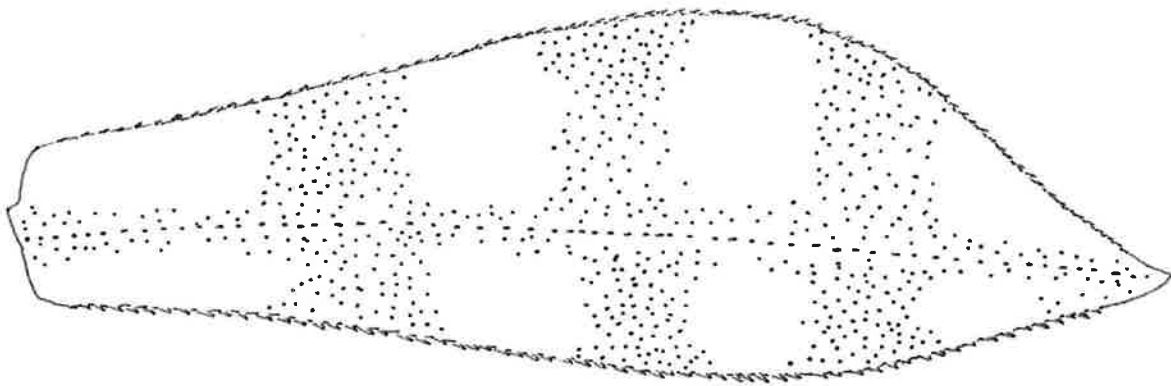
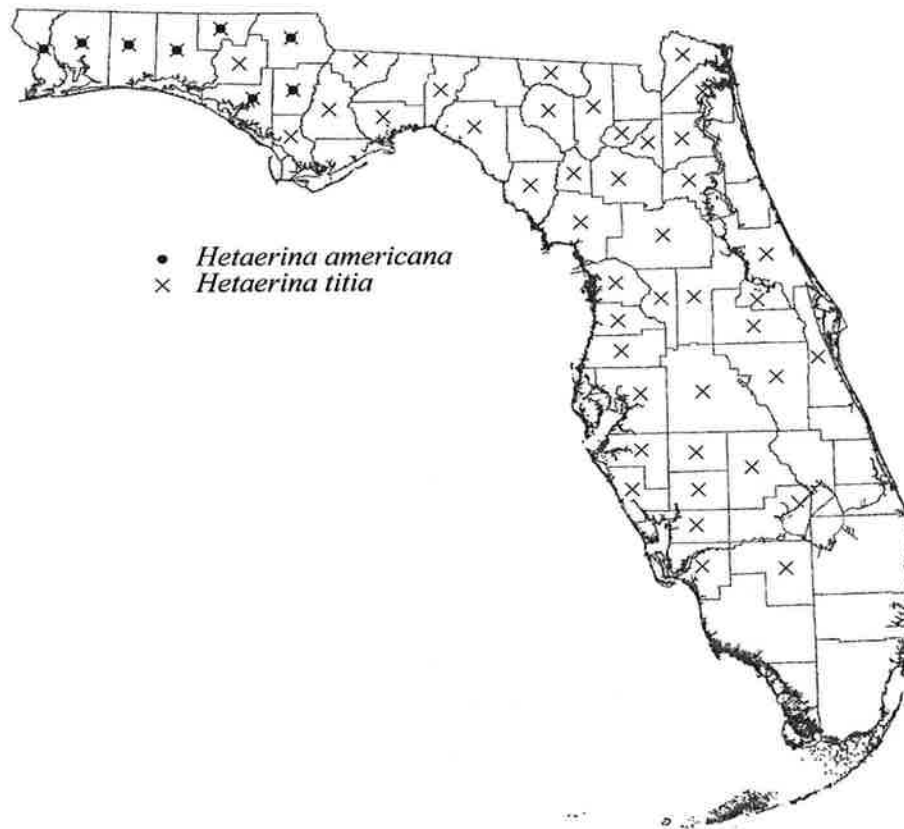


Fig. 22.



Map 2. Range of *Hetaerina* species.

Family Lestidae

Regional diagnosis: Proximal half of the prementum distinctly petiolate, spoon-shaped, the narrow proximal part as long as or longer than expanded distal part; movable hook of each palpal lobe with 2 or 3 setae; gill tips rounded.

Florida genera: *Lestes*

Remarks: The larvae of *Lestes* are usually restricted to lentic waters, usually small, sheltered lakes, temporary pools and ponds with marshy or boggy margins and abundant emergent vegetation, less commonly in pond-like expansions of streams with little flow (Westfall, Jr., et al., 1996).

Genus *Lestes* Leach 1815

Syn.: *Anapates* Charpentier, *Puella* Brulle

Florida species: *L. disjunctus* Selys, *L. forficula* Rambur, *L. inaequalis* Walsh, *L. rectangularis* Say, *L. spumaris* Hagen in Selys, *L. tenuatus* Rambur, *L. vidua* Hagen, *L. vigilax* Hagen in Selys

Key to Florida species of *Lestes*

1) Lateral spines present on abdominal segments 1, 2, or 3-9; all gills of equal width along entire length, only 1/6 as wide as long (except at extreme tip) 2

1') Lateral spines present on abdominal segments 4, 5, or 6-9; gills gradually tapering distally, widest part of median gill 1/3 to 1/5 length of gill, with dorsal margin convex 3

2) Lateral spines on segments 1-9; black-brown band on apices of third tarsal segments; denticulate process of lateral lobe with definite teeth (Fig. 23) *Lestes inaequalis*

2') Lateral spines on segments 2 or 3-9; no such dark band on apices of third tarsal segments; denticulate process of lateral lobe merely serrated (Fig. 24) *Lestes vigilax*



Fig. 23



Fig. 24

3) Slender proximal part of prementum at most about twice the length of the expanded distal part (Fig. 25) 4

3') Slender proximal part of prementum distinctly greater than twice the length of the expanded distal part, usually 2.5 times as long or more (Fig. 26) 5

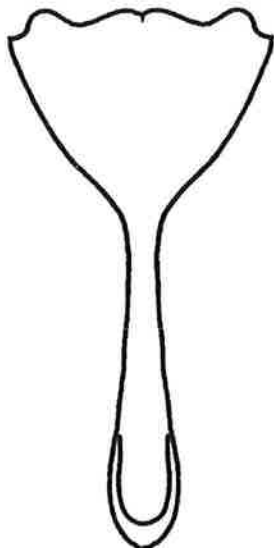


Fig. 25

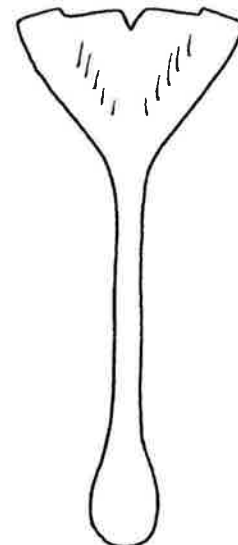


Fig. 26

4) Palpal lobe with the short, denticulate process definitely not truncate, more or less hook-like (Fig. 27); tips of ovipositor extending well beyond apex of segment 10, usually to midpoint of pedicels of lateral gill . . . *Lestes spumaris*

4') Palpal lobe with the denticulate process and inner hook very shallow, much less than 1/2 the depth of the notch between the denticulate process and outer hook (Fig. 28) . . . *Lestes tenuatus*



Fig. 27



Fig. 28

5) Prementum at most 2.5 times as long as the width of the distal part at base of palpi (Fig. 29) . . . 6

5') Prementum at least 2.75 times as long as the width of the distal part at base of palpi (Fig. 30) . . . 7

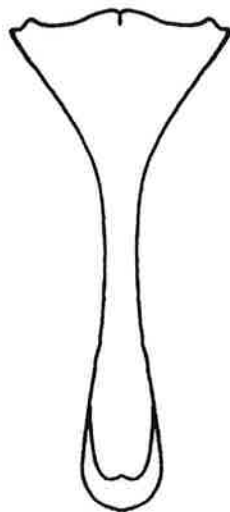


Fig. 29

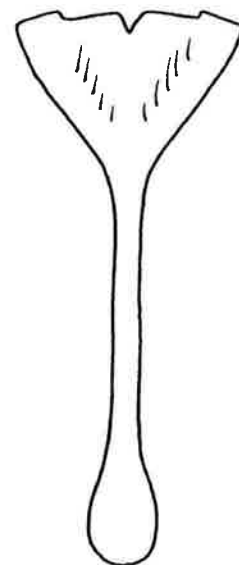


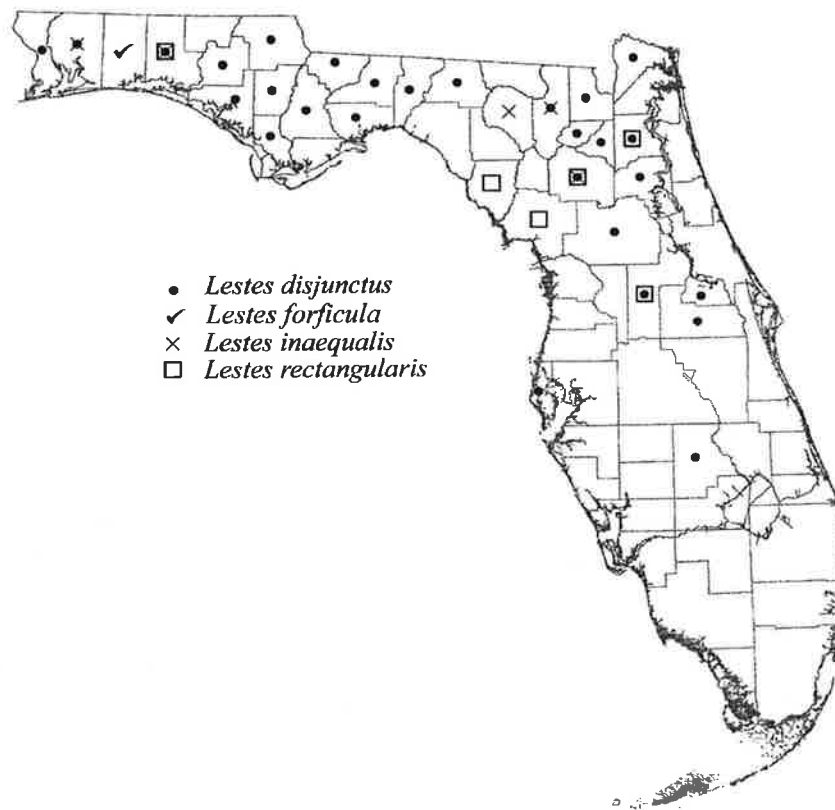
Fig. 30

6) Labium very long and slender, extending past thorax to abdomen *Lestes disjunctus*

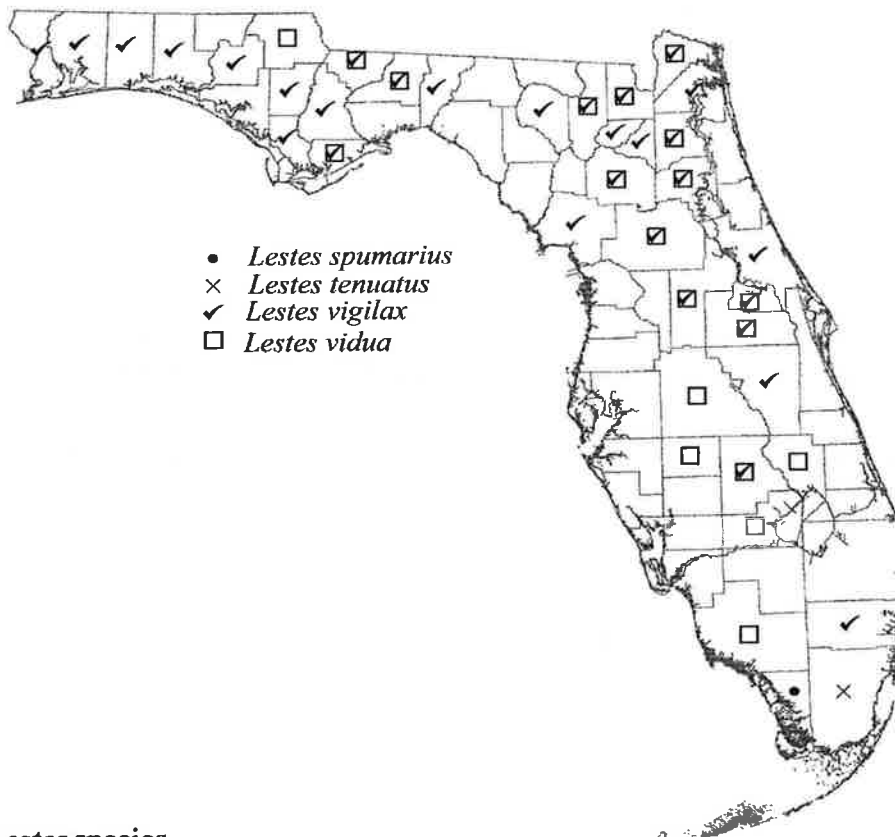
6') Labium shorter, not extending past thorax *Lestes rectangularis*

7) Cercus of male distinctly longer than greatest length of abdominal segment 10; female with ovipositor extending only to apex of segment 10; lateral spines of segment 8 usually longer than those of segment 9 . .
. . *Lestes forficula*

7') Cercus of male about equal to greatest length of abdominal segment 10; ovipositor of female extending beyond apex of segment 10; lateral spines of segment 8 at most equal to those of segment 9 *Lestes vidua*



Map 3. Range of *Lestes* species.



Map 4. Range of *Lestes* species.

Family Coenagrionidae

Regional diagnosis: First antennal segment not so elongate, distinctly less than the combined length of the remaining segments; prementum with small closed cleft or none; lateral caudal gills flat or somewhat inflated; proximal half of the prementum not distinctly petiolate, more triangular; movable hook of each palpal lobe with no setae; gill tips usually pointed.

Florida genera: *Argia*, *Enallagma*, *Ischnura*, *Nehalennia*, *Neoerythromma*, *Telebasis*

Key to Florida Genera of Coenagrionidae

1) Premental setae absent; palpal lobes with two distal pointed hooks; palpal setae 0-5 (Fig. 31); body form usually short and stout; caudal gills of some species, in dorsal view, quite thick or triquetral . . . *Argia* spp. (page 27)

1') Premental setae present; palpal lobes with one distal, pointed hook and a truncate, denticulate lobe; palpal setae 3-10 (Fig. 32); body form usually longer and more slender; caudal gills in dorsal view never thick or triquetral . . . 2

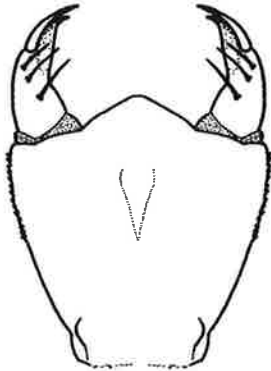


Fig. 31

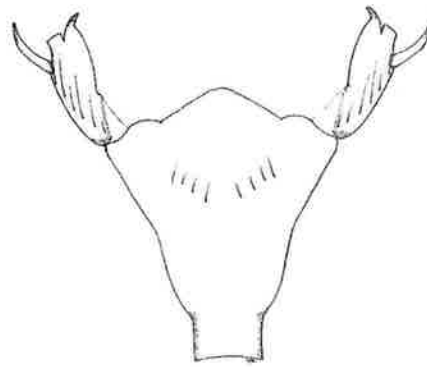


Fig. 32

2) Lateral gills one-third as broad as long; apical sixth of each lateral gill with a terminal angle of 70° or more excluding filamentous tip, if present; gill resembles the shape of a lightbulb (Fig. 31) . . . *Telebasis byersi* (page X)

2') Lateral gills not more than 1/4 as broad as long; apical sixth of each lateral gill with a terminal angle of about 60° or less (Fig. 33) . . . 3

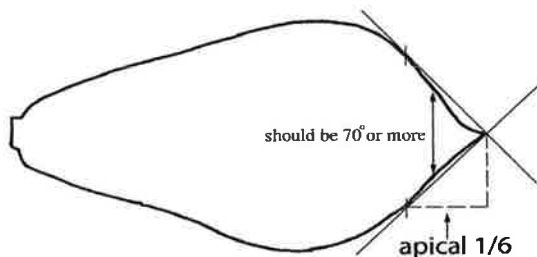


Fig. 33

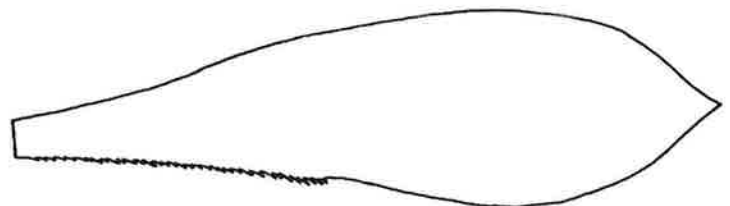


Fig. 34

3) Gills narrowed very abruptly shortly before apex, so that the tips are long and almost filamentous (Fig. 35) *Nehalennia* spp. (in part) (page 49)

3') Gills narrowed less abruptly, the tips not at all filamentous, although sometimes acuminate (Fig. 36) . . 4

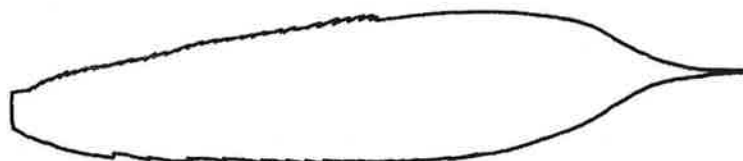


Fig. 35

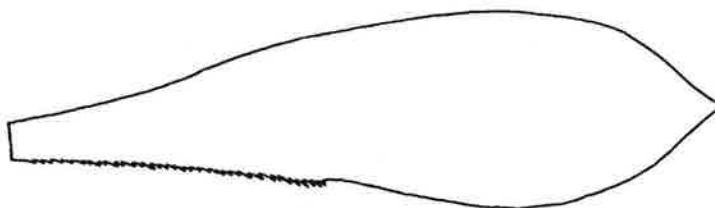


Fig. 36

4) One premental seta of normal length present, although one to three small setae may be present on medial side 5

4') At least two premental setae of normal length present 6

5) Palpal setae 3-4; numerous long, stiff setae on lateral carinae of all abdominal segments beyond first; length usually 17 mm or more . . . *Enallagma* spp. (in part) (page 31)

5') Palpal setae 5-6; no long, stiff setae present on lateral carinae of anterior abdominal segments, although often present on posterior segments; length usually 15 mm or less . . . *Nehalennia* spp. (in part) (page 49)

6) Lateral carinae of abdominal segments 2-8, in dorsal view, slightly concave, with apexes prominent and bearing two or more stout, curved setae (Fig. 37); usually 3 premental setae present; eyes with dark pattern of spots, or lines forming hexagonal-shaped cells; antennae with 6 segments* (Fig. 38); lateral carinae of abdominal segments 2-8 with a single row of setae of variable stoutness . . . 7

6') Lateral carinae of abdominal segments 2-8 with margins straight or slightly convex, apexes not prominent, and with apical setae, if present, not noticeably larger than the preceding setae (Fig. 39); 2-5 premental setae present; eyes usually with a pattern of lateral, alternating pale and dark bands; antennae with 7 segments (Fig. 40); lateral carinae of abdominal segments 2-7 with numerous small setae not arranged in a single row . . . *Ischnura* spp. (page 45)

* note that sixth antennal segment may appear to be divided into two segments

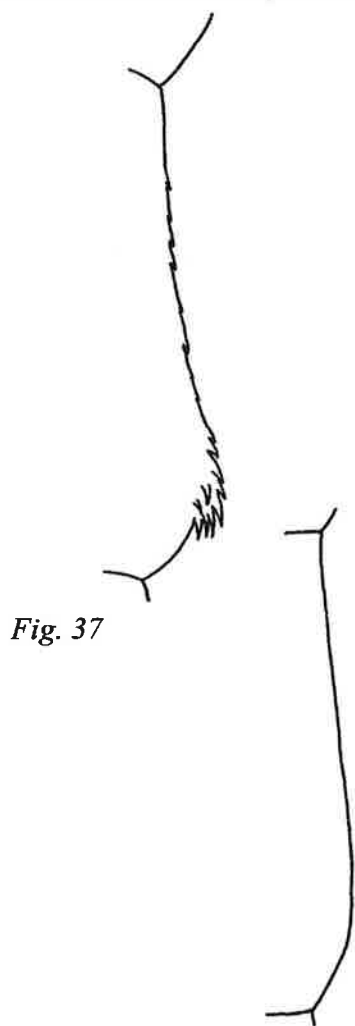


Fig. 37

Fig. 39

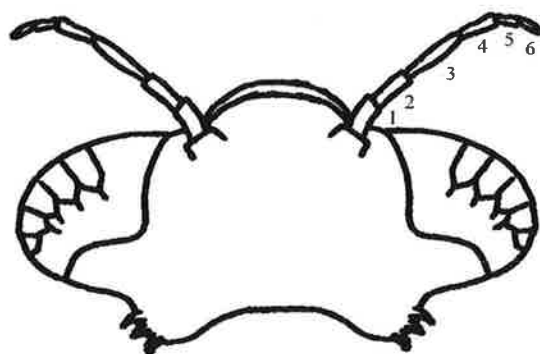


Fig. 38

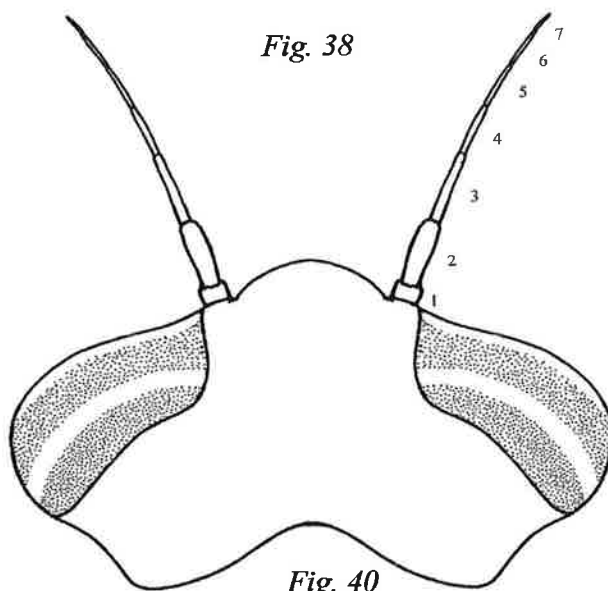


Fig. 40

7) Venter of abdominal segments 2-4 with a more or less transverse, apical group of stiff, conspicuous setae, or nearly all segments devoid of conspicuous ventral setae; lateral carinae of abdominal segment 9 less prominent than those of preceding segments, and with no stout setae; usually 4 palpal setae . . .

***Enallagma* spp.** (in part) (page 31)

7') Venter of all abdominal segments without such a conspicuous transverse, apical group of setae, instead setae of equal size and evenly scattered; lateral carinae abdominal segment 9 nearly as prominent as those of segment 8 and carinae of segment 8 and 9 both bearing one stout seta; usually 5 palpal setae . . .

Neoerythromma cultellatum (page 52)

Genus *Argia* Rambur 1842

Syn.: *Chalcargia* Kennedy, *Diargia* Calvert, *Hyponeura* Selys, *Leptargia* Kennedy, *Micrargia* Kennedy

Regional diagnosis: First antennal segment not so elongate, distinctly less than the combined length of the remaining segments; prementum with small closed cleft or none; lateral caudal gills flat or somewhat inflated; proximal half of the prementum not distinctly petiolate, more triangular; movable hook of each palpal lobe with no setae; gill tips usually pointed; premental setae absent; palpal lobes with two distal pointed hooks; palpal setae 0-5; body form usually short and stout; caudal gills of some species, in dorsal view, quite thick or triquetral

Florida species: *A. apicalis* (Say), *A. bipunctulata* (Hagen), *A. fumipennis* (Burmeister) Syn.: *obscura* Rambur, *A. moesta* (Hagen) Syn.: *intruda* Williamson, *putrida* (Hagen), *A. sedula* (Hagen), *A. tibialis* (Rambur) syn.: *binotata* Walsh, *fontium* (Hagen)

Key to Florida species of *Argia*

1) Lateral caudal lamellae triangular in cross section* (Fig. 41) . . . *Argia bipunctulata*

* flat gills of preserved specimens may swell and superficially resemble *A. bipunctulata*

1') Lateral caudal lamellae flat in cross section or nearly so (Fig. 42) . . . 2

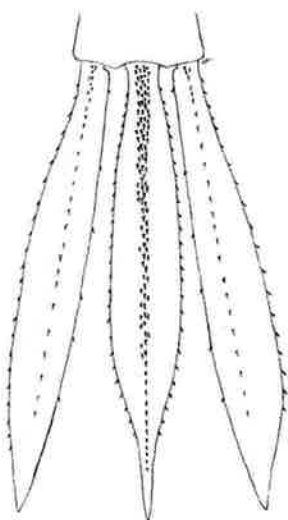


Fig. 41

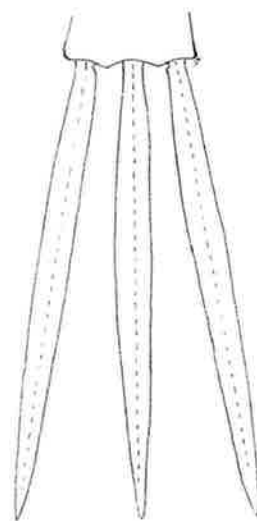


Fig. 42

2) Caudal lamellae with a marginal fringe of stiff setae mixed with fine long hairs toward apex (Fig. 43). . 3

2') Caudal lamellae without stiff marginal setae or with only a few near base (Fig. 44) . . . 4

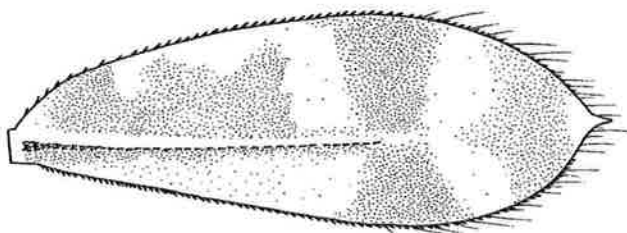


Fig. 43

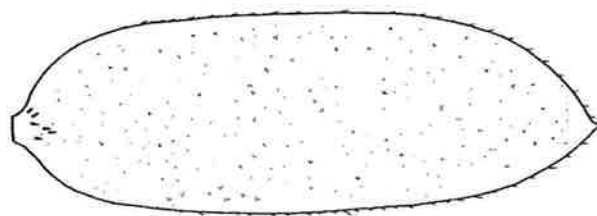


Fig. 44

3) First and second antennal segments pale; notch or indentation separating end hook from inner margin of ligula; dark bands on femora narrower than intervening spaces; caudal lamellae with coarse dark blotches on a pale background and each with a dark transverse band immediately beyond middle (Fig. 45) . . . *Argia sedula*

3') First and second antennal segments at least partly or wholly dark; notch separating end hook from inner margin of ligula absent; dark bands on femora wider than intervening spaces; caudal lamellae dark and nearly uniform except near each apex where there may be a pale V-shaped mark (Fig. 46) . . . *Argia fumipennis*

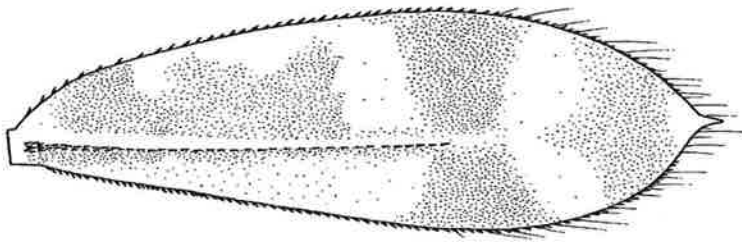


Fig. 45

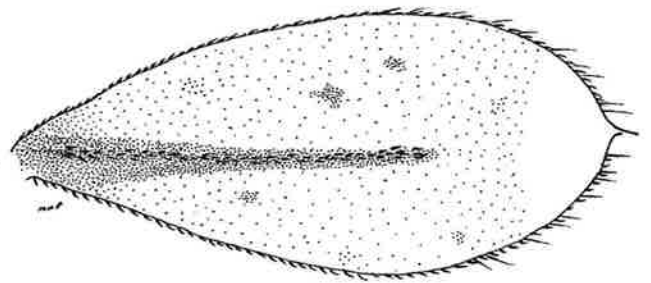


Fig. 46

4) Lateral carina of lateral gills with stout setae, if any, rather scattered and with numerous fine hairs; hind femora each with one wide, dark band; tracheation of gills usually not distinct; palpal setae 0-1 (Fig. 47) . . . *Argia moesta*

4') Lateral carina of lateral gills with setae extending at least 1/3 the length of the gills; hind femora with two dark bands; tracheation of gills usually distinct; palpal setae 1-4 (Fig. 48) . . . 5

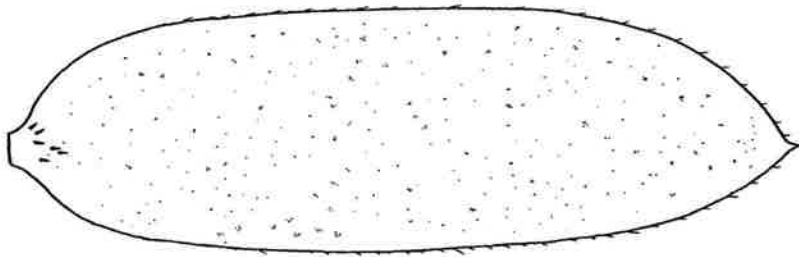


Fig. 47

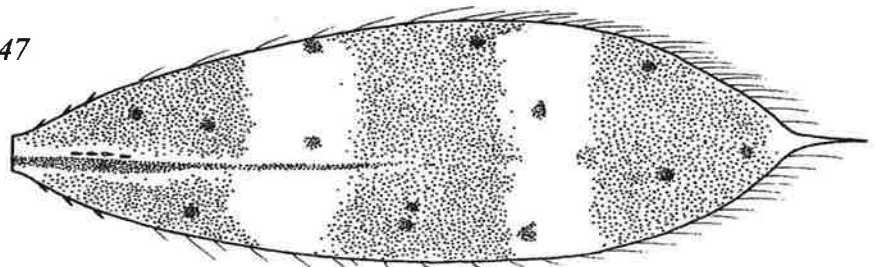


Fig. 48

5) Lateral gills widest about the mid-point, about $\frac{2}{5}$ as wide as long (Fig. 49); usually 2-4 palpal setae; dark bands of femora usually wider than the intervening spaces *Argia apicalis*

5') Lateral gills usually widest distinctly beyond middle, usually $\frac{1}{3}$ as wide as long (Fig. 50); 1-2 palpal setae; dark bands of femora usually narrower than the intervening spaces *Argia tibialis*

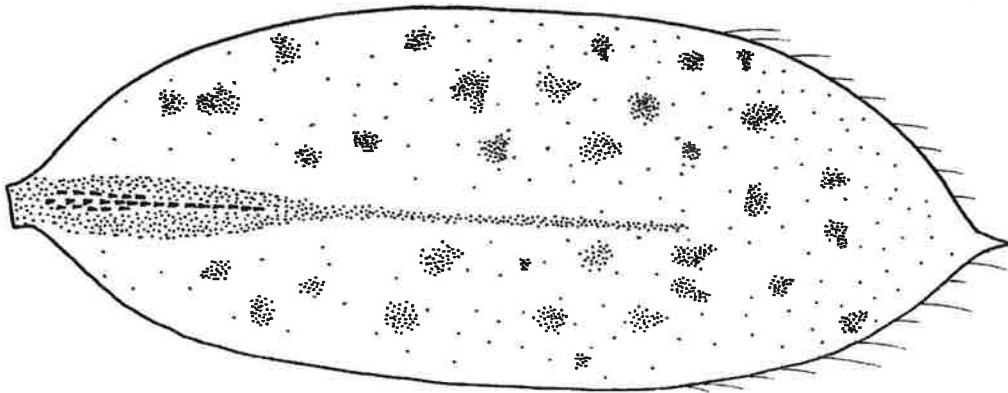


Fig. 49

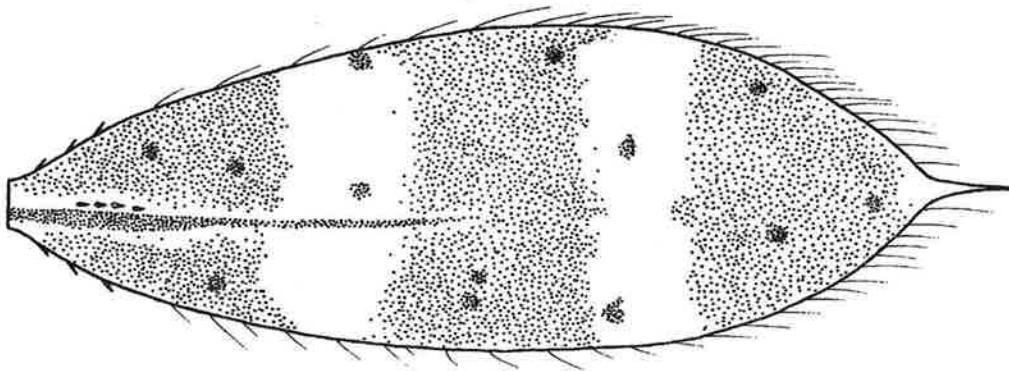
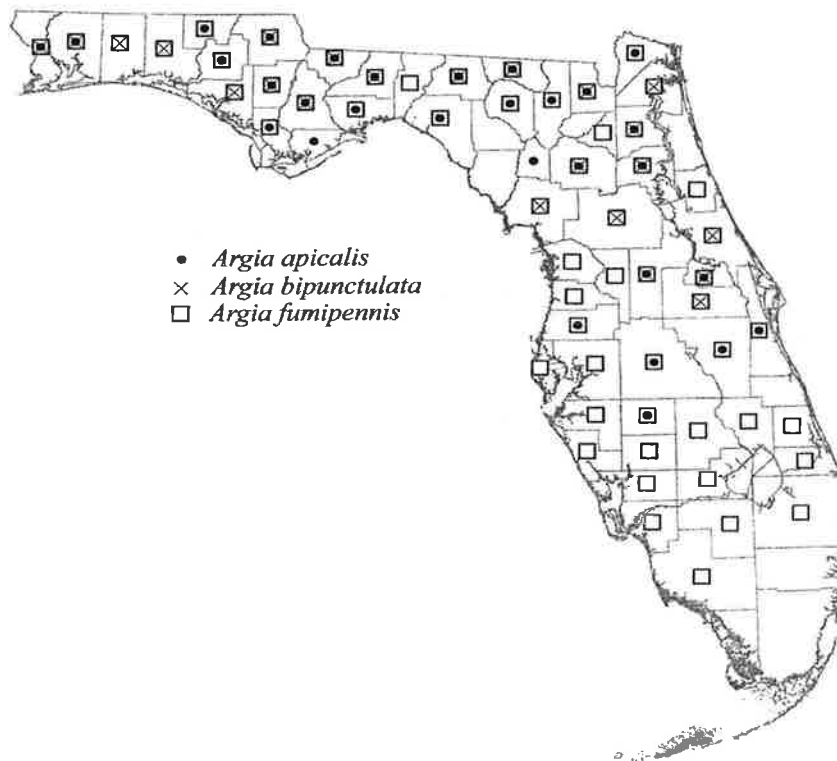
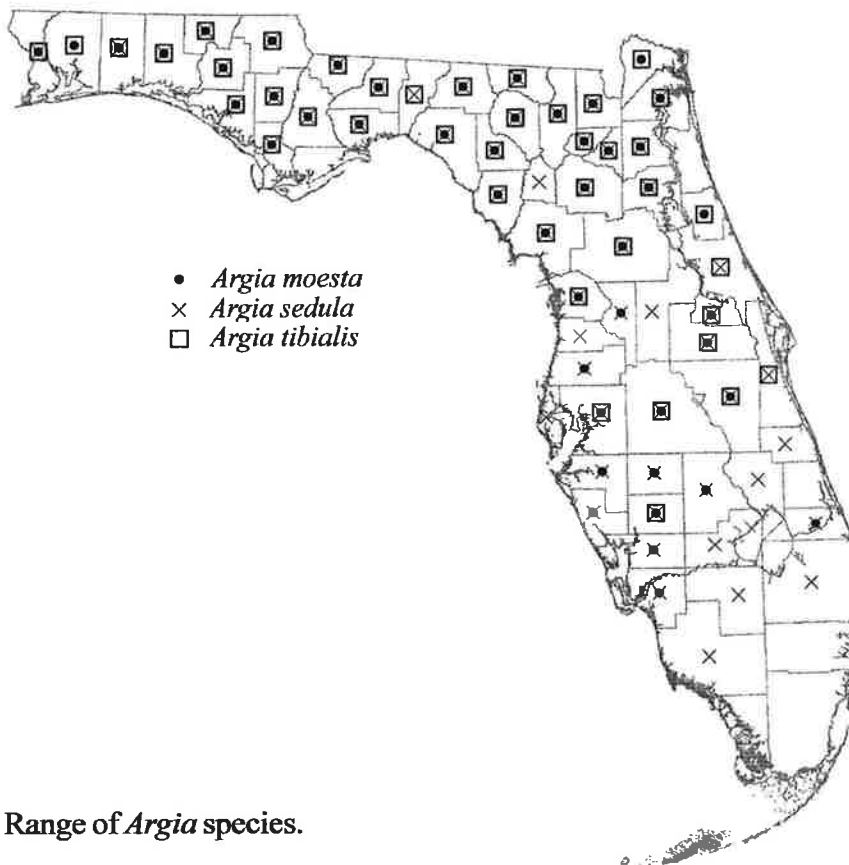


Fig. 50



Map 5. Range of *Argia* species.



Map 6. Range of *Argia* species.

Genus *Enallagma* Selys

Syn.: *Aenallagma* Selys, *Africallagma* Kennedy?, *Ischnallagma* Kennedy?, *Libyagrion* Fraser?,
Proischnura Kennedy?, *Teleallagma* Kennedy, *Thermagrion* Foerster?

Regional diagnosis: First antennal segment not so elongate, distinctly less than the combined length of the remaining segments; prementum with small closed cleft or none; lateral caudal gills flat; proximal half of the prementum not distinctly petiolate, more triangular; movable hook of each palpal lobe with no setae; gill tips not at all filamentous, although sometimes acuminate; at least 1 premental setae of normal length present; palpal setae 3-4; lateral carinae of abdominal segments 2-8 with a single row of setae of variable stoutness; eyes can have all dark eyes, or dark pattern of spots or lines forming hexagonal shaped cells; antennae with 6 segments.

Florida species: *E. basidens* Calvert,

E. civile (Hagen) Syn.: *canadense* (Provancher), *plebium* Selys, *simile* Selys,

E. coecum Hagen syn.: *krugii* Kolbe,

E. concisum Williamson,

E. daeckii (Calvert),

E. davisii Westfall,

E. divagans Selys,

E. doubledayi (Selys),

E. dubium Root,

E. durum (Hagen),

E. geminatum Kellicott, Syn.: *piscinarium* Williamson,

E. pallidum Root,

E. pollutum (Hagen),

E. signatum (Hagen) Syn.: *dentiferum* Walsh,

E. sulcatum Williamson,

E. vesperum Calvert Syn.: *laurenti* Calvert,

E. weewa Byers

Key to Florida species of *Enallagma*

1) Second segment of antenna distinctly longer than first segment, the third segment at least twice as long as the first (Fig. 51); dorsal antenodal stout setae of median gill, if present, forming a complete series, although sometimes proximally very minute; gills with pigment usually restricted to tracheae, sometimes 1 to 3 indistinct transverse stripes and/or an axial stripe; eyes usually unpatterned . . . 2

1') Second segment of antenna not longer than first segment, the third segment less than twice as long as the first (Fig. 52); dorsal antenodal setae of median gill partly or wholly reduced to slender hairs or confined to the vicinity of the nodus; gills generally more extensively pigmented; eyes usually patterned with dark stripes or spots . . . 8



Fig. 51



Fig. 52

2) Median gill without dorsal, antenodal, stout setae; lateral carinae of abdominal segments 3 to 8 without stout, spine-like setae (Fig. 53); rear of head usually without prominent stout setae, only bearing fine hairs (Fig. 54) . . . *Enallagma daeckii* (in part)

2') Median gill with dorsal, antenodal, stout setae; lateral carinae of abdominal segments 3 to 8 with stout, spine-like setae (Fig. 55-56); rear of head with at least a few prominent, stout setae (Fig. 57) . . . 3



Fig. 53

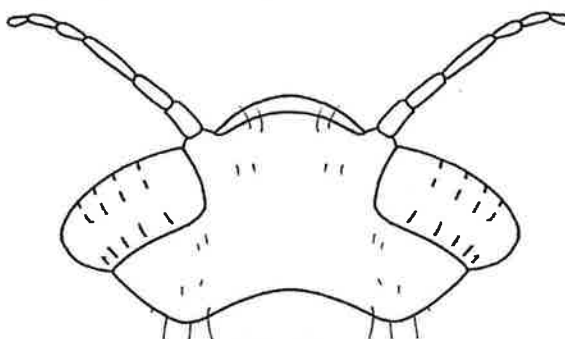


Fig. 54

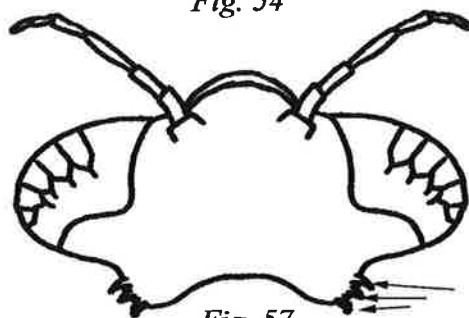


Fig. 57



Fig. 55



Fig. 56

3) Posterolateral margins of head produced into prominent lobes; distance from base of antenna to the hindmost part of head's margin, about $1/2$ the width of the head across the eyes (Fig. 58); length exclusive of gills and antennae more than 15 mm . . . *Enallagma durum* (in part)

3') Posterolateral margins of head rounded, not especially prominent, distance from base of antenna to hindmost part of head margin distinctly less than $1/2$ width of the head across the eyes (Fig. 59); length usually less than 15 mm . . . 4

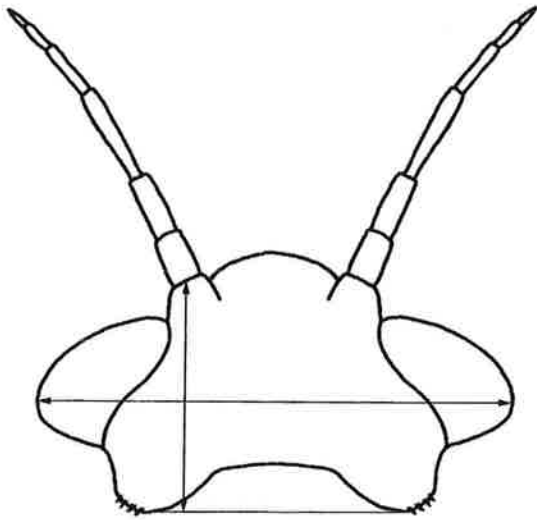


Fig. 58

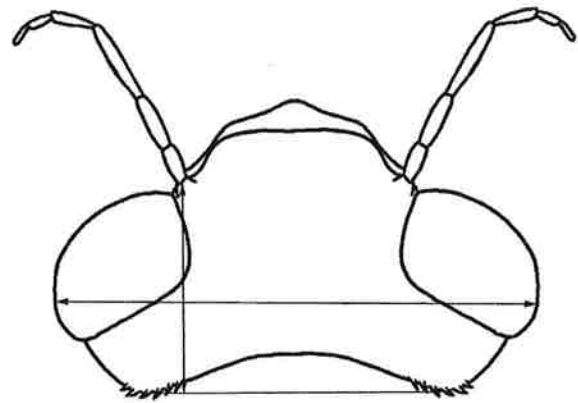


Fig. 59

4) Dorsal antenodal series of setae of the median gill less than $3/4$ length of ventral antenodal series of lateral gills with the setae distinctly less prominent and more widely spaced, usually numbering fewer than 15; tracheae of gills relatively closely branched; gill tips rounded . . . *Enallagma davisii*

4') Dorsal antenodal series of setae of the median gill at least $3/4$ length of ventral antenodal series of lateral gills, with the setae about equally prominent and closely spaced, numbering at least 15; tracheae of gills generally less closely branched; gill tips distinctly pointed . . . 5

5) Dorsal antenodal setae of median gill numbering 15-20; median gill usually shorter than 4.5 mm
Enallagma geminatum

5') Dorsal antenodal setae of median gill almost always 20 or more (usually at least 25); median gill usually longer than 4.5 mm 6

6) Anterior median projection (ligula) of prementum more or less evenly convex along margins and usually slightly truncate at apex (Fig. 60); cerci of male in dorsal view wider than long (Fig. 61)
Enallagma doubledayi

6') Anterior median projection of prementum more or less triangular, with the sides straight or slightly concave and the apex usually somewhat angulate, never truncate (Fig. 62); cerci of male in dorsal view longer than wide (Fig. 63) ***Enallagma civile***

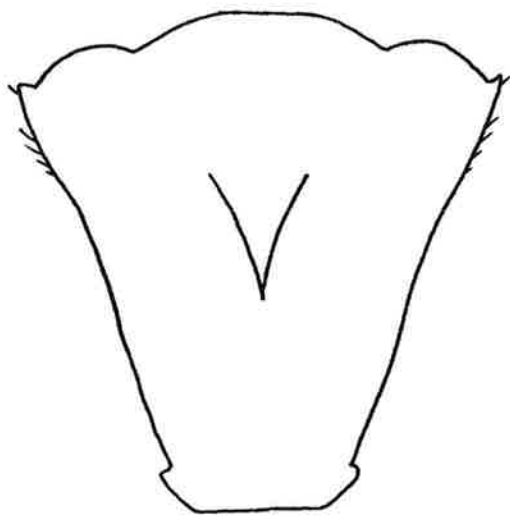


Fig. 60

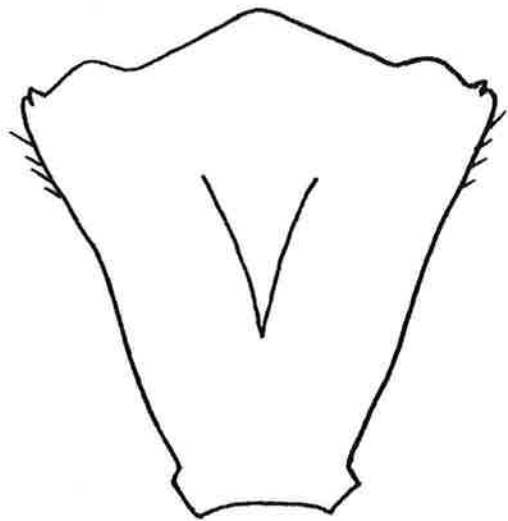


Fig. 62

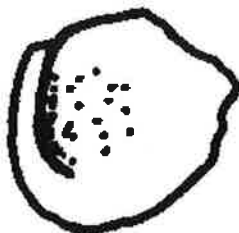


Fig. 61



Fig. 63

7) Posterolateral margins of head almost always produced into prominent lobes, distance from base of antenna to hindmost part of the head margin nearly $\frac{1}{2}$ the width of the head across the eyes (Fig. 64); lateral carina of abdomen prominent but usually not projecting abruptly from end of each segment, and generally bearing many slender hairs but few or no stout setae (Fig. 65) except *durum* (Fig. 66) and *basidens* (Fig. 67); gills usually with patches of closely branched and deeply pigmented tracheae 8

Posterolateral margins of head rounded but not especially prominent, distance from base of antenna to hindmost part of head margin distinctly less than $\frac{1}{2}$ the width of the head across the eyes (Fig. 68); lateral carina of abdomen projecting abruptly from posterior part of each segment but not prominent in front, with a group of stout setae on the prominence but otherwise nearly bare (Fig. 69); gills without patches of closely branched and deeply pigmented tracheae 15

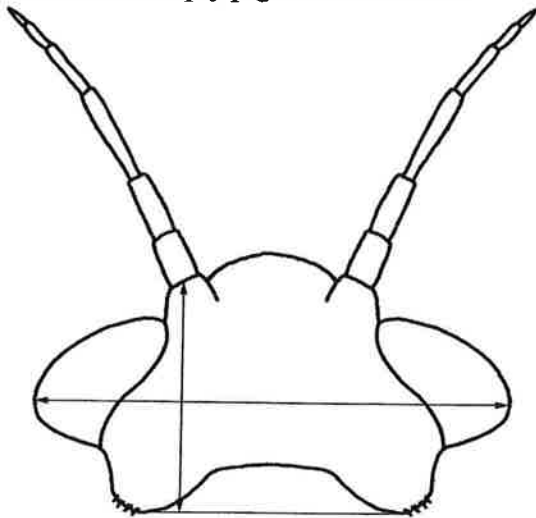


Fig. 64

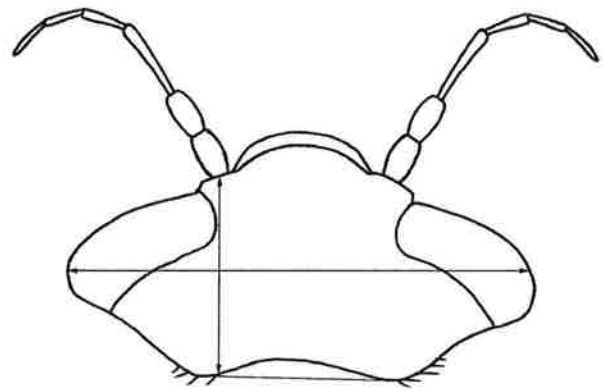


Fig. 68



Fig. 65



Fig. 66



Fig. 67



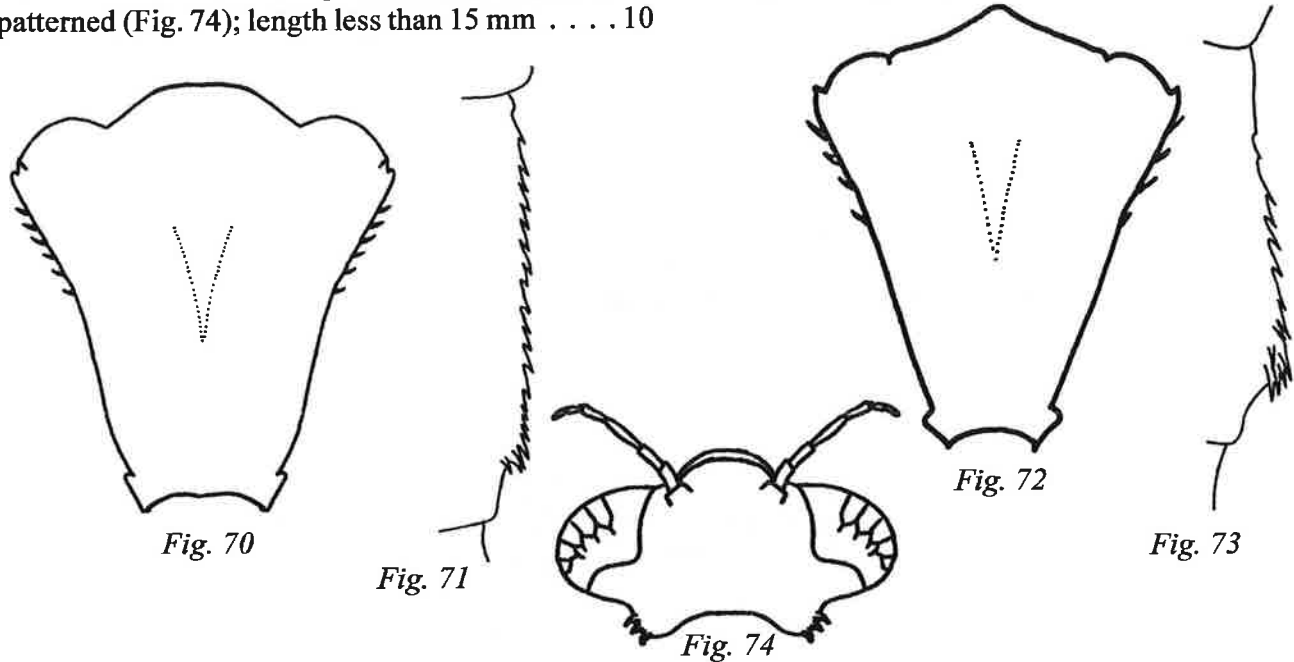
Fig. 69

8) One premental seta on each side of midline (rarely a tiny, scarcely discernible second); 3 or 4 palpal setae *Enallagma coecum*

8) Two or more easily seen premental setae on each side of midline; generally 4 or more palpal setae . . 9

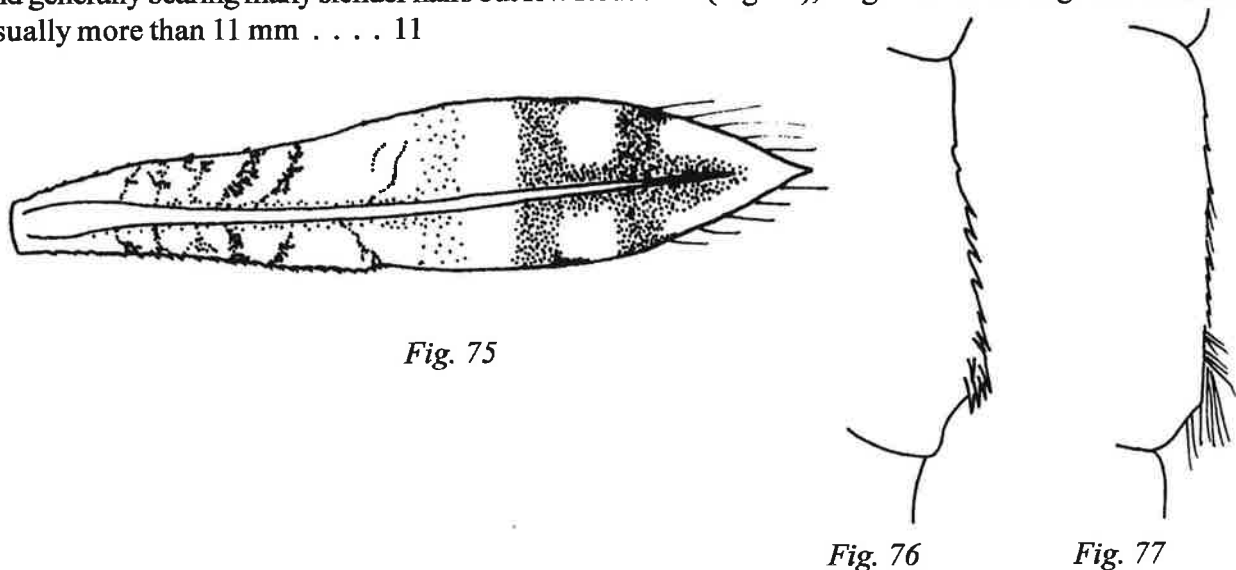
9) Anterior median projection (ligula) of prementum truncate or broadly rounded (Fig. 70); lateral carinae of abdomen with a fairly complete series of stout setae on each segment (Fig. 71); eyes without pattern; length exclusive of gills and antennae more than 15 mm *Enallagma durum* (in part)

9') Anterior median projection (ligula) of prementum prominent and subacuminate (Fig. 72); lateral carinae of abdomen without a complete series of stout setae on each segment (Fig. 73); eyes usually distinctly patterned (Fig. 74); length less than 15 mm 10



10) Median gill with 2 to 4 apical, dark, transverse bands often confluent along axis; lateral gills usually similar, although sometimes dark pigment nearly fills preapical area (Fig. 75); lateral carinae of abdomen projecting rather abruptly from the posterior part of each segment, with a scattered group of stout setae on the prominence (Fig. 76); length exclusive of gills and antennae usually 11 mm or less *Enallagma basidens*

10') Median gill without such dark apical bands, although an irregular and diffuse dark area may be present; lateral carinae of abdomen prominent but not projecting abruptly from the end of each segment, and generally bearing many slender hairs but few stout setae (Fig. 77); length exclusive of gills and antennae usually more than 11 mm 11



11) Gills without a distinct nodus or abrupt color change beyond midlength, but with 4 or 5 widely spaced dark bands formed by patches of closely branched and darkly pigmented tracheae; gills at least 6 times as long as wide (Fig. 78) *Enallagma divagans*

11') Gills with a distinct nodus or at least an abrupt color change about 1/3 to 1/2 of the distance from the apex (Fig. 79); gills usually 4 to 6 times as long as wide 12

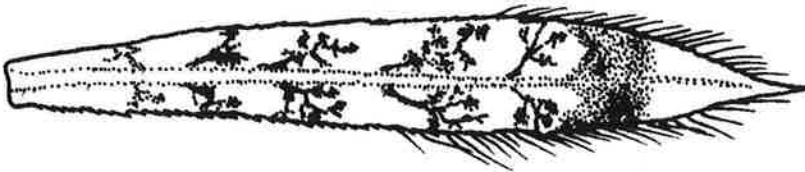


Fig. 78

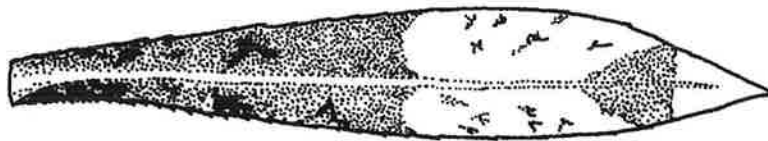


Fig. 79

12) Median gill with long, slender, widely spaced hairs along entire dorsal margin; gills with 1 or 2 central sigmoid, crescentic, or oval-shaped dark spots traversing axis, sometimes reaching ventral margin; posterior lobes of head usually without prominent stout setae *Enallagma daeckii* (in part)

12') Median gill without such long, dorsal hairs, or with long hairs only on apical 1/3; gills with basal or apical pigment more extensive, not in shape of isolated spots; posterior lobes of head usually with prominent, stout setae 13

13) Median gill usually with distinct stiff dorsal setae proximal to nodus; gills proximal to nodus usually less deeply pigmented or with pigment restricted to basal and axial areas *Enallagma weewa*

13') Median gill with stiff dorsal setae absent or extremely tiny and almost invisible; gills usually uniform dark brown from base to nodus 14

14) Gills with nodus generally located at 2/3 or more of their length from base to apex (Fig. 80); median gill usually about 6 times as long as wide; males with cerci slightly expanded distally and appearing slightly emarginate in posterolateral view (Fig. 81) *Enallagma pallidum*

14') Gills with nodus generally located between 1/2 and 2/3 their length from base to apex (Fig. 82); median gill usually 4 to 6 times as long as wide; males with cerci entire and not expanded distally (Fig. 83) *Enallagma traviatum*

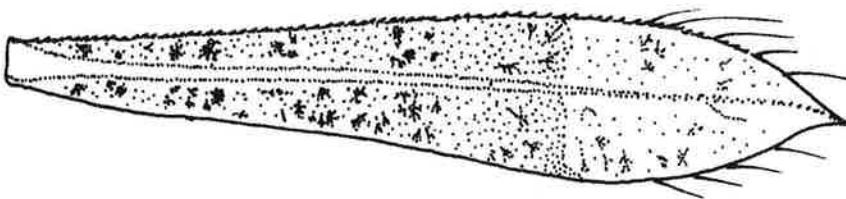


Fig. 80



Fig. 81

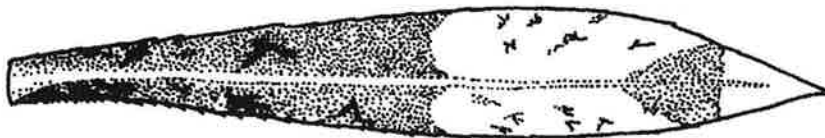


Fig. 82



Fig. 83

15) Anterior margin of prementum concave medially (Fig. 84) *Enallagma sulcatum*

15') Anterior margin of prementum convex medially (Fig. 85) 16

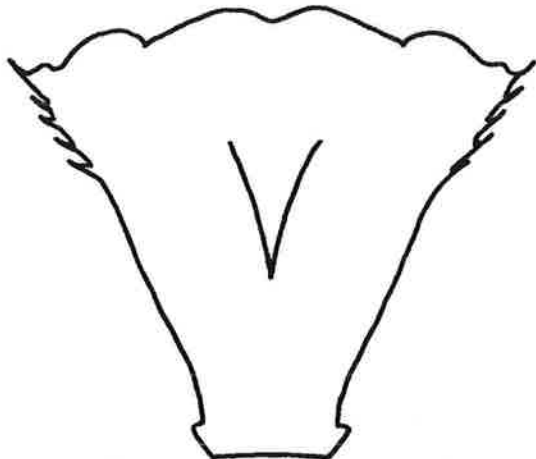


Fig. 84

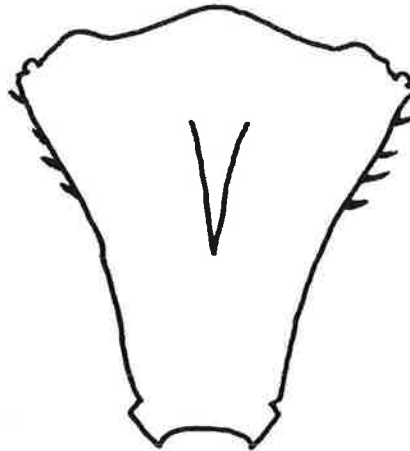


Fig. 85

16) Dorsal margin of median gill without prominent stout setae; median gill at most 3 times as long as its greatest width, the distal 2/3 greatly expanded (lateral view) with the dorsal margin strongly convex; tracheae of gills widely spaced, usually directly opposite and perpendicular to the axis (Fig. 86) . . .

Enallagma vesperum

16') Dorsal margin of median gill with at least a few prominent setae just proximal to nodus; median gill at least 3 times as long as wide, usually longer, and widening gradually from the base with the dorsal margin not so strongly convex; tracheae much more numerous and closely spaced, making an acute angle with the axis (Fig. 87) 17

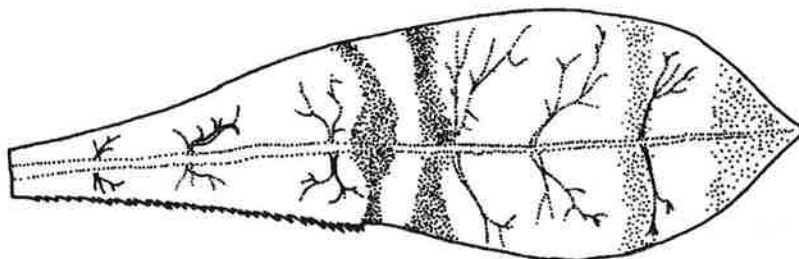


Fig. 86

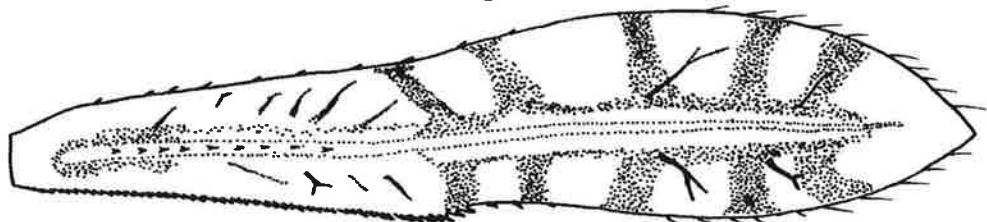


Fig. 87

17) Number of stout setae on ventral margin of lateral gills less than 30; median gill with nodus located less than or near (sometimes slightly beyond) $1/3$ its length from base to apex (Fig. 88); stout setae present on posterodorsal margin of abdominal segment 4 18

17') Number of stout setae on ventral margin of lateral gills 40-55 (rarely less than 40); median gill with nodus located between $1/3$ to $1/2$ its length from base to apex (Fig. 89); usually no stout setae on posterodorsal margin of segment 4 19

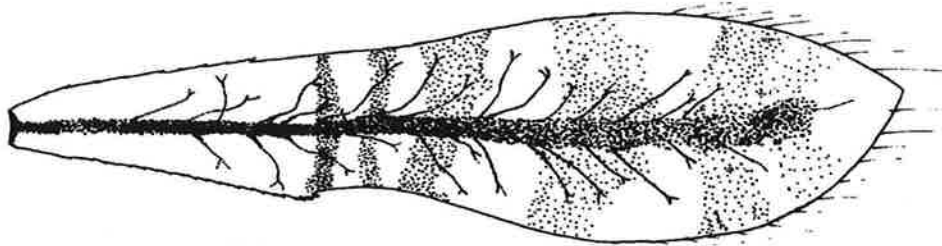


Fig. 88

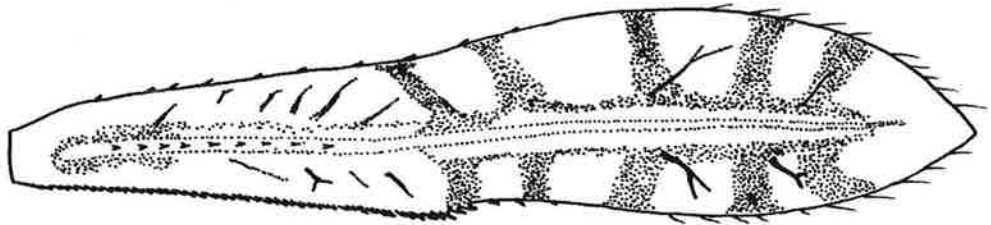


Fig. 89

18) Tracheae of gills proximal to nodus branched 3 or more times (Fig. 90); posterolateral prominences of abdominal segments 3-5 with 5 or 6 (rarely 4) stout setae *Enallagma concisum*

18') Tracheae of gills proximal to nodus branched only once or twice (Fig. 91); posterolateral prominences of abdominal segments 3-5 with 2 or 3 (rarely 4) stout setae *Enallagma dubium*

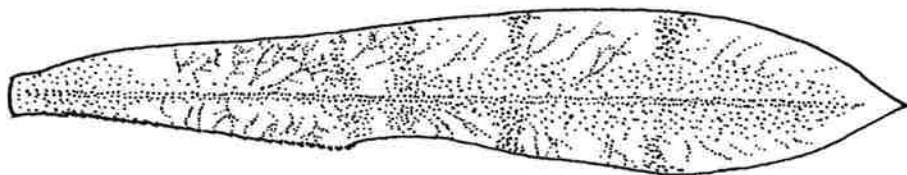


Fig. 90

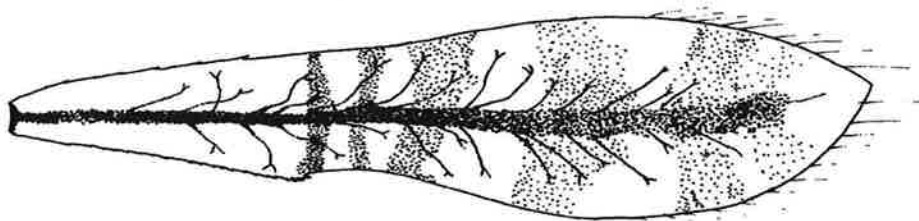


Fig. 91

19) Number of stout setae on ventral margin of lateral gills 46 or fewer; number of stout setae on lateral carina of lateral gills 20-30; cerci of male in lateral view about 1.5 times as long as wide, the posterior margin oblique and slightly concave (Fig. 92) . . . *Enallagma pollutum*

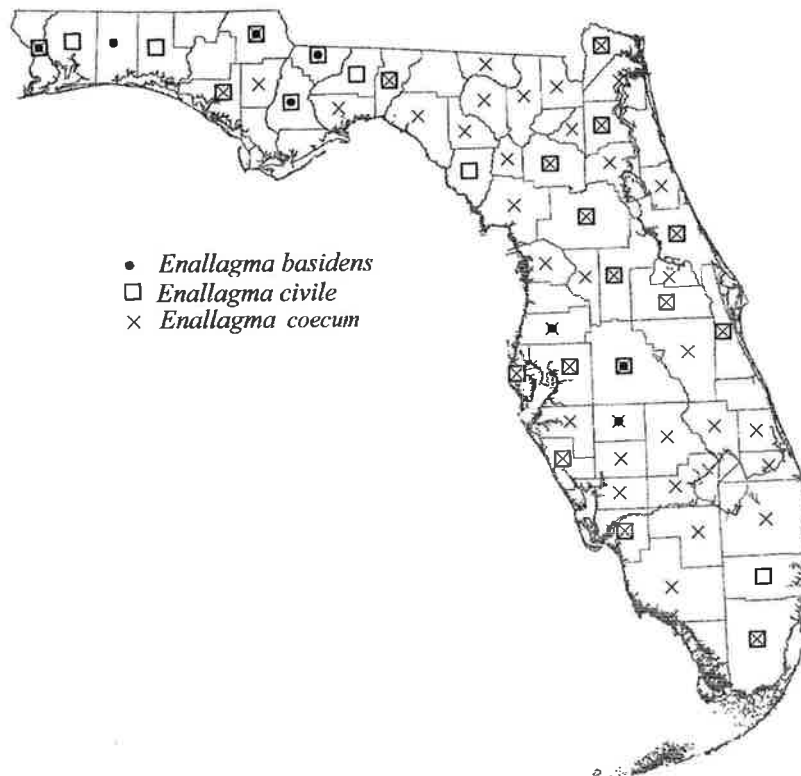
19') Number of stout setae on ventral margin of lateral gills 45 or more; number of stout setae on lateral carina of lateral gills 30-40; cerci of male in lateral view twice as long as wide, the apex conical (Fig. 93) . . . *Enallagma signatum*



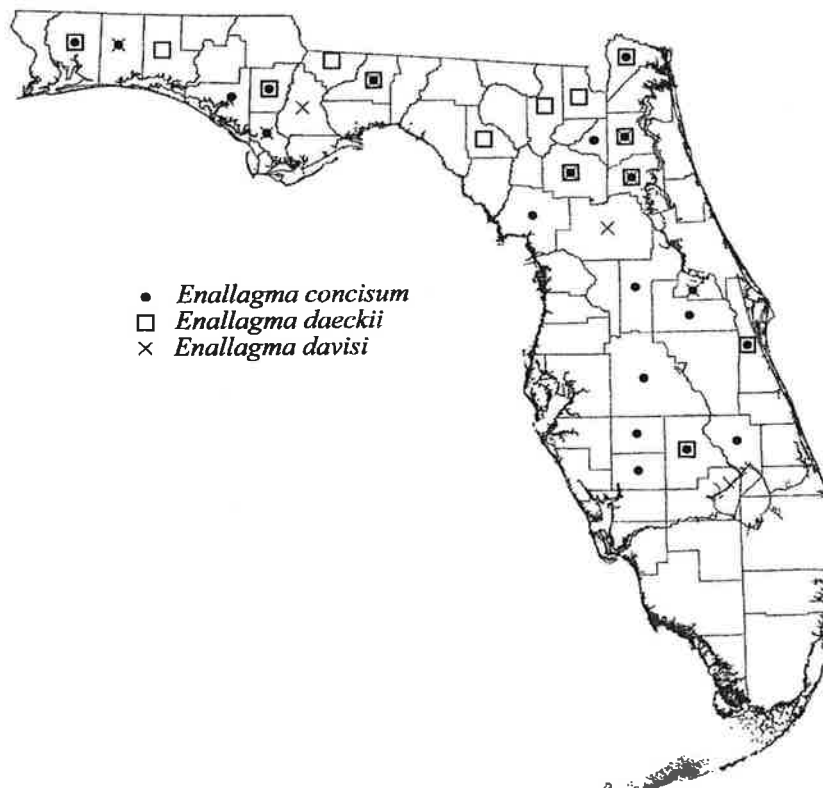
Fig. 92



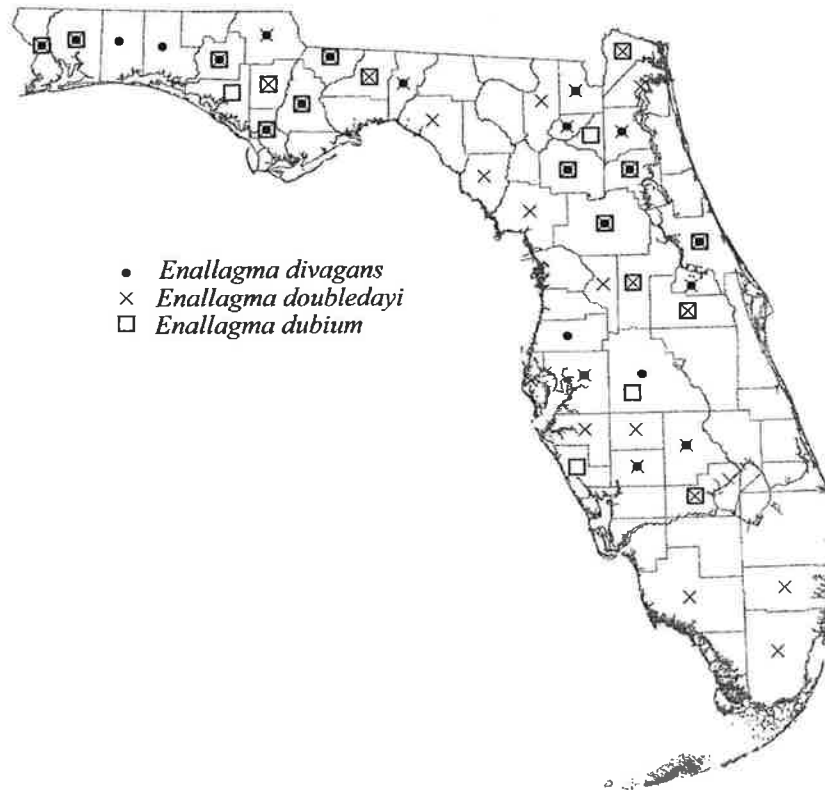
Fig. 93



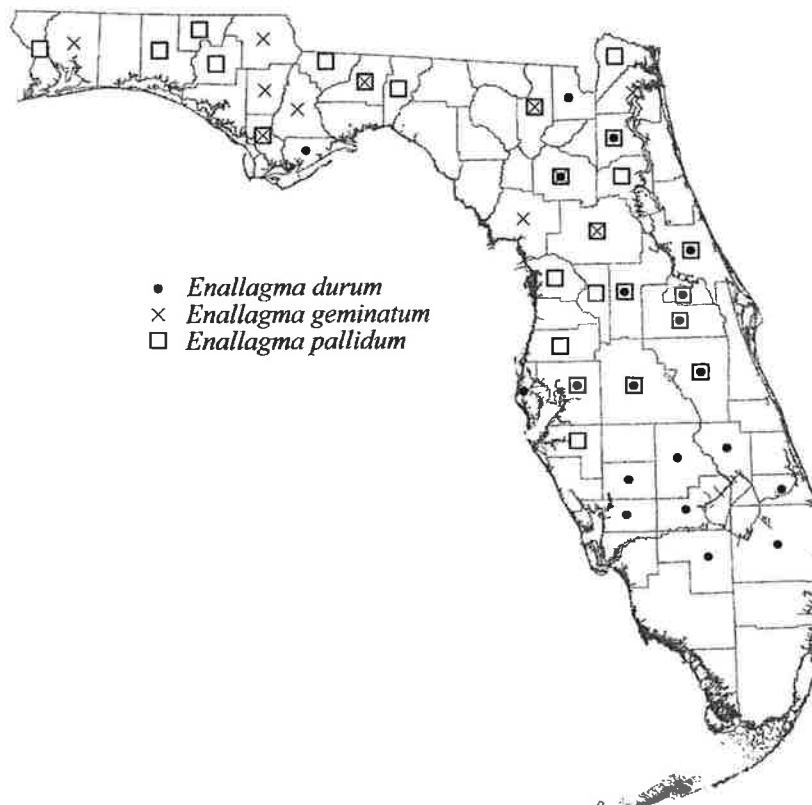
Map 7. Range of *Enallagma* species.



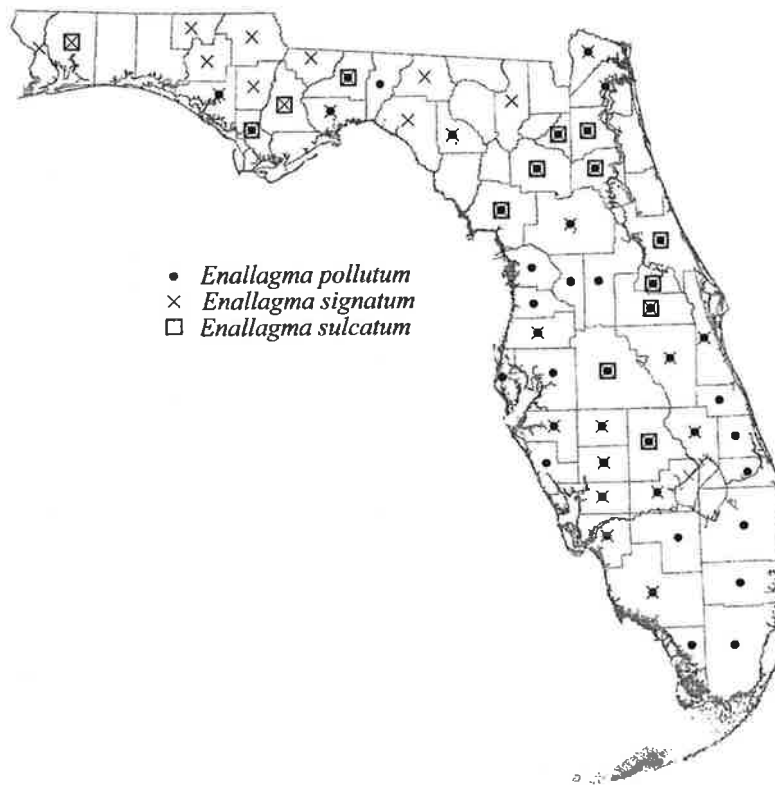
Map 8. Range of *Enallagma* species.



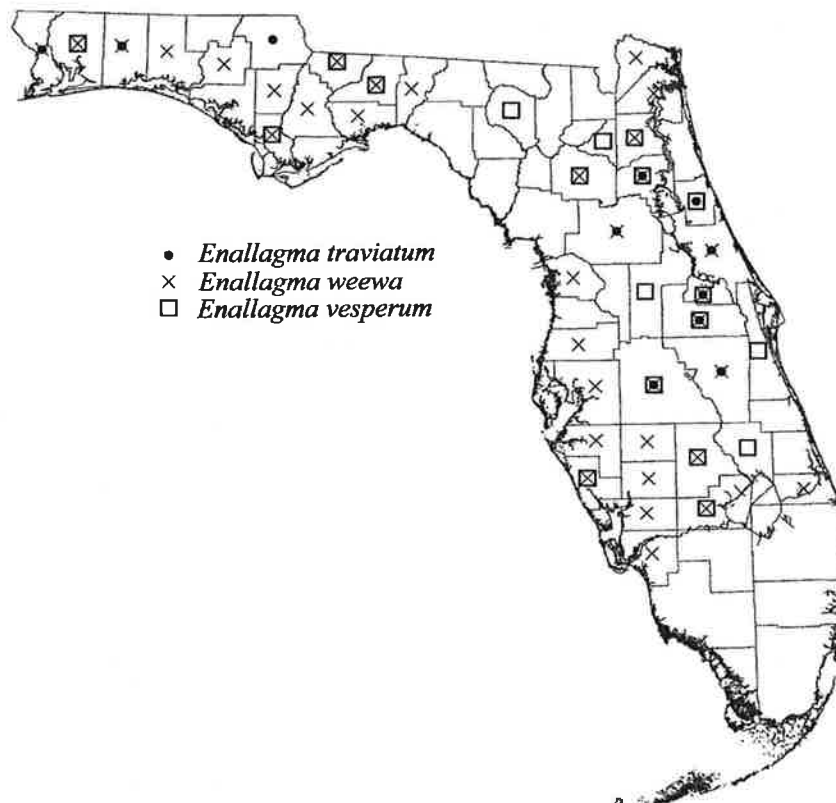
Map 9. Range of *Enallagma* species.



Map 10. Range of *Enallagma* species.



Map 11. Range of *Enallagma* species.



Map 12. Range of *Enallagma* species.

Genus *Ischnura* Charpentier 1840

Syn.: *Bedfordia* Mumford, *Ischnosoma* Wallengen, *Micronympha* Kirby

Regional diagnosis: First antennal segment not so elongate, distinctly less than the combined length of the remaining segments; prementum with small closed cleft or none; lateral caudal gills flat; proximal half of prementum not distinctly petiolate, more triangular; movable hook of each palpal lobe with no setae; 2-5 premental setae present; palpal lobes with one distal hook and a truncate denticulate lobe; body form usually longer and more slender, caudal gills in dorsal view never thick or triquetral; lateral gills not more than 1/4 as broad as long; apical sixth of each lateral gill with a terminal angle of about 60° or less; lateral carinae of abdominal segments 2-8 with margins straight or slightly convex, apices not prominent, and with apical setae, if present, not noticeably larger than the preceding setae; eyes usually with a pattern of lateral, alternating pale and dark bands; antennae with 7 segments; lateral carinae of abdominal segments 2-7 with numerous small setae not arranged in a single row.

Florida species: *I. hastata* (Say) Syn.: *anomalum* (Rambur), *venerinotatum* (Haldemann), *I. kellicotti* Williamson,
I. posita (Hagen) ssp.: *acicularis* Donnelly,
I. prognata (Hagen)
I. ramburii (Selys) syn.: *credula* (Hagen), *defixa* (Hagen), *iners* (Hagen), *tuberculata* (Selys)

Key to Florida species of *Ischnura*

1) Gills without a distinct nodus, stiff setae extending almost the entire length of both the dorsal and ventral margins; membrane of gill entirely unpigmented, the tracheae quite widely spaced and often unpigmented and invisible; widest point about at the middle (Fig. 94); associated with lily pads . . . *Ischnura kellicotti*

1') Gills with a more or less distinct nodus, stiff setae extending not more than about 2/3 their length (Fig. 95); other characters variable . . . 2

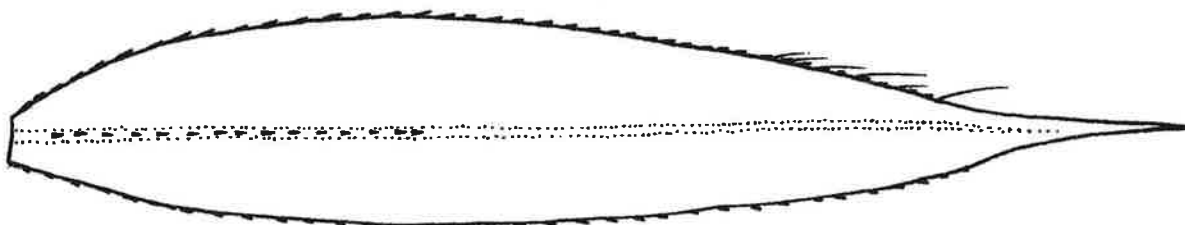


Fig. 94

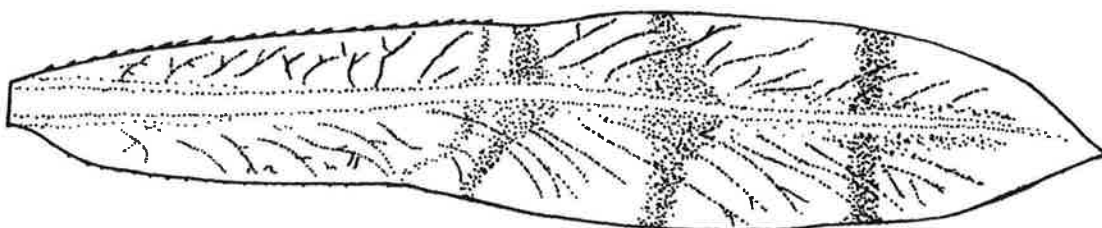


Fig. 95

2) Gills with nodus well-defined across their entire width, nearly transverse and straight or sinuate; membrane of gills proximal to nodus often distinctly darker than more distal, except for 4 dark, arcuate crossbands usually present in latter area (Fig. 96); length of gills 6 or 7 times their width; metafemur 2.8 mm or longer; male cerci in lateral view distinctly truncate, the distal margin slanting upward, in dorsolateral view with apex subacuminate *Ischnura prognata*

2') Gills with nodus oblique or, if transverse, not straight or sinuate but deeply arcuate, or nearly invisible except by position of marinal setae; gills proximal to nodus generally with pigmentation restricted to trachea and /or a narrow, diffuse band on either side of axial tracheae; gills not more than 5-1/2 times as long as wide; if gills have straight, transverse nodus or are more than 5-1/2 times as long as wide (as in some *I. hastata*), metafemur is less than 2.5 mm long; male cerci otherwise 3

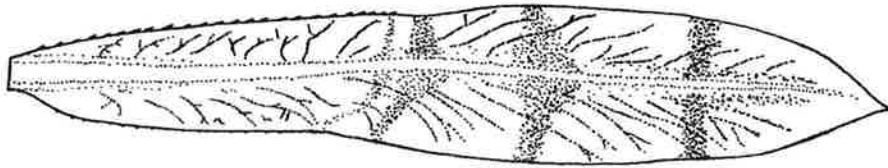


Fig. 96

3) Pigmentation of gills usually restricted to tracheae; ventral series of stout setae of lateral gill usually distinctly more than twice as long as dorsal series (Fig 97); dorsal series of stout setae of median gill extending at least twice as far as ventral series of stout setae; usually six palpal setae *Ischnura ramburii*

3') Gills often with one or more dark crossbands distal to nodus, in addition to tracheal pigment (Fig. 98); dorsal series of stout setae of median and lateral gill often extending less than twice as far as ventral series of stout setae; usually 5 palpal setae 4

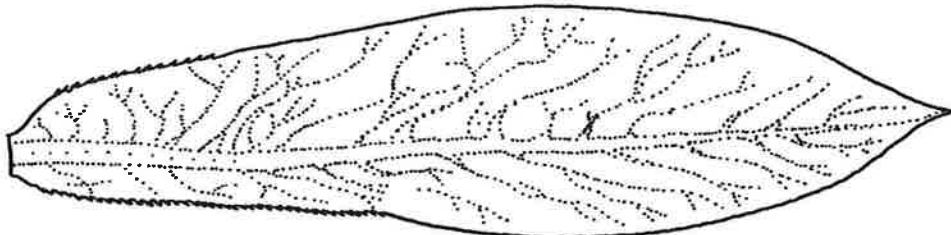


Fig. 97

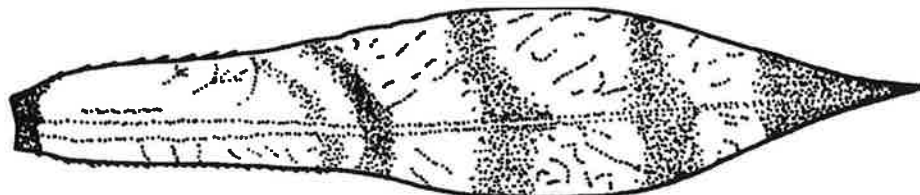


Fig. 98

4) Metafemur usually shorter than 2.3 mm; gills usually without dark crossbands (Fig. 99)

Ischnura hastata

4') Metafemur usually longer than 2.3 mm; gills usually with several dark crossbands (Fig. 100)

Ischnura posita

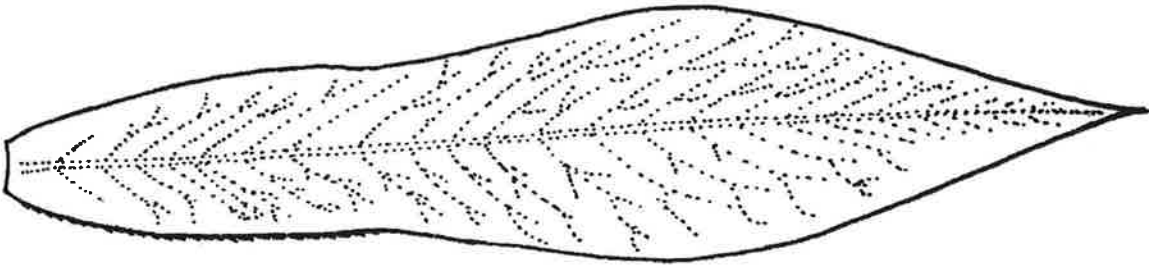


Fig. 99

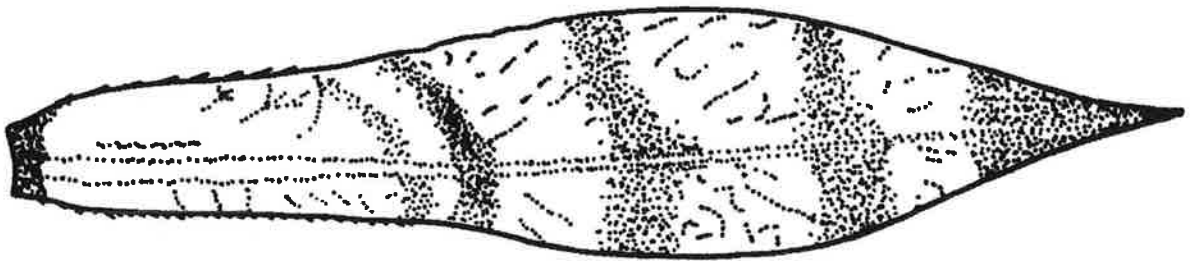
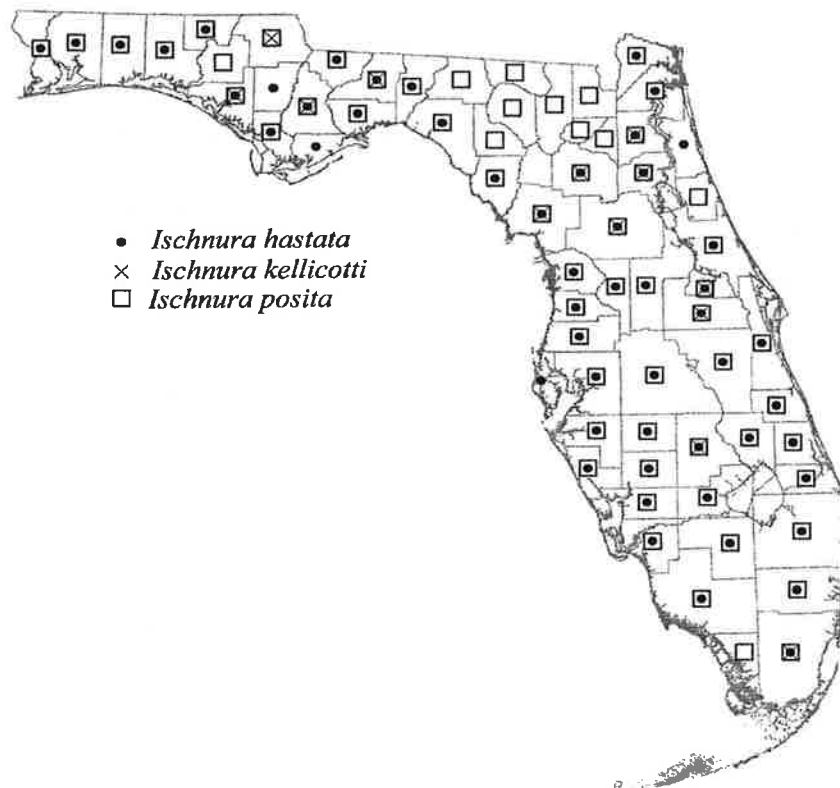
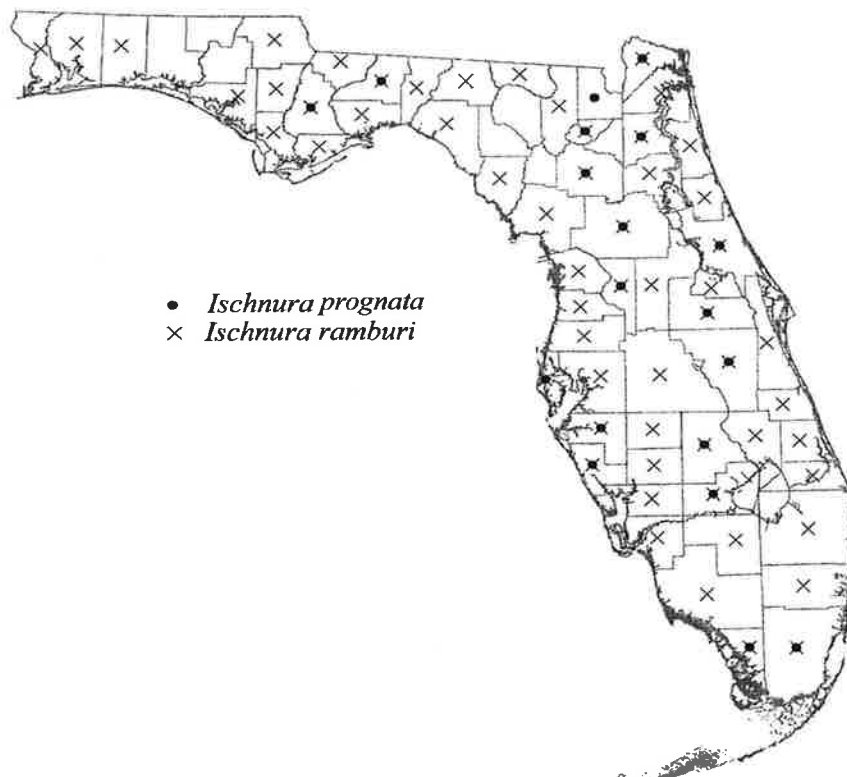


Fig. 100



Map 13. Range of *Ischnura* species.



Map 14. Range of *Ischnura* species.

Genus *Nehalennia* Selys 1850

Syn.: *Argiallagma* Calvert, *Trichocnemis* Selys (in part)

Regional diagnosis: First antennal segment not so elongate, distinctly less than the combined length of the remaining segments; prementum with small closed cleft or none; lateral caudal gills flat; proximal half of the prementum not distinctly petiolate, more triangular; movable hook of each palpal lobe with no setae; gills narrowed very abruptly shortly before apex, so that the tips are long and almost filamentous or gills narrowed less abruptly, the tips not at all filamentous, although sometimes acuminate; one premental seta of normal length present, although one to three small setae may be present on medial side; palpal setae 5-6; no long, stiff setae present on lateral carinae of anterior abdominal segments, although often present on posterior segments; length usually 15 mm or less.

Florida species: *N. gracilis* Morse, *N. integricollis* Calvert, *N. minuta* (Selys) *N. pallidula** Calvert

* larvae undescribed

Remarks: *N. pallidula* is the only damselfly endemic to Florida and is geographically the most restricted ecologically and behaviorally the least known of the genus. The larvae are small and slender and most similar to *N. minuta* (Tennesson, 2010), inhabiting lentic, or occasionally, very slowly flowing waters, mostly at the base of vegetation (Westfall, and May, 2006).

Key to Florida Species of *Nehalennia*

1) Three long premental setae present, usually also one very short one; gills narrowed very abruptly shortly before apex, so that the tips are long and almost filamentous (Fig. 101) . . . *Nehalennia minuta*

1') One long premental setae present, 0-3 much shorter ones; gills narrowed less abruptly, tips not filamentous, although sometimes acuminate (Fig. 102) . . . 2

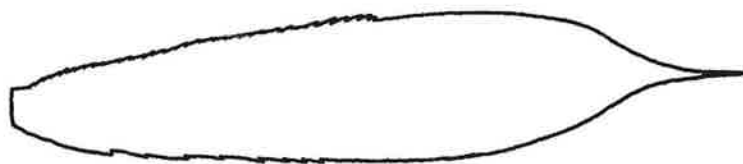


Fig. 101



Fig. 102

2) Gills proximal to nodus much more darkly pigmented than the distal portion (Fig. 103); posterolateral surface of head with three to six small distinct spines on each side that are dark at the base; tibiae, especially of the prothoracic legs, with a very prominent group of dark setae at apexes . . . *Nehalennia integricollis*

2') Gills not darker proximal to nodus (Fig. 104); posterolateral surfaces of head with 4 to 6 indistinct and nearly colorless spines; apical group of setae on tibiae not nearly so prominent . . . *Nehalennia gracilis*

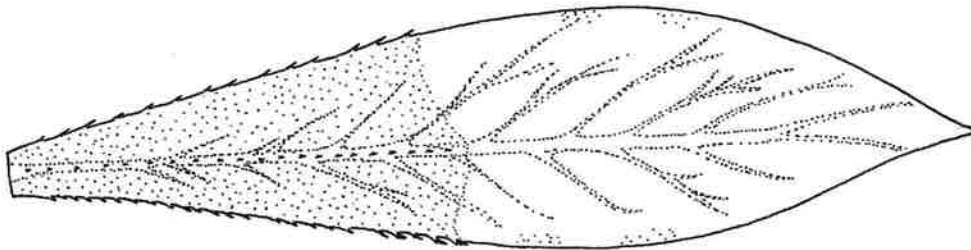


Fig. 103

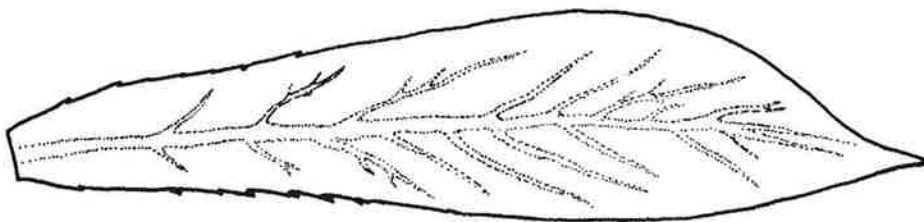
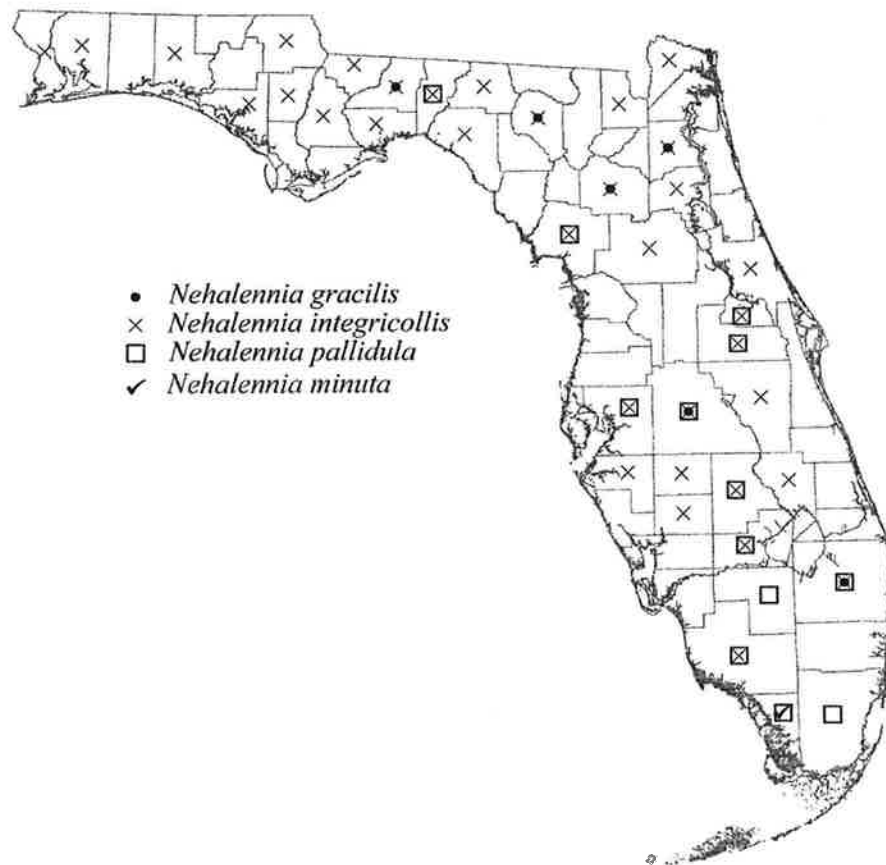


Fig. 104



Map 15. Range of *Nehalennia* species.

Genus *Neoerythromma* Kennedy 1920

Regional diagnosis:

Lateral gills not more than 1/4 as broad as long; apical sixth of each lateral gill with a terminal angle of about 60° or less; premental setae present; palpal lobes with one distal, pointed hook and a truncate, denticulate lobe; body form longer and more slender; caudal gills in dorsal view never thick or triquetral; gills narrowed less abruptly, the tips not at all filamentous; lateral carinae of abdominal segments 2-8, in dorsal view, slightly concave, with apices prominent and bearing two or more stout, curved setae; eyes with lines forming hexagonal-shaped cells; antennae with 6 segments; lateral carinae of abdominal segments 2-8 with a single row of setae of variable stoutness; venter of all abdominal segments has setae of equal size and evenly scattered; lateral carinae of abdominal segment 9 nearly as prominent as those of segment 8 and carinae of segment 8 and 9 both bearing one stout seta; usually 5 palpal setae.

Florida species: *Neoerythromma cultellatum* (Hagen in Selys)



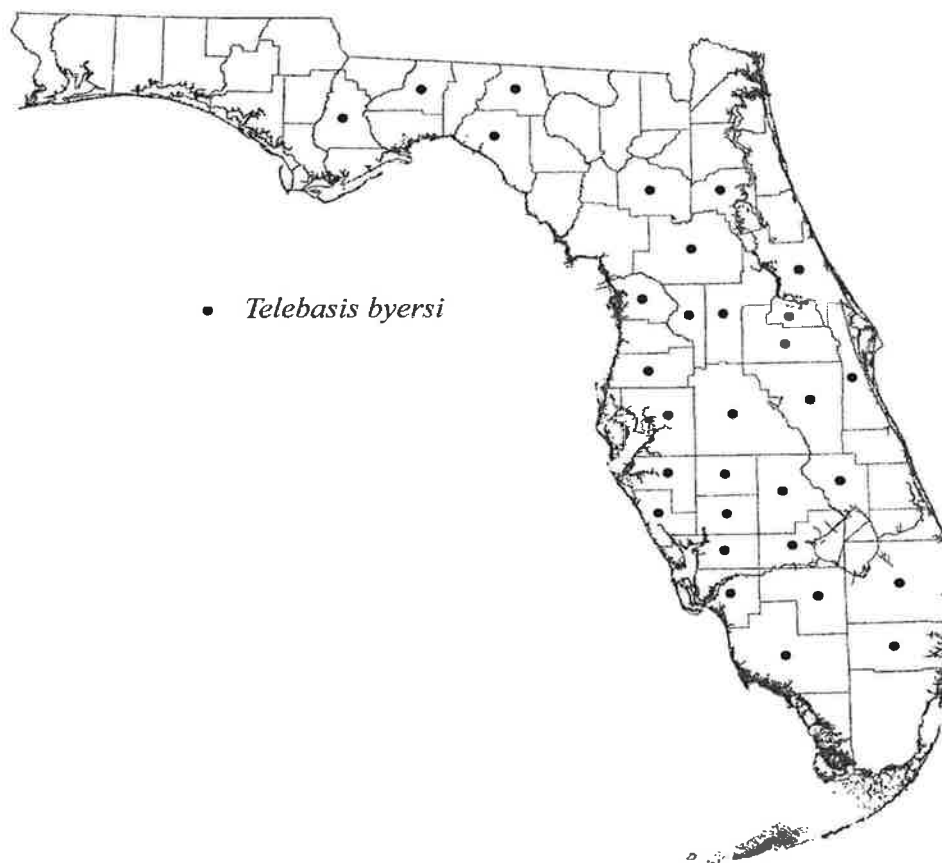
*Map 16. Range of *Neoerythromma cultellatum*.*

Genus *Telebasis* Selys 1865
Syn.: *Erythrargrion* Selys 1876

Regional diagnosis: First antennal segment not so elongate, distinctly less than the combined length of the remaining segments; prementum with small closed cleft or none; lateral caudal gills flat; proximal half of the prementum not distinctly petiolate, more triangular; movable hook of each palpal lobe with no setae; 1-3 premental setae present; palpal lobes with one distal, pointed hook and a truncate, denticulate lobe; body form usually longer and more slender; lateral gills one-third as broad as long; apical sixth of each lateral gill with a terminal angle of 70° or more excluding filamentous tip, if present.

Florida species: *T. byersi* Westfall

Remarks: The gills of *Telebasis* are the most characteristic feature, being quite broad, at least 1/3 their maximum length (Westfall, Jr. and May, 1996).



Map 17. Range of Telebasis byersi.

Glossary

abdomen	the third or posterior, major division of the insect body consisting of ten apparent segments
accuminate	ending in a long tapering point
acute	sharply pointed
antenna	paired segmented appendages, borne one on each side of head, functioning as sense organs
anterior	at the front; toward the front
apical	at, or forming the apex
arcuate	curved as in a bow
carinae	narrow cuticular ridge
caudal	toward or in the direction of the tail
cercus	highly modified appendage of the tenth abdominal segment, in larvae reduced to small conical process
cleft	a split or indentation
coxae	basal segment of leg
distal hook	a fixed hook like projection of the anteromedial corner of the labial palp of larvae
epiproct	dorsal cuticular projection from the 10th abdominal segment, in larvae a triangular plate forming dorsal part of the anal appendage group
femur	the third, and usually the stoutest segment of the leg, articulated to the body through the trochanter and coxa and bearing the tibia at its distal end
gonapophyses	projections that surround the sexual orifices
instar	any one of the larval stages between egg and adult
labium	most posterior of the mouthparts; in larvae elongated, hinged, and modified for prey capture
larva	immature feeding stage of an insect that undergoes a major reorganization of body form when transforming to the adult stage; also known as nymph
lateral	at the side, pertaining to the sides
lentic	pertaining to or living in still water
ligula	anterior, median projection of the larval prementum
lobed	having rounded divisions
lotic	pertaining to or living in moving water
mandible	most anterior of the paired mouthparts, and the main chewing organs
maxilla	second of the paired mouthparts, between the mandibles and the labium
median	at or including the longitudinal midline
palpal lobe	modified labial palp, used for prey capture
palpal setae	modified labial palp, used for prey capture
paraproct	ventrolateral lobe or process projecting from the 10th abdominal segment, in larvae bearing the lateral gills
petiolate	having a narrow stem-like base
postmentum	proximal portion of the labium in larvae folded backward beneath the head and thorax at rest, thrust forward to capture prey
premental setae	row of prominent setae on the prementum
prementum	distal portion of the labium, which bears the labial palps; in larvae it is hinged on the postmentum and thrust forward to capture prey
setae	cuticular hairs or bristles, includes most of the small hairs on the surface

subacute	nearly acute but with the extreme apex rounded
tarsi	the leg segment attached to the apex of the tibia
tibia	the fourth segment of the leg
triquetral	three ridged and triangular in cross section
trochanter	a segment of the leg between the coxa and femur
ventral	pertaining to the undersurface of the body
wing pads	pouch-like, dorsal folds on the meso- and metathorax of larvae that give rise to the adult wings, and within which the latter can be seen during the last instar

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Appendix: Figure Sources

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