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DIAGNOSTIC KEYS AND NOTES ON THE DAMSELFLIES (ZYGOPTERA) OF FLORIDA

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DIAGNOSTIC KEYS AND NOTES ON THE DAMSELFLIES (ZYGOPTERA) OF FLORIDA

CLIFFORD JOHNSON AND MINTER J. WESTFALL, JR.[1]

SYNOPSIS: This study presents a current species list and identification guide to the 45 species of damselflies (Zygoptera) occurring in Florida, a guide to morphological terms, and a short text improving accuracy of determinations. Illustrated characters of each species and sex accompany the keys. Color patterns, behavior traits, and habitat preferences serving as identifying characters in the field support the keys. The text provides general distribution within the state for each species, and references to larval descriptions. Attention is directed to problems in damselfly ecology.

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INTRODUCTION

This report presents a current list and identification guide to adult damselflies in Florida. The 45 species identified in the state are listed in Table 1 with date of original description and authority. Literature citations for species descriptions and synonyms have not been included, as taxonomic history is outside the paper's objective. Table 1 shows that more than 73 per cent of the state's 45 species were known prior to 1900 (*Lestes disjunctus* Selys originally recognized in 1862) and only two new species and two subspecies have been described since 1930. This decline in appearance of new taxa reflects a stabilizing taxonomy rather than inactivity of systematists.

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Needham and Heywood (1929), long out of print, contains taxonomic keys for North American species, and Byers (1930) specifically keys the Florida Odonata. The subsequent 40 years have significantly increased our knowledge of the fauna, and the above keys often prove unreliable for diagnosis.

ACKNOWLEDGMENTS

We wish to recognize the assistance of all individuals who have contributed to collections studied. Dennis R. Paulson's extensive field work in south Florida has added immeasurably to our southern distribution records. The assistance of the University of Florida students who have tested the keys deserves special recognition for their efforts have contributed measurably to the keys' success. The assistance of Paul Laessle in preparing the figures for publication is kindly acknowledged.

METHODS AND MATERIALS

Materials used for this guide include Odonata in the Florida State Collection of Arthropods and other collections at the University of Florida in addition to many published and unpublished field observations. Preceeding each genus and species key is a brief statement on geographical range, characteristics, and habitat preferences. An expanded explanation is given for difficult key characters where experience has proved necessary. The keys have been developed using students unfamilar with Odonata and progressively modified until such students, without the aid of a determined collection for comparison, repeatedly reached correct identifications. Success with the keys requires proper orientation of dorsal and lateral views of the structures in question. Inattention to this requirement was found to be the largest single cause for incorrect diagnosis; consequently the required orientation is given throughout the keys. Abdominal appendages in males occasionally dry or accidentally become lodged in an atypical position. This condition is usually obvious, but may lead to difficulty when not recognized. Some variation from the figures must be expected. Where such variability has affected diagnosis, the keys have been expanded and several lengthy key couplets are required.

Males of all species are identified by the following characters: The genital fossa accommodating the penis lies conspicuously in the sternum of abdominal segment 2 and the anterior part of segment 3; in addition, the abdominal appendages, a superior and inferior pair, occur just posterior to segment 10. These appendages are illustrated for most species. Females lack a genital fossa and possess an ovipositor at the terminal end of the abdomen (Fig. 13J,K). Use of morpho-

Table 1. The damselfly fauna of Florida

Lestidae	
Lestes disjunctus australis Walker 1952	*Lestes tenuatus* Rambur 1842
Lestes inequalis Walsh 1862	*Lestes vidua* Hagen 1861
Lestes rectangularis Say 1839	*Lestes vigilax* Hagen 1862
Calopterygidae	
Calopteryx dimidiata Burmeister 1839	*Hetaerina titia* (Drury) 1773
Calopteryx maculata (Beauvois) 1805	*Hetaerina tricolor* (Burmeister) 1839[1]
Hetaerina americana (Fabricius) 1798	
Coenagrionidae	
Anomalagrion hastatum (Say) 1839	*Enallagma geminatum* Kellicott 1895
Argia apicalis (Say) 1839	*Enallagma pallidum* Root 1923
Argia bipunctulata (Hagen) 1861	*Enallagma pollutum* (Hagen) 1861
Argia fumipennis atra Gloyd 1968	*Enallagma signatum* (Hagen) 1861
Argia f. fumipennis (Burmeister) 1839	*Enallagma sulcatum* Williamson 1922
Argia moesta (Hagen) 1861	*Enallagma traviatum* Selys 1876
Argia sedula (Hagen) 1861	*Enallagma vesperum* Calvert 1919
Argia tibialis (Rambur) 1842	*Enallagma weewa* Byers 1927
Argiallagma pallidulum (Calvert) 1913	*Ischnura kellicotti* Williamson 1898
Enallagma basidens Calvert 1902	*Ischnura posita* (Hagen) 1861
Enallagma cardenium Selys 1876	*Ischnura prognatha* (Hagen) 1861
Enallagma civile (Hagen) 1861	*Ischnura ramburi* (Selys) 1850
Enallagma concisum Williamson 1922	*Nehalennia gracilis* Morse 1895
Enallagma davisi Westfall 1943	*Nehalennia integricollis* Calvert 1913
Enallagma divagans Selys 1876	*Neoerythromma cultellatum* (Hagen) 1876
Enallagma doubledayi (Selys) 1850	*Teleallagma daecki* (Calvert) 1903
Enallagma dubium Root 1924	*Telebasis byersi* Westfall 1957
Enallagma durum (Hagen) 1861	

[1]Status questionable. See text.

logical terms has been kept to a minimum, but familiarity with numerous structures and veins is required. The line drawings are of structural traits and do not include hairs or color patterns. Experience has shown that these illustrations properly orient the user without a lengthy description of odonate morphology.

Wing venation is shown in Figure 1 and identified as follows: Longitudinal veins are the costal, C; cubital veins 1 and 2, Cu_1 and Cu_2; combined 1st and 2nd branches of the median vein, M_{1-2}; four medial branches, M_1 to M_4; radial vein, R; and the radial sector, Rs. Specialized cross veins are the arculus, A; nodus, N; and subnodus, Sn. The anal crossing, Ac, appears also as a cross vein. Other identified cross veins are the ante- and postnodal cross veins, An and

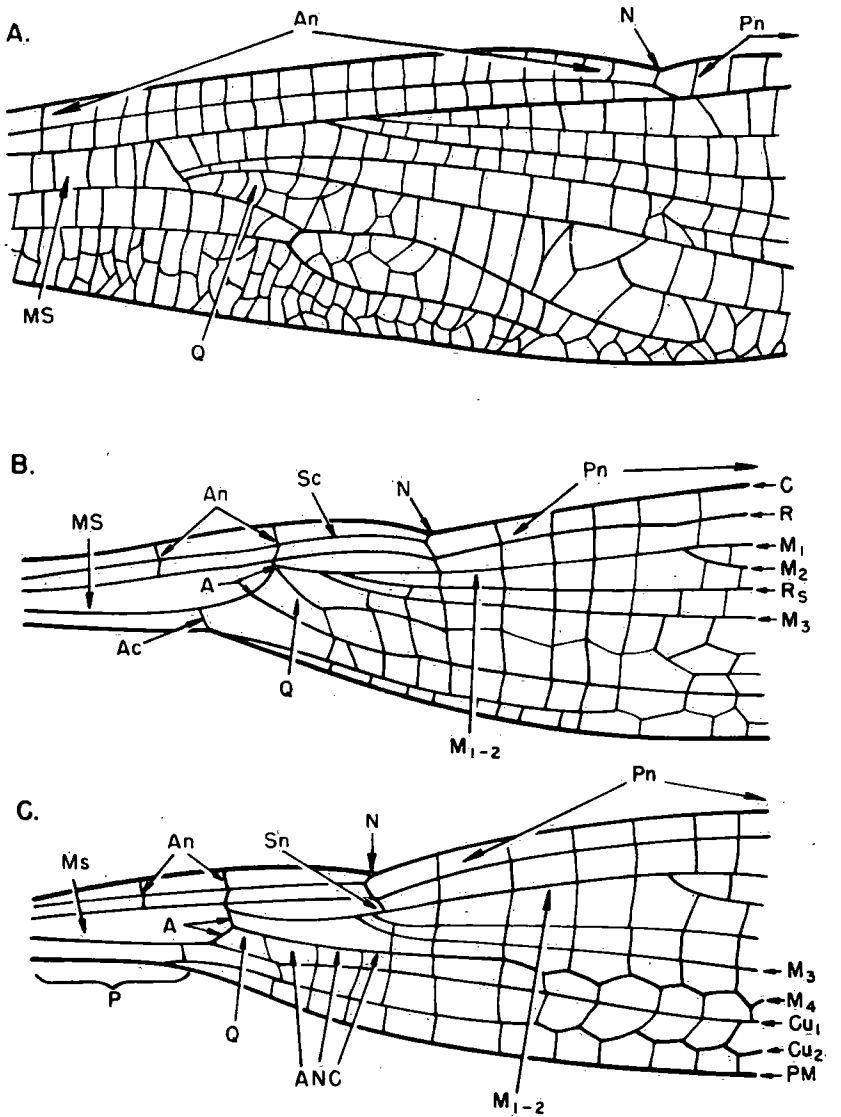

FIGURE 1. Basal portion of fore wings in: A, Calopterygidae, *Hetaerina americana;* B, Lestidae, *Lestes vigilax;* C. Coenagrionidae, *Argia tibialis.* Veins identified in text.

Pn. Postnodal cross veins are counted from the first cross vein distal to the nodus (Fig. 1) outward to the cross vein just proximal to the

brace vein, b, under the stigma, st, (Fig. 7C). Specific cells are the antenodal cells, ANC; median space, MS; and quadrangle, Q.

Body structures shown in Figure 2 are identified as follows: Pro-

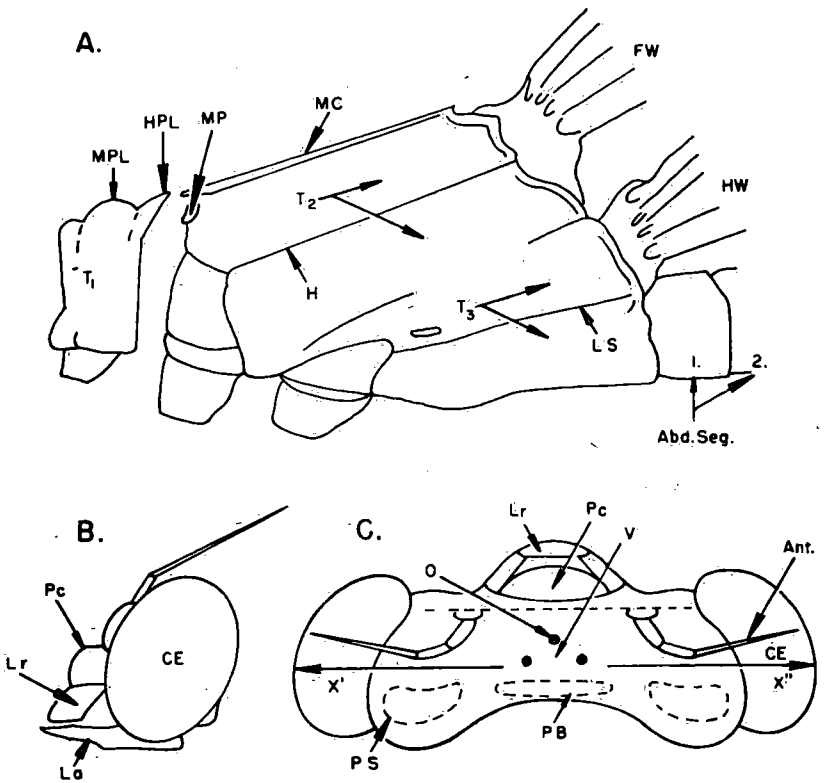

FIGURE 2. A, lateral view of thorax (prothorax disarticulated); B, head; C, dorsal view of head. Structures identified in text.

thorax, T_1; mesothorax, T_2; metathorax, T_3; pterothorax, $T_{2+}T_3$; middle and hind prothoracic lobes, MPL and HPL; mesostigmal plates, MP; median carina, MC; humeral suture, H; metapleural suture, LS; abdominal segments 1 and 2, abd. seg. 1 and 2; compound eyes, CE; ocelli, O; vertex, V; postclypeus, PC; labrum, Lr; labium, La; and antennae, Ant. Body length refers to the total length from anterior tip of the head to the apex of abdominal segment 10. Abdominal and body length do not include appendages. Greatest width across the compound eyes refers to a line drawn over the width of the head connecting points x' and x'' shown in Figure 2.

Color patterns of the body consist of alternating dark and pale stripes on the pterothorax. The middle abdominal segments may be predominantly pale or dark with narrow pale or dark transverse rings or bands located over the base or apex of each segment. The terminal abdominal segments often have more extensive pale dorsal surfaces. The thoracic pattern typically consists of a dark middorsal stripe bordered laterally on either side by a pale antehumeral and dark humeral stripe in that order. The basic pattern is shown by *Argia sedula* in Figure 10G. An additional dark stripe may occur on the metapleural suture. The head pattern typically consists of a pair of pale postocular spots, PS, often a pale postoccipital bar, PB, and a variable facial pattern (Fig. 2). Pale areas occur in a wide range of colors while the dark stripes, rings, or bands are usually brown, black or metallic bronze. Pale areas are largely reduced in some species and the dark pattern then consists of metallic greens, blues, or bronze. Much variation exists on these basic patterns and additional explanation, where needed, is provided with the individual keys. See Walker (1953) for an introduction to odonate morphology.

Species and sex can usually be recognized for adults in the field through a combination of color characters and behavior; consequently a guide to the more useful field traits has been given following the respective key. Use of such characters naturally requires a prior study of determined museum specimens, but specific recognition in the habitat is one of the assets damselflies offer for ecological investigation. N. W. Moore (1960) was correct in referring to odonates as the "bird watchers' insects."

Distributional records are certainly not complete, but they provide a general picture of faunal dispersion and are also summarized following the keys. Distributions occurring in north and northwest Florida and south into the peninsula are given as southward to the southernmost county record. Distribution limited to south Florida is given as south from the northernmost county record. Statewide distributions are given as such, and individual counties are listed for species recorded in only one to three counties. A further observation on distribution is given in the Discussion.

Description and diagnosis of larval forms are less complete; however, Gloyd and Wright (1959) contains an excellent key for the U. S. genera (except *Neoerythromma* and *Argiallagma*). References to larval descriptions are given following species keys. Larva is used rather than nymph in terminology of immature stages following Snodgrass (1954).

Key to the Families

1 a) Numerous antenodal and several quadrangle cross veins: wings not petiolate (Fig. 1A); wings pigmented with some black, brown or red in males, black, brown or nonpigmented in females ..... Calopterygidae

b) Two antenodal and no quadrangle cross veins; wings petiolate (Fig. 1B, C); nonpigmented or with translucent brown 2

2 a) Vein M_3 separating from M_{1-2} nearer the arculus than nodus (Fig. 1B); stigma more than twice as long as wide ..... Lestidae

b) Vein M_3 separating from M_{1-2} nearer the nodus than the arculus (Fig. 1C); stigma not twice as long as wide ..... Coenagrionidae

Lestidae

One lestid genus, *Lestes*, occurring in both eastern and western hemispheres, is represented in Florida by six species. All Florida species have the wings colorless or slightly edged with brown, and the thoracic and abdominal dorsum in metallic green, bronze, or brown colors. Male colors are brighter than females, but they may develop a grayish pruinosity, an external exudate that obscures their patterns in old age.

Males of *disjunctus* and *vidua* are structurally close and may constitute a source of confusion. The thoracic dorsum of females may occasionally possess both green and bronze metallic colors. Such females should be scored as bronze at couplet 1 (b). The stripe pattern in couplet 3 of the female key is clarified by the following note. The pale antehumeral stripe of lestids is more lateral than in most damselflies and may overlie part of the humeral suture. The dark humeral stripe is therefore largely posterior to the humeral suture.

Key to the Males

1 a) Inferior abdominal appendages longer than superior abdominal appendages (Fig. 3A); thoracic dorsum with metallic green ..... *inequalis*

b) Inferior abdominal appendages shorter than superior abdominal appendages (Fig. 3B-F); thoracic dorsum with or without metallic green 2

2 a) Median border of superior abdominal appendages in dorsal view with a distinct basal and apical tooth separated by an undulating or serrated margin (Fig. 3B-D) 3

b) Median border of superior abdominal appendages in dorsal view with distinct basal tooth and lobed margin to apical end, or with flattened basal projection and apical cluster of numerous small bristle-like teeth (Fig. 3E,F) 5

3 a) Apical tooth of superior abdominal appendage in dorsal view distinctly longer than basal tooth (Fig. 3B); metapleural suture lacking black stripe or elongated spot; thoracic dorsum metallic bronze ..... *rectangularis*

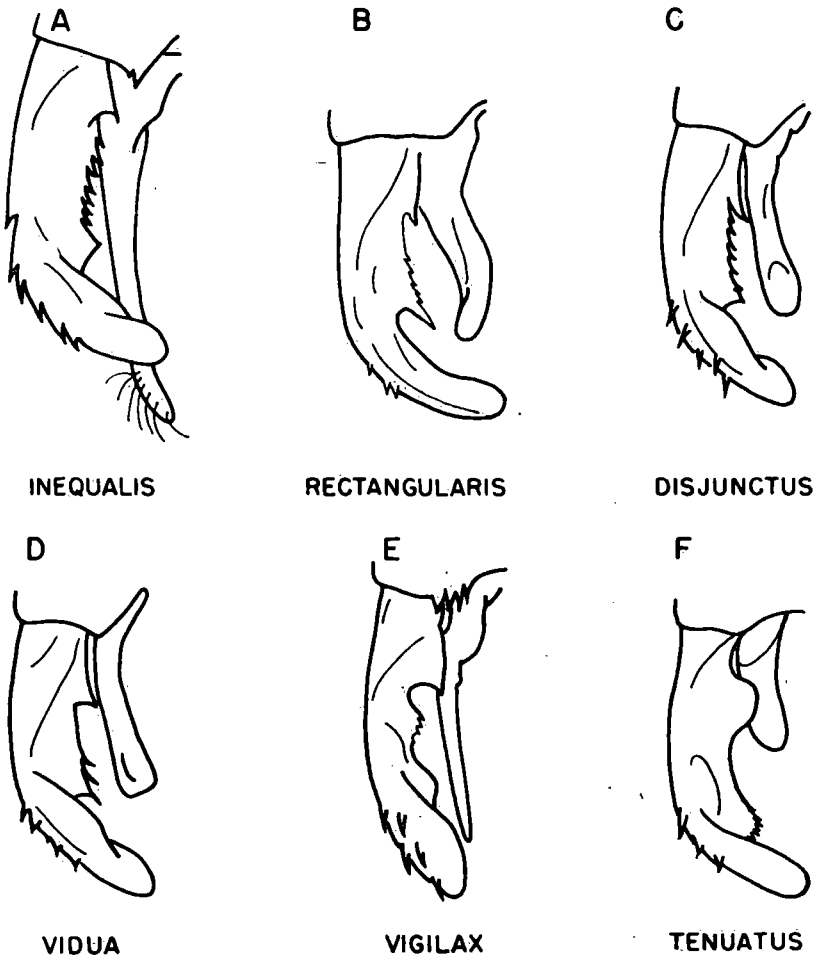

FIGURE 3. Dorsal view of left superior and inferior male abdominal appendages in *Lestes* species following sequence appearing in key.

b) Apical tooth of superior abdominal appendage in dorsal view not longer than basal tooth (Fig. 3C, D); metapleural suture with blackish, often irregular, stripe 4

4 a) Inferior abdominal appendage in dorsal view extends rearward (only slightly in some individuals) beyond apical tooth of superior appendage (Fig. 3C); degree of serration variable between teeth on medial border of superior abdominal appendage; labrum pale bluish ..... *disjunctus australis*

b) Inferior abdominal appendage in dorsal view extends rearward no further than apical tooth of superior appendage (Fig. 3D); labrum dark purple (blackish in some dried museum specimens) ..... *vidua*

5 a) Inferior abdominal appendages long and slender, well over half length of superior appendages (Fig. 3E); distance across compound eyes 5 mm or greater; body length 45 mm or greater; legs predominantly black; thoracic dorsum with metallic green on dark ground color ..... *vigilax*

b) Inferior abdominal appendages short, one half or less length of superior appendages (Fig. 3F); distance across compound eyes less than 5 mm; body length less than 45 mm; legs mottled brown; thoracic dorsum with metallic green on tan ground color ..... *tenuatus*

KEY TO THE FEMALES

1 a) Dorsum of thorax with green markings, often metallic 2

b) Dorsum of thorax with bronze or brown markings, often metallic 4

2 a) A pair of brownish-black spots on ventrolateral surface of metathorax posterior to 3rd pair of legs; external face of tibia pale brown; stigma less than 2 mm in length ..... *tenuatus*

b) Ventrolateral surface of metathorax pale without dark spots; external face of tibia predominantly black; stigma 2 mm or greater in length 3

3 a) Antehumeral pale stripe reddish brown, one-third or greater the width of green area on either side of median carina; hind wing length 26 mm or less ..... *vigilax*

b) Antehumeral pale stripe yellow, linear and less than one-fourth width of green area on either side of median carina; hind wing length 27 mm or greater ..... *inequalis*

4 a) Abdominal segment 7 less than twice as long as ovipositor; abdominal length 30 mm or less ..... *disjunctus australis*

b) Abdominal segment 7 twice as long as ovipositor; abdominal length 30 mm or greater 5

5 a) Ventral surface of metathorax entirely pale, upper end of metapleural suture pale or with very reduced spot; external face of tibia yellow ..... *rectangularis*

b) Ventral surface of metathorax with dark elongated spots and distinct spot on upper end of metapleural suture; external face of tibia predominantly dark brown to black ..... *vidua*

All species inhabit marshy lake margins and ponds in frequently isolated colonies, fly slowly, and perch with half-spread wings on emergent vegetation. Perching with half-spread wings is characteristic of lestids; other perched damselflies usually fold the wings together over the body if not flexing them back and forth in some behavioral display. Clear petiolated wings separate lestids from calopterygids, while large body size and spread-wing perching habit distinguish the group from most coenagrionids. The long slender coenagrionid, *Teleallagma daecki*, has nonlestid perching habits and a pale bluish or tan body color. Body size and color pattern will allow species identification of males in the field after a study of museum specimens (excepting perhaps *disjunctus* and *vidua*). The same traits

should prove useful for females, but require closer discrimination. Several studies of lestids have proved their adaptability to problems in population biology, see Bick and Bick (1961).

Distribution data are:
L. disjunctus australis: south to Orange County.
L. inequalis: Alachua County.
L. rectangularis: Alachua and Clay Counties.
L. tenuatus: Dade County.
L. vidua: south to Highlands County.
L. vigilax: south to Highlands County.

Larval descriptions of *L. disjunctus australis, rectangularis,* and *vigilax* were given by Garman (1917 as *L. forcipatus*), Needham (1903) and Walker (1914) respectively and later supplemented by Walker (1953). Larvae of *inequalis, tenuatus,* and *vidua* are still undescribed.

Calopterygidae

The large body size and conspicuous colors together with territorial and often complex courtship behaviors have combined to make these damselflies a favorite tool for several types of field investigation.

The calopterygids are represented in Florida by two genera, both ecologically associated with streams. *Calopteryx* includes a group of species distributed generally in the northern hemisphere; *Hetaerina* consists of an array of species restricted to North and South America that reaches its highest diversity in the southern latitudes. Individuals are readily recognized by their broad, nonpetiolated wings, and body colors of brown or metallic greens, blue, and bronze with pale areas largely reduced. Red, brown, or black wing pigments, separately or in combination, distinguish sex, with males showing the brighter colors. Females usually have much less or no wing pigment.

Key to the Genera

1 a) No cross veins in median space; little or no pale area in body pattern, coloration metallic green or bluish; wing pigments blackish, red colors absent, stigma absent in males, present and distinctly white in females ..... *Calopteryx*

b) Several cross veins in median space; distinct pale and metallic dark areas or brownish body patterns; male fore wings have basal red area with or without adjacent brownish pigments, stigma in both sexes .... *Hetaerina*

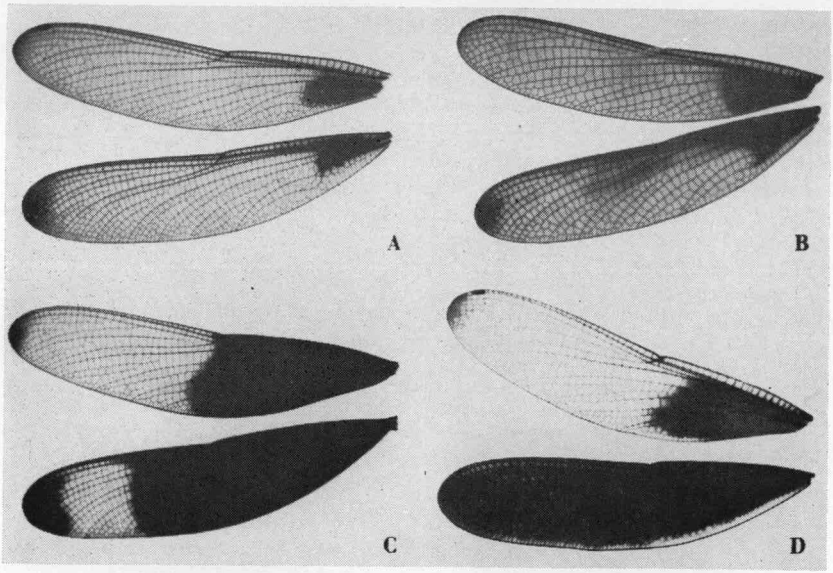

FIGURE 4. Selected patterns in variation of fore and hind wings of males in *Hetaerina titia* complex. Type A characterizes *Hetaerina tricolor*.

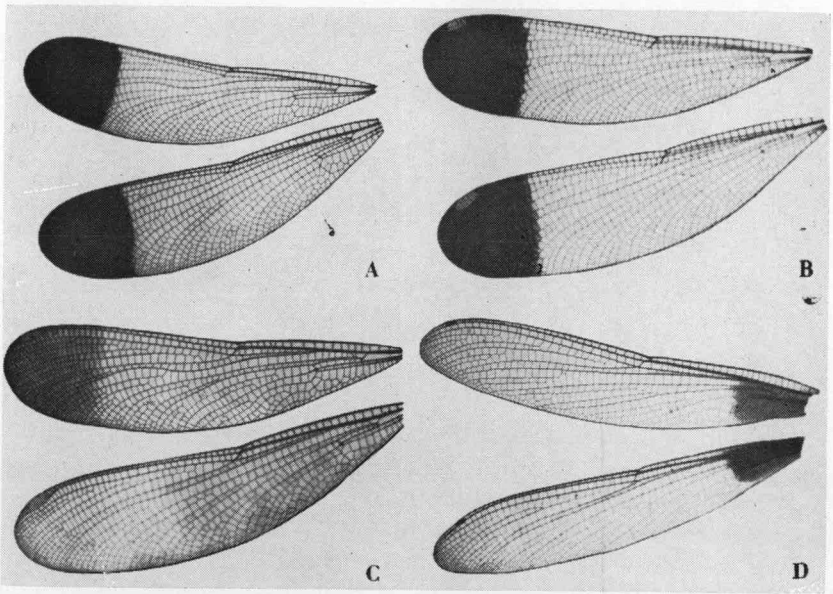

FIGURE 5. Wing patterns in *Calopteryx dimidiata*: A, male; B and C females; and D, wing pattern of male *Hetaerina americana*.

Calopteryx

KEY TO THE MALES

1 a) Wings translucent brown to opaque black for full length (Fig. 6A); ventral surface of abdominal segments 9 and 10 whitish ..... *maculata*

b) Wings with basal five-sixths to three-fourths area clear, apical portion distinctly marked with brown or black pigment (Fig. 5A); ventral surface of abdominal segments 9 and 10 black ..... *dimidiata*

KEY TO THE FEMALES

1 a) Wings with brownish-black pigment over full length, often with greater intensity in apical fourth (Fig. 6B); ventrolateral surface of pterothorax blackish. ..... *maculata*

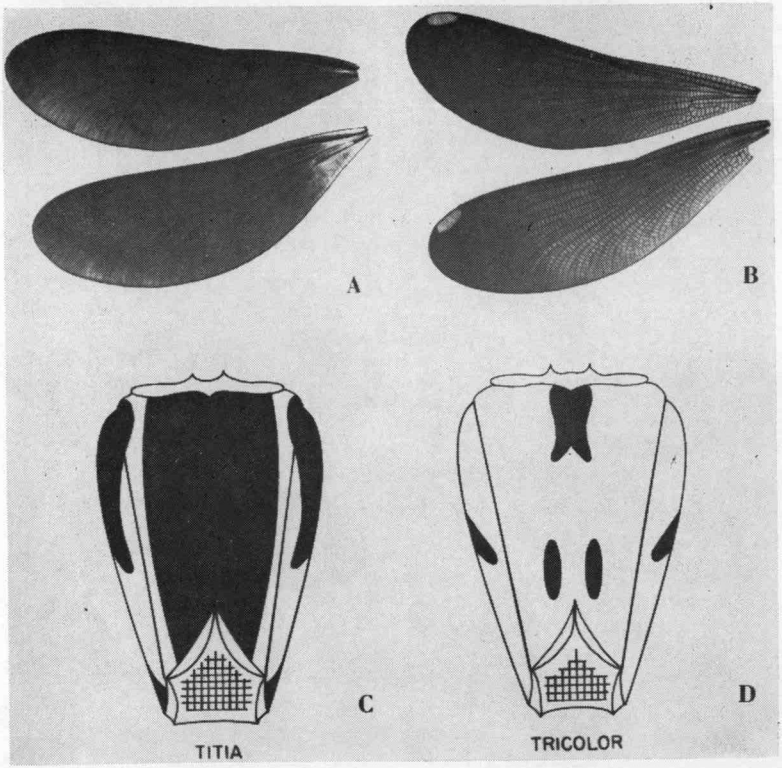

FIGURE 6. Wing patterns in *Calopteryx maculatah*: A, male; B, female; C, D, dorsal views of thoracic patterns in females of the *Hetaerina titia* complex.

b) Wings devoid of brownish-black pigment or, if present, restricted to apical fourth or less (Fig. 5B,C); ventrolateral surface of pterothorax pale ..... *dimidiata*

Field identification follows the color pattern differences given in the keys supplemented by the following notes. Female *maculata* have fully pigmented wings but are usually darker in the apical fourth. Teneral *maculata* have only smoky-gray wing colors. Female *dimidiata* may have wings with little to no pigment, or the apical fourth may be pigmented similar to the male pattern. Females of both species have distinctive white stigmas.

Calopteryx species present several intriguing ecological questions. *C. maculata* occurs along a wide variety of stream-riverine conditions and often disperses well inland. *C. dimidiata* apparently requires more specific conditions and often exists in isolated colonies. Dispersal inland from the breeding sites is much more limited in *dimidiata*. Where assemblages of the two species occur, niche segregation or differences in courtship reproductively isolating them have yet to be studied, though the courtship sequence in *maculata* has been analyzed (Johnson, 1962). Habitat selection, courtship, and territorial behaviors have been well studied in European species (Buchholtz, 1951; Pajunen, 1966), indicating their suitability for such work.

The Florida populations of *maculata* have been treated as a subspecies, *C. m. floridana,* by Huggins (1927). The problem is discussed by Byers (1930).

Distribution data are:
C. dimidiata: south to De Soto Co.
C. maculata: south to Highlands Co.

The larva of *C. maculata* was described originally by Needham (1903) and in greater detail by Walker (1953). Wright (1946) described the larva of *C. dimidiata.*

Hetaerina

KEY TO THE MALES:

1 a) Basal red spot on fore wing bordered distally by no pigment or brownish black color extending apically for variable distance, hind wing pigment brown and varying from basal spot to entire wing (Fig. 4A-D); pigmentation paler in teneral specimens ..... *titia* complex

b) Basal red spot in fore and hind wings, may reach distally to nodus; apical wing areas nonpigmented (Fig. 5D); red color limited to fore wing in teneral specimens with hind wing spot brown ..... *americana*

KEY TO THE FEMALES

1 a) Ventrolateral surface of abdomen brown, slightly lighter, if any, in color

than dorsum; dorsum of head and abdomen dark brown; thorax brown with broad metallic green band on either side of median carina, or band isolated into two elongate spots (Fig. 6C,D) ..... *titia* complex

b) Ventrolateral surface of abdomen pale-colored and distinctly contrasting with metallic green dorsum; dorsum of head and abdomen metallic green, latter usually with a pale basal ring per segment; dorsum of thorax with broad metallic green band on either side of median carina .... *americana*

Hetaerina titia as recognized in the above key may include two species, *titia* and *tricolor*. The latter species was originally described in 1839 and synonymized with *titia* in 1912; Johnson (1963) discusses the problem. The two-species interpretation is based on distinctive behavioral differences, two thoracic color patterns in females (Fig. 6C,D) and differences, though less distinct, in male wing patterns (Johnson, 1963). The latter studies were made with populations in central Texas where no female intergrades were found. In addition to the above criteria, flight season differences were noted, color differences were found not environmentally modified, and little if any gene exchange occurred between the two forms. Subsequent study of the Florida collections (unpublished) have revealed infrequent female intergrades for thoracic pattern and an apparent lack of different flight seasons. Consequently these species are identified here under the taxon *titia* complex, awaiting a more comprehensive study.

The only caution required in identifying hetaerinas involves the sequential development of wing patterns during the teneral stages. In *titia* forms, the basic patterns in pale color may be determined soon after emergence, but in *americana* the hind wing spot in males is initially brown, and both fore and hind wings become deep red with age. The hind wing spot in male *titia* remains brown; however, the veins within the spot may be red. Female *titia* wings range from clear to variable amounts of brown, and female *americana* may exist with no wing pigment or with diffuse brown to orange basal spots. The female condition is not an age effect and the variation in *americana* is similar to that mentioned for *Calopteryx dimidiata*, possibly representing a sex-limited dimorphism as occurs in *Ischnura* and suggested in *Enallagma*. This type of variation is identified more fully below.

Distribution data are:

H. americana: Jackson County.
H. titia complex: south to DeSoto County.

The larva of *H. americana* was described originally by Needham

(1903) and in greater detail by Walker (1953). Byers (1930) described the larva of *titia*, but it is impossible to associate the description in the *titia* complex.

COENAGRIONIDAE

Most damselflies at any suitable habitat are coenagrionids, and the Florida fauna is no exception with nine genera represented; 34 species have been collected in the state. Enallagmas and ischnurans have essentially cosmopolitan damselfly distributions, although reaching their highest species diversities in North America. *Anomalagrion* occurs in much of South America and adjacent islands, and *Nehalennia* occurs in the Palearctic as well as North America. The remaining five genera are limited to smaller nearctic and neotropical distributions. These species, usually with small body size, characteristically have brightly colored bodies in males, rather cryptically colored females, and with one notable exception (*Argia fumipennis*), clear colorless wings. *Anomalagrion* and *Teleallagma* are monotypic genera; *Argiallagma, Neoerythromma,* and *Telebasis* are represented by single species in the state while *Nehalennia, Ischnura, Argia,* and *Enallagma* have 2, 4, 6 and 17 species respectively in the state.

Taxonomists have largely used adult male characters for recognizing genera. Females have fewer and less specific structural traits; in addition their color patterns are frequently less distinctive, often obscured with age, or exist in dimorphic phases. Diagnostic keys for nearctic genera have consequently identified only males for *Teleallagma, Anomalagrion, Ischnura,* and *Enallagma* (Needham and Heywood, 1929; Smith and Pritchard, 1956). The following key avoids a unisexual treatment through additional couplets and alternate routes for determination.

Color characters involve stripe patterns of the thorax and to a less extent the external faces of the tibiae and shapes of postocular spots. These qualities are considered with thoracic, head, and abdominal colors and their change with age. Where the above characters are not self explanatory, they are explained in the key and referred to necessary figures. The variable color patterns required of female determination constitutes the most likely source of confusion. The external exudate, pruinescence, may partially obscure patterns in *Anomalagrion* and *Ischnura.* A small drop of acetone will usually

expose the underlying pattern temporarily. Pruinescence is developed to greater degree in males of other genera.

KEY TO THE GENERA

1 a) Majority of spines on 2nd and 3rd tibiae long, distance between spines approximately one-half of spine length (Fig. 7B); if thoracic dorsum metallic green, a distinct pale antehumeral stripe exists and females with a vulvar spine (such as Fig. 13K) 2

b) Spines of tibiae short, distance between spines approximately equal to spine length (Fig. 7A); if thoracic dorsum metallic green, it is never

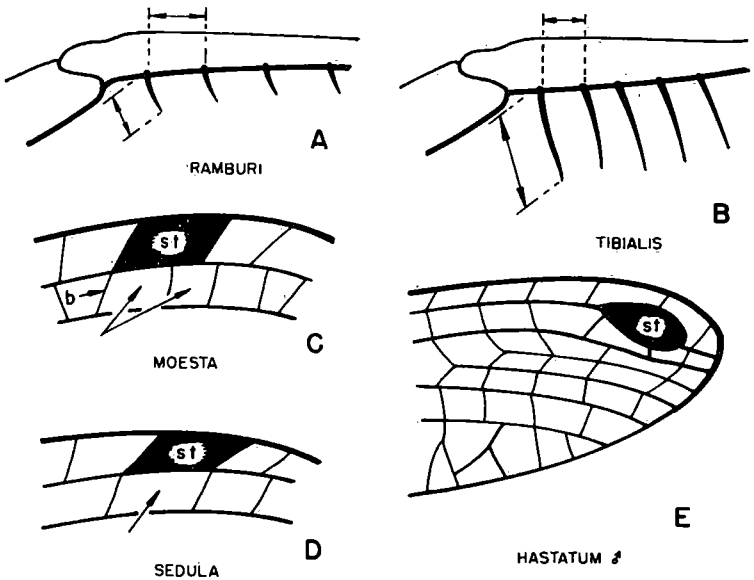

FIGURE 7. Variation in tibial spines and stigma structure in selected coenagrionids. Structures identified in text. Arrows indicate key characters.

bordered laterally by pale antehumeral area and such females never with vulvar spine (such as Fig. 13J) 3

2 a) M_2 separating from M_{1-2} near the 5th and 4th postnodals on the fore and hind wings respectively; postnodals 8 or less; sternum of abdominal segment 8 with a vulvar spine in females; abdominal appendages of male without distinct arms in lateral view (Fig. 18D); avg body length 25-27 mm ..... *Argiallagma pallidulum*

b) M_2 separating from M_{1-2} near the 6th and 5th postnodals or beyond on the fore and hind wings respectively; postnodals 9 or greater; sternum of abominal segment 8 without a vulvar spine in females; male appendages and body lengths variable ..... *Argia*

3 a) Thoracic dorsum solid metallic green to bronze; abdominal dorsum pre-

dominantly greenish-black; sternum of abdominal segment 8 without vulvar spine in females; avg body length 24-27 mm ..... *Nehalennia*

b) No such combination of characters 4

4 a) Thoracic dorsum with black dorsal stripe finely divided by pale-colored carina and distinctly notched laterally in posterior half; a small elongated dark spot midway along each humeral suture; antehumeral area and thoracic sides reddish brown in males, brown in females; abdominal dorsum red in males, brown in females; sternum of abdominal segment 8 without vulvar spine in females; inferior abdominal appendage of male extends rearward beyond apical level of superior appendage (Fig. 18E); avg body length 28-31 mm ..... *Telebasis byersi*

b) No such combination of characters 5

5 a) Abdominal length 34 mm or greater; Cu_2 terminating near midway point between nodus and origin of M_2; petiole of wing usually extends distally to anal crossing; dorsal thoracic stripe in males narrow and humeral stripes reduced to elongated spots, stripe pattern further reduced in females; superior abdominal appendage of males in lateral view with distinct ventrally directed lobe (Fig. 18A); sternum of abdominal segment 8 with vulvar spine in females ..... *Teleallagma daecki*

b) Abdominal length less than 34 mm; Cu_2 terminating near origin of M_2 or beyond; petiole of wing usually terminated by hind margin of wing slightly proximal to anal crossing; variable color patterns, male appendages and presence of vulvar spine in females 6

6 a) Males 7

b) Females 11

7 a) Stigma of fore wing removed from wing margin (Fig. 7E); abdominal segment 10 elevated into spine, superior abdominal appendage with distinct dorsoposteriorly-directed arm in lateral view (Fig. 18B); avg body length 23-27 mm ..... *Anomalagrion hastatum*

b) Stigma of fore wing not removed from wing margin; abdominal segment 10 and appendages not as in Fig. 18B 8

8 a) Entire front of head between compound eyes yellowish-white distinctly bordered posteriorly at approximate level of anterior ocellus by black of vertex and rear of head; elongated postocular spots present; abdominal segment 8 and 9 without black dorsal markings, segment 10 dorsally black and not elevated on rear margin; M_2 usually separating from M_{1-2} near the 4th and 3rd postnodals in the fore and hind wings respectively; superior abdominal appendages longer than segment 10 and with a ventrally directed denticle in lateral view (Fig. 18C); unlikely beyond south Florida ..... *Neoerythromma cultellatum*

b) Front of head anterior to ocelli with black markings, pale colors ranging from oranges, tans, blues, greens and purples; if black absent from face, abdominal segment 8 and 9 with black dorsal markings; M_2 separation variable; with or without elevated rear margin of abdominal segment 10; abdominal appendages never with structure shown in Fig. 18C 9

9 a) M_2 separating from M_{1-2} near 5th and 4th postnodals or beyond in the fore and hind wings respectively; abdominal segment 10 not elevated on rear dorsal margin; stigma similar in fore and hind wings ..... *Enallagma*

b) M_2 separating from M_{1-2} near the 4th and 3rd postnodals in the fore and

hind wings respectively; abdominal segment 10 may or may not have elevation on rear dorsal margin into spine-like process; stigma color may differ between fore and hind wings in well-matured individuals 10

10 a) Abdominal segment 10 elevated on rear margin into spinelike process (Fig. 18G-I); or if not, inferior abdominal appendage consists of dorsally-directed tooth and ventroposteriorly directed arm extending rearward beyond apical level of superior appendage in lateral view (Fig. 18F); stigma may differ in fore and hind wings (except *I. posita*) .... *Ischnura*

b) Abdominal segment 10 not elevated and inferior abdominal appendage never in lateral view as Fig. 18F-I; stigma similar in fore and hind wings ..... *Enallagma*

11 a) Sternum of abdominal segment 8 without a vulvar spine (Fig. 13J) 12

b) Sternum of abdominal segment 8 with a vulvar spine (Fig. 13K) 13

12 a) Dorsal and humeral dark thoracic stripes bordering distinct pale antehumeral stripes ..... *Neoerythromma cultellatum*

b) Thoracic dorsum with dorsal black stripe and orange laterally (no humeral stripe) becoming dark brown or greenish with age and dorsal stripe obscured in older individuals, or each pale antehumeral area exists as two separate spots, the anterior one elongated, whole dorsum becoming obscured with age into a solid bluish-gray (spot pattern revealed by acetone treatment) 19

13 a) Distinct dorsal and humeral blackish thoracic stripes bordering pale antehumeral stripes; antehumeral colors include light tan, blues, and green 14

b) Distinct dorsal thoracic stripe present as solid band or finely divided on the carina, or absent; pale thoracic area lateral to dorsal stripe (if present) orange, brown, or bluish; never with distinct humeral stripe (latter may be represented by small isolated spots) 17

14 a) M_2 separating from M_{1-2} near the 5th and 4th postnodals or beyond on the fore and hind wings respectively ..... *Enallagma*

b) M_2 separating from M_{1-2} near the 4th and 3rd (or 2nd) postnodals on the fore and hind wings respectively 15

15 a) Postocular spots obscured; body length 30 mm or less; dorsum or abdominal segments 3-7 bluish-gray or black; no dark stripe on metapleural suture ..... *Anomalagrion hastatum*

b) Postocular spots distinct or, if obscured, associated with body length of 30 mm or greater; dorsum of abdominal segments 3-7 black (often with metallic green tint), brown or pale orange; with or without dark stripe on metapleural suture 16

16 a) Postocular spots exist as large triangles occupying majority of postocular area with apex directed anteriorly, or as small circles and associated with a blue abdominal segment 8 ..... *Ischnura*

b) Postocular spots are elongated transversely with or without connections to pale postocular bar; if spots exist as circles, abdominal segment 8 with black markings ..... *Enallagma*

17 a) M_2 separating from M_{1-2} near the 5th and 4th postnodals or beyond on the fore and hind wings respectively 18

b) M_2 separating from M_{1-2} near the 4th and 3rd (or 2nd) postnodals on the fore and hind wings respectively 19

18 a) Dorsum of thorax with dorsal black stripe and orange laterally becoming dark brown or greenish with age (dorsal stripe obscured in older individuals); transverse postocular spots and bar broadly confluent with pale of rear head area but spots, bar and rear head areas obscured by black at early age ..... *Ischnura*

b) Dorsum of thorax with or without dorsal black stripe and pale blue or bluish-brown laterally; distinct bluish postocular spots with well defined borders, often with pale postocular bar; these patterns not obscured with age ..... *Enallagma*

19 a) Body length less than 30 mm; dark middorsal thoracic stripe; humeral stripe narrow, faint or absent; pale antehumeral stripe continuous; abdominal segments 8, 9, and 10 black ..... *Anomalagrion hastatum*

b) Body length 30 mm or greater, *or* antehumeral area divided into 2 spots (requires close examination), *or* abdominal segments 8, 9, and 10 largely pale ..... *Ischnura*

Argia

The following key to females requires examination of mesostigmal plates and anterior end of the median thoracic carina. These structures occurring on the anterior dorsal edge of the mesothorax must be viewed dorsally; therefore, the head and prothorax must often be relaxed and articulated forward to provide a clear view. The male abdominal appendages are small and their diagnostic features often require study of both dorsal and lateral aspects.

KEY TO THE MALES

1 a) Dorsum of abdominal segments 3-6 pale blue with black apical rings; body length usually less than 30 mm; fore wing length usually less than 17 mm; inferior abdominal appendage in lateral view not bifid (Fig. 8B) ..... *bipunctulata*

b) Dorsum of abdominal segments 3-6 violet with black apical rings, or brownish-black with pale-colored basal rings, or brownish-black without such basal rings; body length usually greater than 30 mm; fore wing length usually greater than 17 mm; inferior abdominal appendage in lateral view bifid (Fig. 8A,C,E,F); or if not (Fig. 8D), stigma surmounts 1.5 to 2 cells (Fig. 7C) and body length always greater than 34 mm .. 2

2 a) Stigma surmounts 1.5 to 2 cells (Fig. 7C); inferior abdominal appendage in lateral view not bifid (Fig. 8D); distinct bluish-white pruinescence on dorsum of head and thorax in nonteneral individuals ..... *moesta*

b) Stigma surmounts 1 cell (rarely 1.5 cells) (Fig. 7D); inferior abdominal appendage in lateral view bifid or notched (Fig. 8A,C,E,F); little or no pruinescence on dorsum of head and thorax 3

3 a) Abdominal segment 8 black, 9 and 10 bluish on dorsum; ventral arm of inferior appendage in lateral view not extending posteriorly beyond dorsal arm (Fig. 8F) ..... *tibialis*

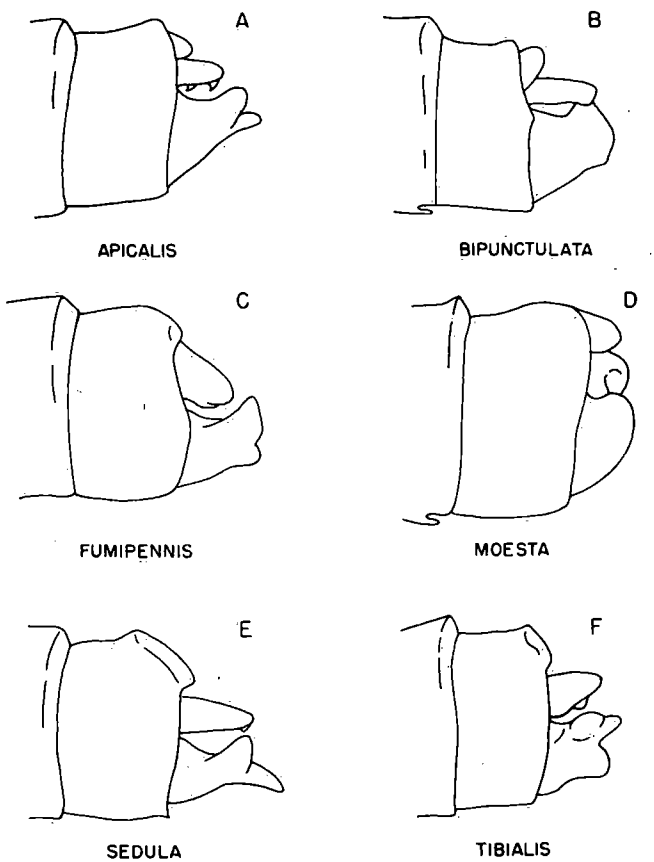

FIGURE 8. Lateral view of male abdominal appendages in *Argia* species.

b) Dorsum of abdominal segments 8, 9, and 10 blue or bluish-purple; ventral arm or denticle of inferior appendage in lateral view extends posteriorly well beyond dorsal arm (Fig. 8A,E); or if not (Fig. 8C) wings are distinctly brown 4

4 a) In dorsal view, ventral arms of the inferior abdominal appendages with inward curved apical tips (Fig. 9Ca); pale antehumeral area dark blue ..... *sedula*

b) In dorsal view, ventral arms of the inferior abdominal appendages with distinct laterally divergent curvature from medial base to apical tips (Fig. 9A,B); pale antehumeral area light blue to deep violet 5

5 a) Superior abdominal appendage in lateral view with a distinct apical tooth directed ventrally, a second more basal tooth present but often obscured in lateral view depending on articulation of the appendage (Fig. 8A); wings clear (rarely clouded with white or pale brown); middorsal dark thoracic

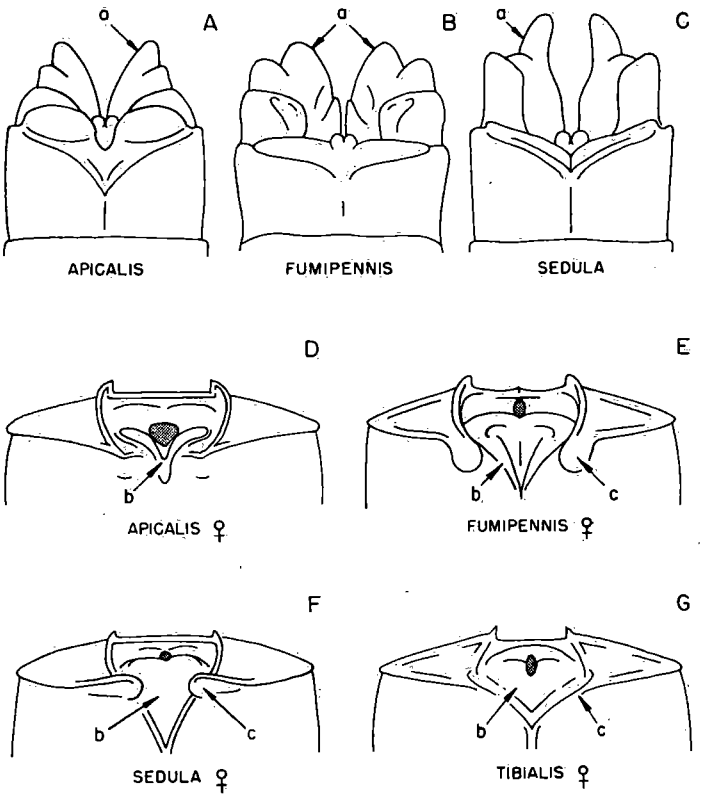

FIGURE 9. Dorsal view of male abdominal appendages and female mesostigmal plates in *Argia* species. Arrows indicate key characters.

stripe narrow, usually restricted to dorsal carina; pale antehumeral area light blue or violet, humeral stripe variable (Fig. 10A,B) ..... *apicalis*

b) Superior abdominal appendage in lateral view without ventrally-directed tooth-like projections (Fig. 8C); wings distinctly yellowish-brown to dark brown; middorsal dark thoracic stripe not restricted in width to dorsal carina; pale antehumeral area pale to deep violet 6

6 a) Dorsum of abdominal segments 2-6 violet with narrow black apical rings; Florida west of the Suwannee River ..... *fumipennis fumipennis*

b) Dorsum of abdominal segments 3-7 brown to brownish-black with narrow pale-colored basal rings (rings obscured in old individuals); peninsular Florida east of the Suwannee River excepting the southernmost four counties, isolated colony in Torreya shrub of Liberty County in nw Florida ..... *fumipennis atra*

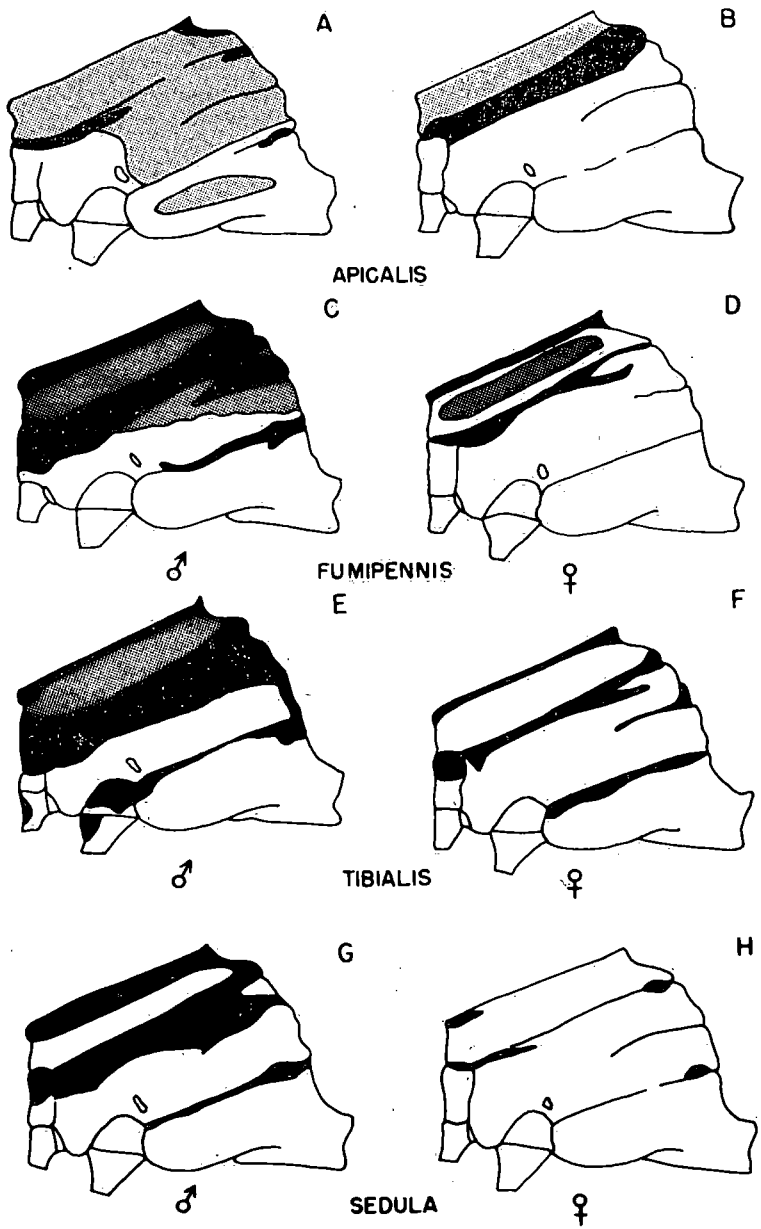

FIGURE 10. Lateral view of thoracic patterns in *Argia* species.

KEY TO THE FEMALES

1 a) Dorsum of abdominal segment 8 blue, black ventrolaterally; body length rarely greater than 30 mm; fore wing length rarely greater than 17 mm; dorsal and humeral dark thoracic stripes wide, the latter not forked but possessing a posterior pale spot (Fig. 11D) ..... *bipunctulata*

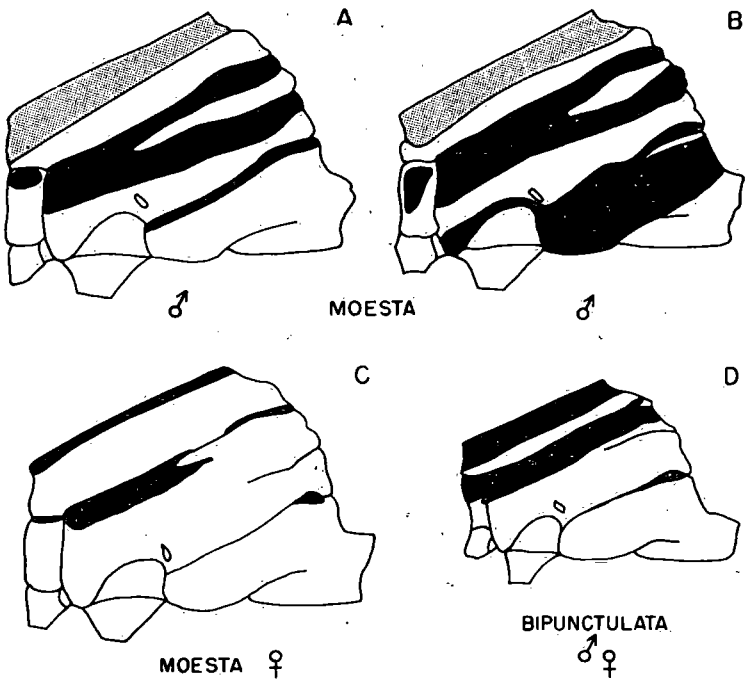

FIGURE 11. Lateral view of thoracic patterns in *Argia* species.

b) Dorsum of abdominal segment 8 dark brown to black, 9 and 10 variably marked; body length rarely less than 30 mm; fore wing length rarely less than 17 mm; dark humeral thoracic stripes absent or variable in pattern, often forked (Fig. 10,11) 2

2 a) Stigma surmounts 1.5 to 2 cells (Fig. 7C); body length rarely less than 38 mm; fore wing length rarely less than 24 mm ..... *moesta*

b) Stigma surmounts 1 cell (rarely 1.5 cells); body length rarely greater than 37 mm; fore wing length rarely greater than 24 mm 3

3 a) In dorsal view, anterior end of median thoracic carina bifurcates between posterior medial borders of the mesostigmal plates in the form of two elevated ridges (Fig. 9Db) ..... *apicalis*

b) In dorsal view, anterior end of median thoracic carina expanded between posterior medial borders of mesostigmal plates in the form of two flat plates (Fig. 9Eb-Gb) 4

4 a) In dorsal view, posterior medial borders of mesostigmal plates not extended

posteriorly into projecting lobes or raised into elevated rims (Fig. 9Gc) ..... *tibialis*

b) In dorsal view, posterior medial borders of mesostigmal plates extended posteriorly into projecting lobes or raised into elevated rims (Fig. 9Ec, Fc) 5

5 a) In dorsal view, posterior medial borders of mesostigmal plates raised into elevated rims (Fig. 9Fc) ..... *sedula*

b) In dorsal view, posterior medial borders of mesostigmal plates extended posteriorly into projecting lobes (Fig. 9Ec) ..... *fumipennis fumipennis, fumipennis atra*[1]

Argians are typically associated with stream habitats, but seepages and lakes are often colony sites. Individuals have a preference for perching on exposed earth and emergent rocks rather than grasses, twigs, limbs. This preference is less developed in *fumipennis* and *bipunctulata,* but all species avoid dense vegetation.

The taxonomic value of body color patterns involves several qualifications. Pale antehumeral colors vary considerably from teneral age to maturity. The rather distinctive colors manifest at maturity are largely lost in museum specimens and may show a reversible change during life reflecting physiological states (Bick and Bick, 1965). Mature male colors range through shades of blue to violet, and the less colorful females also have shades of brown. Pruinescence developed by mature *moesta* males may obscure their dark dorsal thoracic pattern; otherwise thoracic dark-stripe patterns are essentially constant with age. These dark patterns vary between individuals, possibly reflecting local differentiation, and males usually show a more extensive dark pattern than females. The characteristic pattern of each species is shown in Figures 10 and 11, but variations from these patterns must be expected in any sample. The pattern of variation in *moesta* (Fig. 11) was once treated taxonomically with the name *putrida* assigned to eastern populations including Florida. Populations of *apicalis* occurring in north-central Florida south to the Santa Fe River between Alachua and Columbia Counties, apparently on the southernmost fringe of its range, have a distinctive pattern (Fig. 10A,B). Females of these atypical *apicalis* also have both dark middorsal and humeral stripes. The typical *apicalis* pattern is otherwise stable throughout its distribution in North America and similar between the sexes.

Blue antehumeral colors characterize mature males of *apicalis, sedula,* and in lighter shades *bipunctulata.* The latter species is more

[1]Females of these subspecies are apparently not separable. See geographic note in the male key and Gloyd (1968).

readily determined by its small size, enallagma-like abdominal pattern, and its usual association with shallow seepage habitats. The reduced dark pattern in *apicalis* distinguishes that species from *sedula*. Violet antehumeral colors occur in mature males of *tibialis* and *fumipennis*. These species are best separated by wing color as mentioned below. The bluish-white pruinescence of the dorsal thorax distinguishes mature male *moesta* in conjunction with its large size and preference for larger streams and rivers.

The rather drab-colored tenerals and females are more difficult to distinguish. All six species are rarely found together, and a survey of the argian fauna for a habitat may be accomplished using the more distinctive patterns of mature males. Female and teneral identification is then facilitated by associated males and dark thoracic patterns. Where *sedula* and *apicalis* occur together, field determinations should be limited to males. Female *fumipennis* are further characterized by their brown wings.

Abdominal patterns are less variable but offer few useful field traits other than for *bipunctulata*. Wing color is characteristically clear excepting the distinctive brown of *fumipennis*, but *sedula* wings are occasionally tinted with brown and may overlap in color intensity with the lighter brown of some *fumipennis* individuals. Thoracic colors separate these species where overlap of wing colors occurs. Brown wing color serves to distinguish *fumipennis* from *tibialis*, which is rather similar in thoracic patterns and habitat preferences.

Distribution data are:

A. apicalis: south to Columbia-Alachua County line.
A. bipunctulata: south to Orange County.
A. fumipennis atra: east and south of the Suwannee River to Lee, Hendry, and Palm Beach Counties; isolated colony reported in nw Florida (Liberty County) and intergradation with *A. f. fumipennis* in Nassau County in northeast Florida.
A. f. fumipennis: west of the Suwannee River in nw Florida.
A. moesta: south to Charlotte County.
A. sedula: south to Collier County.
A. tibialis: south to Seminole County.

Larval descriptions of *apicalis* and *tibialis*, *moesta*, and *fumipennis* were given by Needham (1903), Needham and Cockerell (1903), and Needham (1904) respectively (Needham (1903) first described *fumipennis* as *violacea*); Seeman (1927) described the larva of *sedula*, and the larva of *bipunctulata* remains undescribed. The above descriptions of *apicalis* and *tibialis* particularly do not agree with known material from over the species range and cannot be used safely. More complete descriptions are given by Walker (1953).

Enallagma

The pale and dark color patterns in *Enallagma* species are essentially similar between the sexes, but pale regions of adult males are colorful, and three species groups may be recognized on this basis. Species with blue colors are *divagans, geminatum, doubledayi, civile, durum, basidens, davisi, traviatum,* and *pallidum,* the latter two being the palest blue. Species with purple colors are *cardenium* and *weewa,* the latter darkening with age and appearing black. Species with yellowish, orange, or reddish colors are *sulcatum, vesperum, signatum, pollutum, concisum,* and *dubium,* the latter two having the redder colors. Teneral individuals may not fit the above grouping; for example *pollutum* and *signatum* are pale blue in the teneral stage and orange as adults. Other than during the transient teneral stage, enallagmas are less subject to pattern changes with age than some argians and female ischnurans. The postocular spot pattern is subject to polymorphic variation (Johnson, 1964a); abdominal patterns of segments 8, 9, and 10 are stable. The pale-colored areas in females occur in shades of tan or brown, though occasional females have pale colors that closely approach the male condition. Walker (1953) has suggested that this variation may represent a form of sex-limited dimorphism similar to the phenomenon in *Ischnura.*

Identification of males requires examination of the superior abdominal appendages for an attached tubercle-like structure. The following key recognizes the presence of the tubercle only if it forms part of the appendage's lateral profile (Fig. 12A,B). Medial projections not laterally visible should not be scored as a tubercle (*durum* has such a tubercle). Tubercles are usually paler in color than the appendage proper but may darken with age.

Identification of females requires an examination of the prothoracic dorsum, mesostigmal plates, anterior dorsum of the mesothorax, and antenodal cell number. In several species the middle lobe of the prothorax has a pair of shallow pits on its dorsum. Close attention is needed for this trait; for instance, the pits *of dubim* occur anteriorly on a black middle lobe and may be missed by casual observation. The mesostigmal plates have distinctive structural differences in several species and must be viewed in dorsal aspect for the following key. Females of *civile* and *doubledayi* are very similar and may be confused. The character given in the key has proved best in testing. The convex medial border of the mesostigmal plates in *doubledayi*

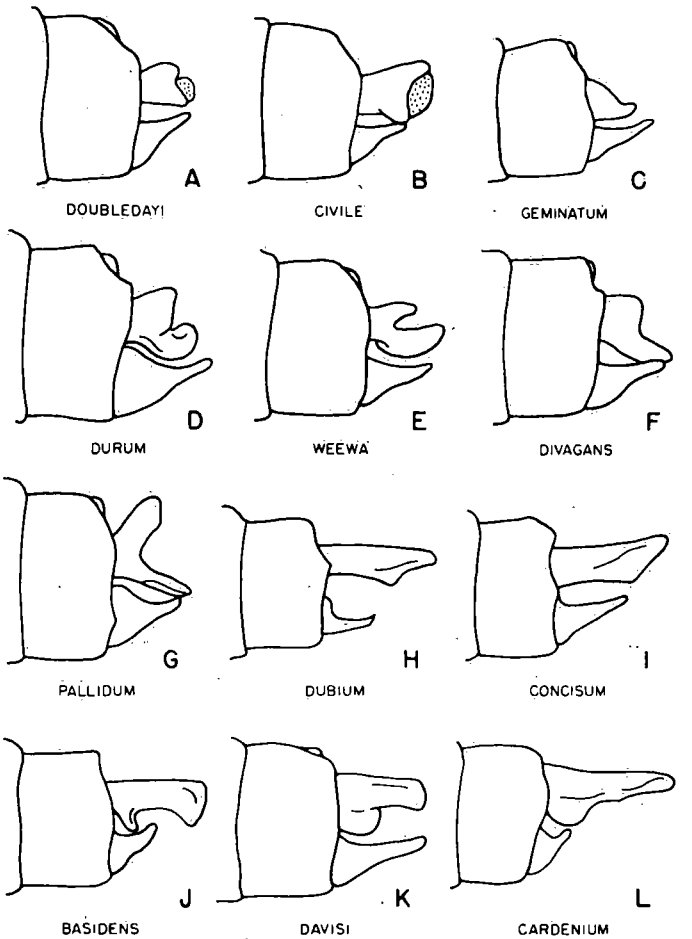

FIGURE 12. Lateral view of male abdominal appendages in *Enallagma* species following sequence appearing in key.

forms the medial half of a circular depression in the mesial fourth of each plate. The depression is defined by varying the angle of illumination. The depression is absent in *civile* with its concave border on the medial end of the mesostigmal plates. To find the prothoracic pits and mesostigmal plates usually one must flex the specimen's head forward. The dorsum of the mesothorax posterior to the rear margin of the mesostigmal plates in several species has a pair of elevated knob or ridgelike projections (Fig. 16A-C). The structures are visible in dorsal view, but are more distinct when viewed at an oblique lateral

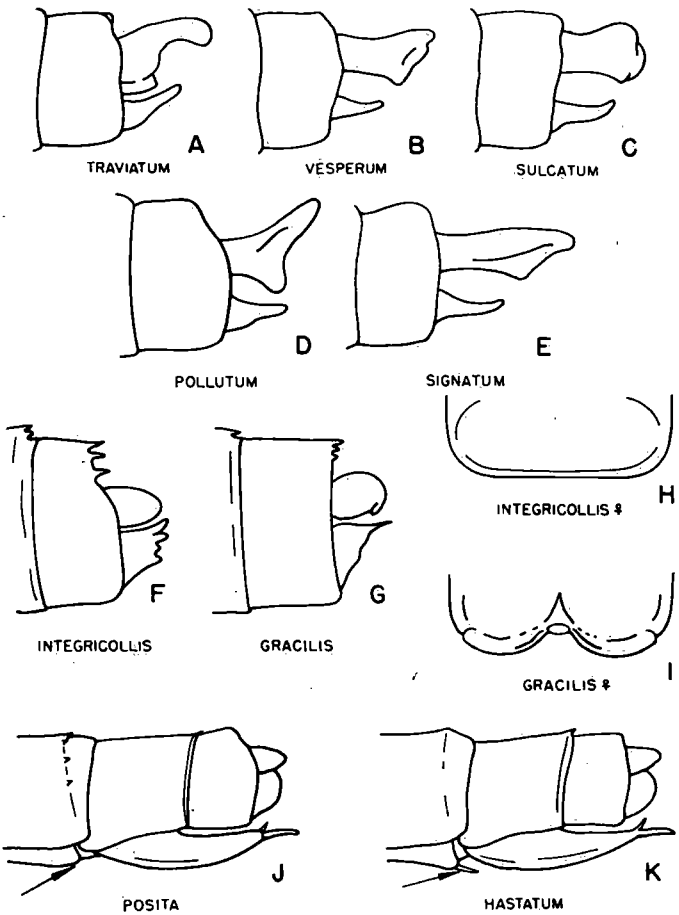

FIGURE 13. Lateral veiw of male abdominal appendages in *Enallagma* and *Nehalennia*; dorsal view of hind prothoracic lobe in female *Nehalennia*; lateral view of terminal abdominal segments and ovipositor in selected coenagrionids. Arrows indicate key characters.

angle. Antenodal cells of the wings are formed by cross veins between the longitudinal viens M_4 and Cu_1 from the quadrangle outward to the level of the subnodus.

The distribution of pale and dark color patterns on the abdomen has diagnostic value, though older females that have oviposited often have the terminal abdominal segments coated with silt and the pattern obscured. Acetone and a fine brush will remove such material.

KEY TO THE MALES

1 a) Superior abdominal appendage in lateral view with distinct tubercle forming dorsoapical margin of appendage or lying between dorsal and ventral arms of the appendage (Fig. 12A, B) 2
b) Superior abdominal appendage in lateral view without such a tubercle 3
2 a) Tubercle of superior abdominal appendage not overlaid in lateral view by dorsal arm of appendage (Fig. 12A) ..... *doubledayi*
b) Tubercle of superior abdominal appendage overlaid in lateral view by dorsal arm of appendage (Fig. 12B) ..... *civile*
3 a) Superior abdominal appendage in lateral view notched on dorsoapical margin with only distinct ventral arm (Fig. 12C); or appendage bifid with dorsal and ventral arms, the latter equal to or greater in length than the dorsal arm (Fig. 12D-G) 4
b) Superior abdominal appendage in lateral view elongate with small tooth or distinct ventral arm directed ventrally (Figs. 12H-L; 13A-C, E); or, appendage bifid with divergent dorsal and ventral arms, the latter shorter in length than the dorsal arm (Fig. 13D) 8
4 a) Inferior abdominal appendage in lateral view greater in length than superior abdominal appendage 5
b) Inferior abdominal appendage in lateral view equal to or less than length of superior abdominal appendage 6
5 a) Dorsum of abdominal segments 3-6 black except narrow blue basal rings (Fig. 14C); body length 28 mm or less; ventral arm of superior abdominal appendage curved dorsally (Fig. 12C) ..... *geminatum*
b) Dorsum of abdominal segments 3-6 blue except black spots in apical half (Fig. 14D); body length 31 mm or greater; ventral arm of superior abdominal appendage curved mesially (Fig. 12D); with small tubercle seen in dorsal view ..... *durum*
6 a) Dorsum of abdominal segment 9 purple, segment 8 black (Fig. 14E); two arms of superior abdominal appendage directed posteriorly in lateral view (Fig. 12E) ..... *weewa*
b) Dorsum of abdominal segments 8 and 9 blue (Fig. 14F, G); superior abdominal appendage in lateral view with rounded knob for dorsal arm and ventral arm directed ventroposteriorly (Fig. 12F); or, appendage with distinct divergent dorsal and ventral arms 7
7 a) Dorsum of abdominal segment 10 black (Fig. 14F); dorsal arm of superior abdominal appendage rounded knob in lateral view, ventral arm directed ventroposteriorly ..... *divagans*
b) Dorsum of abdominal segment 10 blue (Fig. 14G); dorsal and ventral arms of superior abdominal appendage widely divergent in lateral view, former extending upward to dorsal margin of abdominal segment 10 (Fig. 12G) ..... *pallidum*
8 a) Dorsum of abdominal segments 8, 9, and 10 black 9
b) Dorsum of abdominal segment 8 or 9 or both predominantly blue or yellowish-orange 10
9 a) Body length 28 mm or less; 1st 2 antennal segments black; antehumeral stripe narrower than humeral stripe; dorsal margin of superior abdominal appendage in lateral view straight, not elevated in posterior half (Fig. 12H) ..... *dubium*

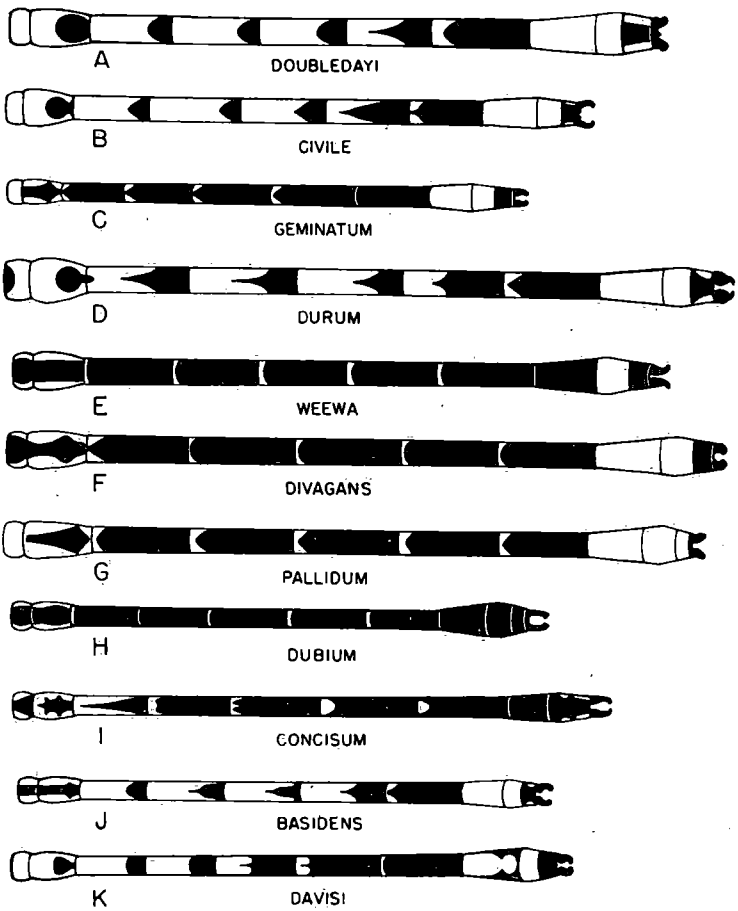

FIGURE 14. Dorsal view of male abdominal patterns in *Enallagma* species following sequence appearing in key.

b) Body length 30 mm or greater; 1st 2 antennal segments pale-colored; antehumeral stripe equal or greater in width than humeral stripe; dorsal margin of superior adbominal appendage in lateral view elevated in posterior half (Fig. 12I) ..... *concisum*

10 a) Dorsum of abdominal segments 8 and 9 predominantly blue or purple (Figs. 14J, K; 15L, M) 11

b) Dorsum of adbominal segment 9 predominantly blue or orange, segment 8 black (Fig. 15N-Q) 14

11 a) Dorsum of abdominal segments 4 and 5 with basal half pale blue (bluish-brown in some museum specimens) (Fig. 14J, K) 12

b) Dorsum of abdominal segment 4 and 5 with basal half black (Fig. 15L, M) 13

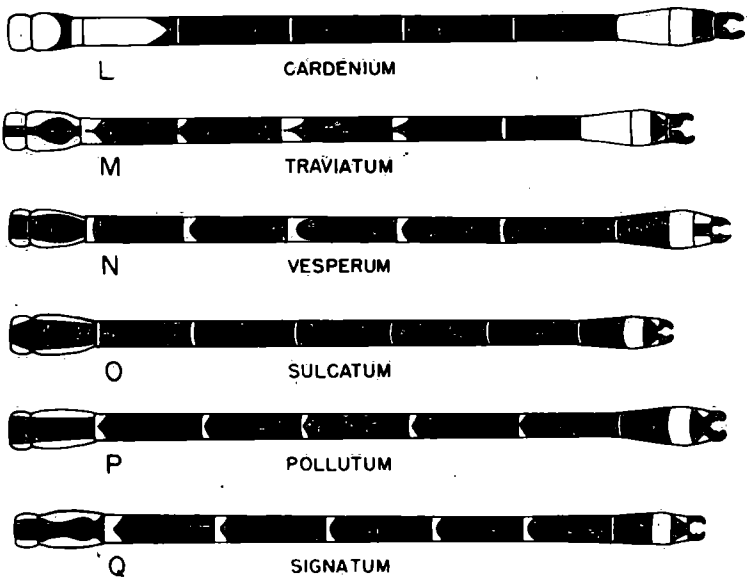

FIGURE 15. Dorsal view of male abdominal patterns in *Enallagma* species following sequence appearing in key.

12 a) Humeral stripe longitudinally divided by pale stripe; inferior abdominal appendage distinctly shorter than superior abdominal appendage (Fig. 12J) ..... *basidens*

b) Humeral stripe not divided by pale stripe; inferior abdominal appendage approximately equal in length to superior abdominal appendage (Fig. 12K) ..... *davisi*

13 a) Inferior abdominal appendage in lateral view one-half or less length of superior abdominal appendage (Fig. 12L); pale body color purple; prothorax predominantly black ..... *cardenium*

b) Inferior abdominal appendage in lateral view more than one-half length of superior abdominal appendage (Fig. 13A); pale body color blue; prothorax not predominantly black, a distinct dorsal and two lateral blue spots on middle lobe ..... *traviatum*

14 a) Dorsum of abdominal segment of 9 blue 15

b) Dorsum of abdominal segment 9 orange or yellow in mature individuals; for teneral specimens compare abdominal appendages 16

15 a) Apical margin of superior abdominal appendage not convex in lateral view (Fig. 13B); antehumeral pale stripe wider than humeral stripe, latter reduced to hair line and restricted to suture part of its length ..... *vesperum*

b) Apical margin of superior abdominal appendage distinctly convex in lateral view (Fig. 13C); antehumeral pale stripe narrower than numeral stripe, latter not restricted to suture along part of its length ..... *sulcatum*

16 a) Superior abdominal appendage in lateral view distinctly bifid at apical

margin producing dorsal and ventral divergent arms (Fig. 13D) ..... *pollutum*

b) Superior abdominal appendage in lateral view elongated, not bifid on apical margin and small tooth on ventral margin (Fig. 13E) ..... *signatum*

KEY TO THE FEMALES

1 a) Middle lobe of prothorax with pair of depressions or pits on the dorsal or dorso-lateral surface 2

b) Middle lobe of prothorax without pair of pits 8

2 a) Dorsum of mesothorax with pair of elevated, knob-like projections just rearward of mesostigmal plates' posterior margin (Fig. 16A-C) 3

b) Dorsum of mesothorax without elevated projections 5

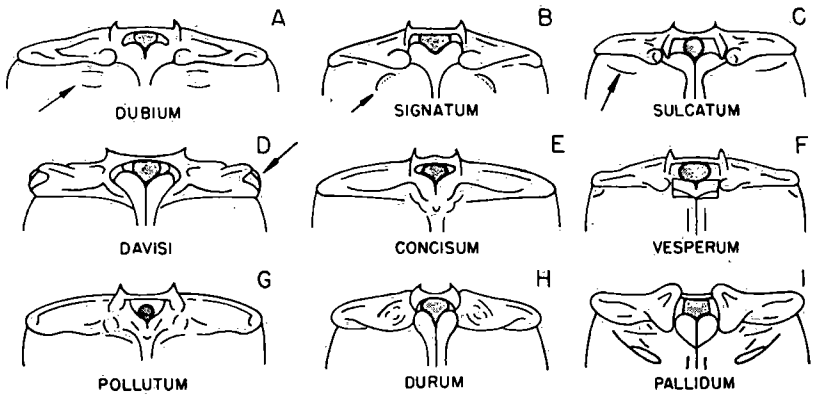

FIGURE 16. Dorsal view of female mesostigmal plates in *Enallagma* species following sequence appearing in key. Arrows indicate key characters.

3 a) Body length 26 mm or less; fore wing length 15 mm or less; postnodal veins 7 or less; middle prothoracic lobe black and its pits located in anterior third of lobe ..... *dubium*

b) Body length 30 mm or greater; fore wing length 19 mm or greater; postnodal veins 8 or greater; middle prothoracic lobe with pale spot pattern on black ground color 4

4 a) Prothoracic pits located in anterior half of middle lobe; dorsum of abdominal segment 9 with black pattern reaching apex ..... *signatum*

b) Prothoracic pits located in midsection of middle lobe; dorsum of abdominal segment 9 with pale bluish cross band on apex ..... *sulcatum*

5 a) Lateral apices of mesostigmal plates composed of yellowish tubercle (Fig. 16D) ..... *davisi*

b) Lateral apices of mesostigmal plates without tubercles 6

6 a) Body length 31 mm or less; fore wing length 17 mm or less; pale spot bordering anterior margin of each prothoracic pit ..... *concisum*

b) Body length 33 mm or greater; fore wing length 20 mm or greater; pale spot bordering each prothoracic pit excepting its dorsal margin 7

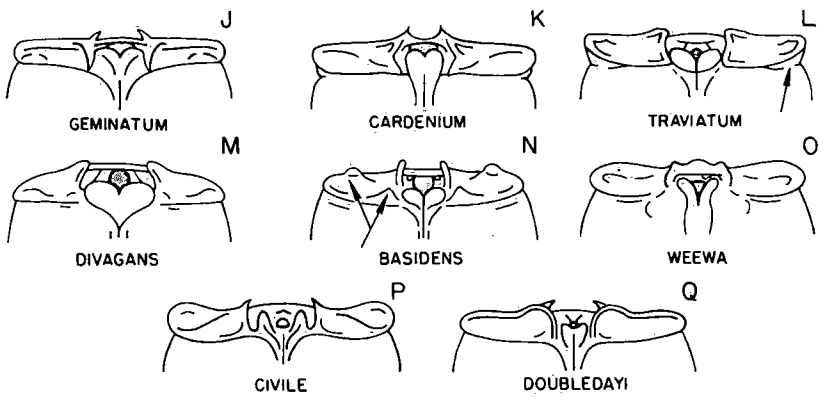

FIGURE 17. Dorsal view of female mesostigmal plates in *Enallagma* species following sequence appearing in key. Arrows indicate key characters.

7 a) Postclypeus predominantly pale on dorsal surface; dorsum of prothoracic middle lobe with a pair of pale stripes bordering middorsal suture ..... *vesperum*

b) Postclypeus with distinct dark band on dorsal surface; dorsum of prothoracic middle lobe with a pair of small pale spots in posterior half ..... *pollutum*

8 a) Antenodal cells in wings 4 to 5 (cells formed by cross veins between M_4 and Cu_1 from level of subnodus to quadrangle) ..... *durum*

b) Antenodal cells in wings 2 to 3 (cells formed as given above) 9

9 a) Posterior medial corners of mesostigmal plates extended into distinct projections directed rearward and elevated ridges present on mesothorax posterior to mesostignal plates (Fig. 16I); prothorax pale, black markings reduced to isolated spots and confined to sutures ..... *pallidum*

b) No such combination of characters 10

10 a) Abdominal segment 8 pale excepting short middorsal black stripe, *or* black with two large pale lateral spots, *or* one large dorsal anterior pale spot, *or* pale apical cross band and ventrolateral margins 11

b) Abdominal segment 8 black over entire dorsum 14

11 a) Abdominal segment 8 with two pale lateral spots separated by middorsal black stripe along entire length of segment; body length 27 mm or less ..... *geminatum*

b) Abdominal segment 8 without such a pale-dark color pattern; body length 29 mm or greater 12

12 a) Abdominal segment 9 black dorsally with two apical pale spots; dorsum of abdominal segment 8 pale over anterior two thirds ..... *cardenium*

b) Abdominal segment 9 blue, black if present confined to basal border 13

13 a) Lateral apices of mesostigmal plates distinctly elevated (Fig. 17L); middorsal thoracic stripe longitudinally divided by pale dorsal carina ..... *traviatum*

b) Lateral apices of mesostigmal plates not elevated from mesothoracic border (Fig. 17M); middorsal thoracic stripe not longitudinally divided (for full length) by pale carina ..... *divagans*

14 a) Humeral stripe divided longitudinally for part of its length by inserted pale stripe 15
b) Humeral stripe well developed and not longitudinally divided by pale color pattern 16
15 a) Body length 30 mm or less; distinct elevated projections on anterior and posterior borders of mesostigmal plates (Fig. 17N) ..... *basidens*
b) Body length 35 mm or greater; mesostigmal plates without distinct elevations (Fig. 17O) ..... *weewa*
16 a) Median borders of mesostigmal plates concave (Fig. 17P); see note in text ..... *civile*
b) Median borders of mesostigmal plates convex (Fig. 17Q); see note in text ..... *doubledayi*

Habitat preference studies for enallagmas are lacking. Two species showing close association with streams are *cardenium* and *weewa*. Other preferences based on more subtle habitat divisions are suggested by general collecting experience, but these observations are not as yet any help in species identification. Recognition of enallagmas at large in the field through male color patterns is possible in some species, but this practice is limited. Individuals of *pollutum* and *signatum* for example occupy similar habitats and cannot be distinguished unless collected. Confusion with other genera may also occur, such as *geminatum* with *Ischnura kellicotti*. Female enallagmas are among the most difficult Odonata to identify, and field determination should probably be limited to tandem pairs where the male is recognizable. Individuals identified in this fashion may be marked for later recognition in certain kinds of field studies (Johnson, 1964c).

Distribution data are:

E. basidens: Gadsden and Jackson Counties.
E. cardenium: south to Dade County.
E. civile: Jackson, Gadsden, and Liberty Counties.
E. concisum: south to Orange County.
E. davisi: Seminole County.
E. divagans: Alachua and Gulf Counties.
E. doubledayi: south to Pinellas and Orange Counties.
E. dubium: south to Alachua County.
E. durum: south to Hendry County.
E. geminatum: Leon, Levy, and Alachua Counties.
E. pallidum: south to Orange County.
E. pollutum: statewide less Florida Keys.
E. signatum: south to Lee County.
E. sulcatum: south to Orange County.
E. traviatum: Leon County.
E. vesperum: south to Glades County.
E. weewa: south to Glades County.

Larvae have been described as follows:

E. basidens, Bird (1931)
E. cardenium, Needham (1904)
E. civile, Needham and Cockerell (1903)
E. doubledayi, Garman (1927)
E. geminatum, Needham (1903)
E. pallidum, Byers (1927)
E. signatum, Needham (1903)
E. vesperum, Walker (1913)

Needham (1904) described the larva of *E. cardenium* as that of a *Leptobasis* species. Byers' (1930) description of the larva of *cardenium* was in error. Ferguson (1944) also described the larva of *basidens* and Walker (1953) has further supplemented the larval descriptions of *civile, geminatum, signatum,* and *vesperum.* The following larvae remain undescribed: *concisum, divagans, dubium, pollutum, sulcatum, weewa,* and *davisi.*

Ischnura

Male ischnurans have species-specific color patterns and distinctive abdominal appendages. Mesostigmal plates in females have less diagnostic value than in *Enallagma* and *Argia;* consequently color pattern differences are largely used. These patterns are subject to a complex variation given in the following outline.

Most species are characterized by a sex-limited female dimorphism. One form, the andromorph, shares the species-specific color pattern with the male, and the second form, the heteromorph, differs in color and usually in stripe pattern. These morphs are well developed soon after emergence. Some species retain distinctiveness of the morphs throughout life, while morphs of other species are obscured with age by an external exudate, a pruinescence that makes all females superficially similar (Johnson, 1964b, 1966). A few species have only one of the above morphs. Two species in Florida, *ramburi* and *kellicotti,* possess both morphs and retain the morph distinctions through life. The other species in the Florida fauna have only one morph, the andromorph in *posita* and the heteromorph in *prognatha.* The color traits are further complicated by age changes.

Whereas male and female *posita* are similar in pattern following emergence, females soon develop a bluish-gray dorsum of both thorax and abdomen through pruinescence. Female *prognatha* and heteromorphic female *ramburi* also pass through a color change typical of

most heteromorphic ischnurans. Soon after emergence a dark dorsal thoracic stripe exists bordered laterally by orange, and humeral stripes are absent. The orange areas become tan to dark brown with age, greenish in *prognatha,* but the females are always distinct from males. Patterns are not obscured with age in *ramburi* and *prognatha* males and andromorphic female *ramburi.* The morph pattern in *kellicotti* differs from the general ischnuran system. Both female morphs share the stripe pattern with the males, but andromorphs have the typical bluish, pale-colored areas characteristic of males while heteromorphs are orange-colored. This difference is also not lost with age.

An older set of terms for the morphs, homeochromatic and heterochromatic, are synonymous to andromorphic and heteromorphic respectively. The wide usage of heterochromatic in other areas of biology reduces its value in the present context (Johnson, 1964b). Byers' (1930) statement that only homeochromatic females occur in *prognatha* was an error hitherto uncorrected; Byers' female description describes accurately the heteromorphic (heterochromatic) pattern.

A brief statement of other variations will increase effectiveness of the keys. The M_2 vein of the fore wing originates closer to the 4th and 5th postnodals in males and females respectively for *prognatha* while both sexes in *Ischnura* usually have an M_2 origin nearer the 4th postnodal. Most species are also sexually dimorphic for postnodal vein number (Johnson, 1969). Female *prognatha* are also inconsistent relative to the presence of the vulvar spine; an occasional female shows a distinct spine, but it is usually absent. Variation of pattern on the 9th abdominal segment of *ramburi* has been recognized taxonomically as *Ischnura credula* and *I. ramburi credula* by different authorities. The variation does have geographic pattern (Paulson, 1966), but it does not seem to be related to speciation.

Ischnurans are frequently associated with shape and color differences in the stigma of fore and hind wings of males. This difference is absent in *posita,* occurs only in color for mature *ramburi* and *kellicotti,* and is well developed in *prognatha.*

KEY TO THE MALES

1 a) Apical dorsum of abdominal segment 10 projected posteriorly into a spine (Fig. 18G); stigma of fore wing distinctly larger than in hind wing ..... *prognatha*

b) Apical dorsum of abdominal segment 10 without distinct spine, but elevated bifid prominence occurs in *posita* and *ramburi* (Fig. 18H-I); stigma not distinctly different in size between fore and hind wings 2

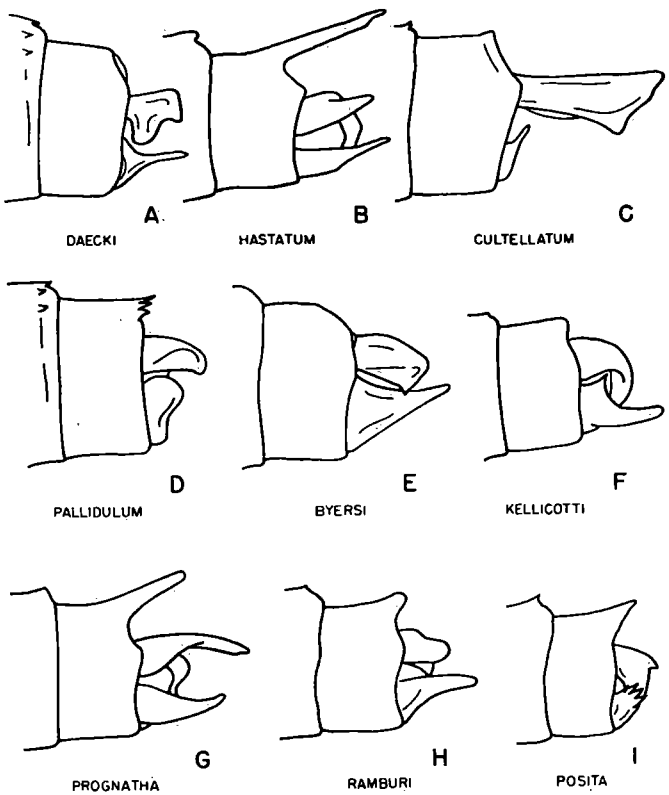

FIGURE 18. Lateral view of male abdominal appendages in *Teleallagma, Anomalagrion, Neoerythromma, Argiallagma, Telebasis,* and *Ischnura* species.

2 a) Inferior abdominal appendages in lateral view with serrated posterior border directed dorsoposteriorly (Fig. 18I); antehumeral pale areas broken into elongated anterior and small posterior spots (spots very rarely connected) ..... *posita*

b) Inferior abdominal appendages in lateral view without serrated posterior border (Fig. 18F, H); antehumeral pale stripes continuous and narrower in width than dorsal or humeral stripes (rarely antehumeral stripes broken into two spots in *ramburi*) 3

3 a) Fore wing length less than 15 mm; abdominal length less than 19 mm; inferior abdominal appendage in lateral view with dorsally-directed basal tooth (occasionally obscured laterally by overlying superior appendage) (Fig. 18F); dorsum of abdominal segment 2 with blue anterior spot and apical ring separated by transverse black band prolonged anteriorly on sides ..... *kellicotti*

b) Fore wing length 15 mm or greater; abdominal length 22 mm or greater; inferior abdominal appendage in lateral view without basal tooth (Fig. 18H); dorsum of abdominal segment 2 metallic greenish-black ..... *ramburi*

KEY TO THE FEMALES

1 a) M_2 separating from M_{1-2} near the 5th and 4th postnodals in fore and hind wings respectively ..... *prognatha*

b) M_2 separating from M_{1-2} near the 4th and 3rd postnodals in fore and hind wings respectively 2

2 a) Without vulvar spine on sternum of 8th abdominal segment; each antehumeral stripe borken into elongated anterior and small posterior spots, thoracic dorsum becoming obscured with age into bluish-grey (spot pattern revealed by acetone); abdominal segment 8 black or bluish-grey on dorsum ..... *posita*

b) With vulvar spine on sternum of 8th abdominal segment; humeral stripe missing or if present, antehumeral stripe not separated into spots (andromorphic *ramburi* rarely with separated antehumeral stripe but with blue abdominal segment 8) 3

3 a) Dark dorsal stripe with orange or brown laterally on thorax, humeral stripe absent ..... heteromorphic *ramburi*

b) Distinct dark dorsal and humeral stripes present; antehumeral colors bluish, greenish or orange 4

4 a) Postocular spots occur as small circles; dorsum of abdominal segment 2 black ..... andromorphic *ramburi*

b Postocular spots large, triangular with apex directed anteriorly; dorsum of abdominal segment 2 with bluish or orange spot associated with black or brown markings ..... *kellicotti*

Most species, including *ramburi* and *posita*, have a wide ecological tolerance often including brackish waters, although they reach highest densities in shallow ponds, weedy lake margins, and sluggish streams. *I. kellicotti* is one of the few odonates in temperate latitudes that has evolved an apparent obligatory relationship with specific plants. It is found only in association with water lilies, *Nuphar*. This association was noted by Williamson (1900) but has not been reported in detail. The complete life cycle occurs about the lily pads; larvae cling to the ventral surfaces and emerge on the dorsal surfaces; adults normally perch and oviposit only on lily pads. *I. prognatha* occurs in local and restricted colonies, judging from the sporadic and infrequent encounters in the field. The available records suggest it prefers a forested, perhaps swampy habitat.

Ischnurans can be identified in the field, but their small size and female variation necessitate careful study. The greenish antehumeral colors, dark dorsal and humeral stripes, and blue abdominal apex identify male and andromorphic female *ramburi*. Heteromorphic *ramburi* females are recognized by their dark dorsal stripe, orange to brown antehumeral colors, and absence of humeral stripes, but they can be confused with females of *Anomalagrion hastatum*, *I. prog-*

natha, and some *Enallagma.* A knowledge of associated males usually expedites identification. Small body size and exclamation-mark pattern of the antehumeral region identify male and young female *posita.* Older *posita* females develop a bluish-gray pruinescence and may then be confused with some female stages of *Anomalagrion hastatum* which, however, always retain a brownish dorsal thoracic stripe. The distinctive blue antehumeral colors, dorsal and humeral thoracic stripe pattern, and preference for lily pads identifies *kellicotti,* but *Enallagma geminatum* may occupy the same habitat and it superficially resembles male and andromorphic female *kellicotti.* Heteromorphic *kellicotti* may be confused with some enallagmas and their field determination should be made with caution. Field encounters with *prognatha* are so uncommon that suspected individuals are usually collected for confirmation.

Distribution data are:

I. kellicotti: south to Highlands County.
I. posita: statewide.
I. prognatha: statewide less Florida Keys.
I. ramburi: statewide.

Needham (1903) first described the larva of *posita,* and Walker (1953) later supplemented it. Needham (1904) incorrectly described the larva of *ramburi* as that of *Teleallagma daecki,* and it wasn't correctly ascribed until Calvert (1928). Larvae of *kellicotti* and *prognatha* remain undescribed.

Smaller Genera

Anomalagrion hastatum

This species is perhaps the smallest damselfly in Florida, but it may be confused with female *Ischnura posita.* Female *hastatum* pass through a color change similar to the sequence in heteromorphic ischnurans. Their early stages following emergence have a dark dorsal thoracic stripe bordered by orange without humeral stripes. The orange areas change to brown, and a whitish pruinescence develops along the ventral half of the pterothorax. The change often leaves a pale narrow lateral border to the dorsal band, and at this stage humeral stripes appear to exist. Abdominal segments 1-5 are predominantly orange with black prevailing on segments 6 to 10, but aging changes the whole abdominal dorsum to a bluish-gray. Females

may or may not have a vulvar spine that is always much smaller than similar spines in *Enallagma* and the larger ischnurans. Male *hastatum* are most readily identified in the field by their slender, yellow-orange abdomen. The species is found statewide and reaches highest densitis in lentic habitats with large expanses of emergent vegetation.

The larva of *hastatum* was described first by Needham (1903) and later by Walker (1953).

Argiallagma pallidulum

These damselflies may be confused in the field with *Nehalennia* species as the greenish bronze thoracic dorsum and body size in each are similar. Habitats with dense emergent vegetation appear to be favored. The species is endemic to Florida, occurring north to Levy Co. The larva is undescribed.

Nehalennia

The greenish-bronze thoracic dorsum occurs in both sexes of both species, but differences in color patterns of the 8th abdominal segment identify males, and females are distinguished by structure of the hind lobe of the prothorax. Abdominal appendages in males are small and hard to see.

KEY TO MALES

1 a) Dorsum of abdominal segment 8 blue with narrow transverse stripe of greenish black on base; abdominal segment 9 and 10 entirely blue; inferior abdominal appendages with one tooth directed rearward in lateral view (Fig. 13G) ..... *gracilis*

b) Dorsum of abdominal segment 8 greenish black with narrow, transverse stripe of blue on apex; abdominal segment 9 and 10 blue with distinct dorsal or lateral black markings; inferior abdominal appendages with a serrated posterior border in lateral view (Fig. 13F) ..... *integricollis*

KEY TO FEMALES

1 a) Posterior margin of prothoracic hind lobe in dorsal view distinctly bilobed (Fig. 13I) ..... *gracilis*

b) Posterior margin of prothoracic hind lobe in dorsal view evenly convex without indentation (Fig. 13H) ..... *integricollis*

The nehalennians are small (body lengths averaging 28 to 30 mm) and may be confused with *Argiallagma* and possibly with certain

color stages of *Anomalagrion.* Lentic habitats with emergent vegetation are associated with highest population densities.

Distribution data are:
N. gracilis: Alachua and Suwannee Counties.
N. integricollis: south to Glades County.

Walker (1913, 1953) described the larva of *gracilis.* The larva of *integricollis* remains undescribed.

Neoerythromma cultellatum

Males have a whitish-yellow facial pattern that may serve as a field trait, but females may be confused with some enallagmas. The species has been found only in Dade Co. (Paulson, 1965). Garcia-Diaz (1938) described the larva of *cultellatum* from material collected in Puerto Rico.

Teleallagma daecki

This damselfly is distinguished by its long abdomen, greater than 34 mm in length, and rather pale body colors. Males are pale blue, females are brown to greenish-yellow and both sexes have reduced dark stripe patterns. *Enallagma pallidum* is somewhat similar in general appearance; otherwise the large size of *daecki* separates it from other coenagrionids. Their perching habit and color pattern eliminate confusion with lestids. Their preferred habitat seems to be margins of swamps and weedy lentic waters. The species occurs south to Highlands County.

Needham (1904) described the larval stage of *Ischnura ramburi* erroneously as that of *T. daecki,* which is still undescribed.

Telebasis byersi

Males are readily recognized by their bright red abdomen and females are identified by their characteristically notched dorsal thoracic stripe. Weedy ponds and sluggish stream margins appear to be favored habitats. The species occurs south to Collier County. Westfall (1957) described the larva.

Discussion

Comparing Byers' records of 1930 with current observations shows

damselfly distribution in Florida has changed considerably over the past 40 years. For example Byers failed to find *Argia sedula* in Alachua County, where he did his most intense collecting and where it is now common. Byers cited questionable Florida records for *Enallagma civile, E. cyathigerum, E. exsulans, Nehalennia irene,* and *Argia translata;* the intervening years have confirmed the presence only of *E. civile. Lestes inequalis, L. rectangularis, Enallagma basidens, Ischnura kellicotti* and *Neoerythromma cultellatum,* unrecorded and unsuspected in 1930, were added later to the Florida fauna.

Two species unknown to Byers were described later from Florida. Westfall (1943) discovered *Enallagma davisi* 13 years after Byers' work. Williamson & Williamson (1930) first reported *Telebasis* from Florida questionably as *salva;* Westfall (1957) described the Florida population as a distinct species, *byersi.*

Only two species Byers (1930) reported, *Nehalennia gracilis* and *Enallagma traviatum,* have not been obtained here since. Apparently no Florida specimens of *E. traviatum* are currently available, but Byers' specimens of *N. gracilis* are in the Florida State Collection of Arthropods and their diagnosis has been reconfirmed.

Nomenclature problems may arise in referring to earlier literature, and the most likely cases are clarified below. The names *Agrion,* Agriidae, Agrionidae and Coenagriidae are frequently substituted for *Calopteryx,* Calopterygidae and Coenagrionidae respectively. This paper follows Montgomery's (1954) analysis. *Calopteryx apicalis* and *C. dimidiata* were described by Burmeister (1839) and separated by color pattern differences now considered as intraspecific variation. The two taxa have never been synonymized and usage has favored *dimidiata,* originally recognized for the southern (Florida) type. Although *C. apicalis* has page priority in the original description, we have retained *dimidiata* pending a formal taxonomic change. A similar case apparently occurs with *Enallagma laurenti* and *E. vesperum.* Both species were described by Calvert (1919) and separated by differences often observed in intraspecific variation, but the two names have never been formally synonymized. The name *laurenti* was given for southern (Florida) populations and has page priority in the original description, but it has rarely appeared in the literature since Byers (1930). Usage has favored *vesperum* and this policy is followed here pending a formal taxonomic change. *Argiallagma pallidulum* was treated as *Nehalennia* in Needham and Heywood (1929) and as *A. minutum* in Byers (1930). *Neoerythromma* is grouped with *Enallagma* by Needham and Heywood

(1929) and *Teleallagma* is treated with *Enallagma* by Byers (1930). Species names have also undergone minor spelling variations with usage. Earlier taxonomic history can be traced from the sources cited above in addition to Fraser (1957).

All species listed as unknown in the larval form have been reared (excepting *Argiallagma pallidulum* and *Lestes inequalis*), and the material is in the Florida State Collection of Arthropods awaiting description. Larvae and exuviae associated by supposition with *Argiallagma pallidulum* and *Lestes inequalis* respectively are also available.

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1964. Style manual for biological journals. (Second Edition)
Amer. Inst. Biol. Sci., Washington. 117 pp.

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