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BANISTERIA

A JOURNAL DEVOTED TO THE NATURAL HISTORY OF VIRGINIA



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BANISTERIA

A JOURNAL DEVOTED TO THE NATURAL HISTORY OF VIRGINIA

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Number 4, 1994

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A Preliminary Checklist of the Damselflies of Virginia, with Notes on Distribution and Seasonality (Odonata: Zygoptera)

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Virginia has a diverse fauna of aquatic insects, although much additional inventory is needed to fully catalog this diversity. Species new to science continue to be discovered in the state (e.g., Kondratieff & Kirchner, 1994). The aquatic groups treated in the "Insects of Virginia" series to date are limited to the true bugs and several families of beetles and flies (Bobb, 1974; Gladney & Turner, 1969; Matta, 1974, 1976; Michael & Matta, 1977; Pechuman, 1973). Species checklists have been compiled for the stoneflies (Kondratieff & Voshell, 1979; Kondratieff & Kirchner, 1987), mayflies (Kondratieff & Voshell, 1983), caddisflies (Parker & Voshell, 1981), and dragonflies (Carle, 1978, 1979, 1982) of the state. The present contribution is the first attempt to publish a comprehensive list of the damselfly species known from Virginia. Carle (1988) compiled a checklist of 51 species which was not published.

Compared to dragonflies, the damselfly fauna of Virginia has received little attention in the past. Literature pertaining in whole or part to the Zygoptera of the state is very limited. I have been unable to find as many as ten references which discuss this element of the state's fauna to any degree. Most of the references that I found are listed in Table 1. The only other paper of note is that by Kennedy (1977). I did not have an opportunity to consult the unpublished thesis of Davis (1938) while preparing this manuscript. However, I reviewed the catalogs of Calvert (1893), Hagen (1861, 1875), and Muttkowski (1910), as well as books by Dunkle (1990), Needham & Heywood (1929), and Walker (1953) for any mention of Virginia damselfly records. It is important to note that the "Berkeley Springs, Virginia" locality which Hagen (1861) listed for seven species (it is the type locality for several of them) is now part of Morgan County, West Virginia. Although this change in Vir-

ginia's boundaries occurred in 1862 (R. L. Hoffman, pers. comm.), subsequent authors (e.g., Muttkowski, 1910; Needham & Heywood, 1929) failed to account for it in their range descriptions for several species. Valid Virginia records have since been published for all but one (*Ischnura prognata*) of these species.

The following annotated checklist of the state's damselfly fauna should be considered as preliminary. I have not conducted an exhaustive search of available collections in preparing this list. In addition to published records, my sources are primarily limited to the collection of the United States National Museum of Natural History, Washington, D.C. (abbreviated as USNM hereafter) and specimens collected statewide from 1988-1994 by the zoological staff of the Division of Natural Heritage (DNH). Only adult damselflies in these two collections were examined by me. Most USNM specimens were collected by the sister and brother team of Bertha P. Currie and Rolla P. Currie during the early part of this century. The majority of their collections were made at Great Falls in Fairfax County. Many of these records were included in Donnelly (1961). At various times during the past quarter century, Oliver S. Flint, Jr., current curator of neuropteroid insects at the USNM, has collected Odonata in Virginia, making several significant discoveries in the process. Recent Malaise trap collections from Clarke and Essex counties were obtained by David R. Smith during trapping for sawflies.

The DNH reference collection has grown considerably during the past three years, particularly through my own efforts, and more recently, those of Christopher S. Hobson. Rather surprisingly, it contains a greater number of species from Virginia than does the USNM collection (Table 1). Surveys by DNH staff have generally emphasized natural ponds and boggy habitats, with less effort

directed towards lotic environments and swamps. Man-made lakes and ponds, as well as eutrophic natural habitats, have received little of our attention. Specimens obtained by DNH staff have been identified using the following references: Carpenter (1991), Dunkle (1990), Garman (1927), Johnson & Westfall (1970), Needham & Heywood (1929), and Walker (1953). I have reconfirmed all of these determinations during the process of preparing this paper. Additional sources used in compiling the present list were a small number of specimens collected (1948-present) by Richard L. Hoffman, and selected records of uncommon or rare species provided to DNH by Frank L. Carle. Table 1 summarizes the records obtained from most of these sources.

The checklist is arranged alphabetically by species within each family. Scientific names follow Garrison (1991), except for the spelling of the specific epithet of *Enallagma daeckii*. I retain the original spelling of Calvert (1903), while acknowledging that the species was named for a Mr. V. A. E. Daecke, collector of the holotype. I also diverge from Garrison (1991) in recognizing Hagen rather than Selys as the author of *Chromagrion conditum* (originally described as *Erythromma conditum*), because this agrees with all other references except Soltesz (1991) that I have consulted.

I have not attempted to provide a comprehensive listing of localities for each species nor attempted to analyze their geographic distribution patterns within the state. The reader is referred to Hoffman (1969) and Woodward & Hoffman (1991) for discussions of the state's physiographic provinces. Seasonality data should be treated as the minimum duration of the flight period in Virginia because of the limited number of specimen records that I have examined. Species indicated by a "+" apparently have not been previously reported from Virginia, although they were presumed to occur in the state on the basis of the range descriptions provided by Dunkle (1990), Needham & Heywood (1929), and Walker (1953), or the continental range maps contained in A. F. Beatty & G. H. Beatty (1971). Other species which I believe are being reported from Virginia for the first time are indicated by an "*".

CALOPTERYGIDAE

This family is represented in Virginia by two genera and seven species. All of these species are associated with flowing water. Available records indicate that only two of them are common in the state.

**Calopteryx aequabilis* Say 1839

This northern species was not reported from Virginia in Johnson's (1974) review of the geographic distribution patterns of the members of this genus. The nearest localities plotted on his range map are in central Pennsylvania. Shiffer (1985a) also did not include Virginia within the known range of *C. aequabilis*. Howe (1921) mentioned that an old record from Virginia had been expunged. Presumably this refers to Hagen's (1875) discussion of a female specimen of *Calopteryx virginica* Drury, which he determined was a synonym of *C. maculata* (Beauvois) rather than *C. aequabilis* Say. Carle (1988) listed five records for this species in Virginia, but I have not seen these specimens and do not know the counties in which they were collected. The sites are in the northwestern part of the state (F. L. Carle, pers. comm.). Both the DNH and USNM collections lack Virginia records of this species. The flight period of *C. aequabilis* is early to mid-summer (Montgomery, 1947), but no dates are available to me for Virginia. The preferred habitat is rocky, spring-fed streams and small rivers (Shiffer, 1985a).

Calopteryx amata Hagen 1889

This northern species was not reported from Virginia by Johnson (1974), although the USNM has specimens collected prior to that date. The only published records for this species in Virginia are two sites included in Carle's (1989) range map. One of these sites appears to be in Alleghany or Bath County, the other in Highland County. I have no information on the former site, but am aware of the following records from Highland County: Laurel Fork at Route 642, 3 July 1971, O. S. Flint, Jr., 3 males (USNM); Jackson River, 1.6 km N of Mustoe, 23 June 1978, F. L. Carle, 2 males, 1 female (Carle collection). The single record listed in Carle (1988) refers to the latter site. Additional surveys in western Virginia should yield more locations for this species, because it occurs at several sites in the mountains of western North Carolina and eastern West Virginia (Johnson, 1974). The preferred habitat is cold, shallow, rocky rivers. The species typically flies during early summer. Virginia flight dates extend at least from 23 June to 3 July. Beatty & Beatty (1970) reported possible communal oviposition in *C. amata*.

**Calopteryx angustipennis* (Selys, 1853)

This Appalachian species was not reported from Virginia

by Johnson (1974) or Tennessen (1979), although Richard Hoffman first collected it in Alleghany County in 1951 (material in INHS). Subsequent records indicate that *C. angustipennis* is widespread but local in the western mountains of the state. The records known to me are from Alleghany, Botetourt, Craig, Culpeper, Rockbridge, and Russell counties. Capture dates of Virginia specimens range from 25 May to 10 July. This species inhabits riffle areas of rocky rivers where sand and gravel predominate (Tennessen, 1984). It is the only species of *Calopteryx* which lacks any trace of brown or black markings on its wings.

Calopteryx dimidiata Burmeister 1839

Johnson (1973b, 1974) listed Virginia records only from Fairfax and Powhatan counties. This species is broadly distributed in the Coastal Plain and Piedmont physiographic regions of North Carolina (Johnson, 1974). More recent records from Appomattox, Bedford, Brunswick, Caroline, Culpeper, Dinwiddie, Greensville, Henrico, and Patrick counties reveal that *C. dimidiata* has a similar range in Virginia. The preferred habitat is sandy streams and small rivers. The flight period in Virginia extends from at least 18 May to 9 August. In North Carolina, it continues until early October (Paulson & Jenner, 1971).

Calopteryx maculata (Beauvois, 1805)

This very common species, which is easily recognized by its completely black wings (females have white stigmas), has been known from Virginia for more than a century (Hagen, 1875). Although subsequently recorded from only four counties by Johnson (1974), it probably occurs in every county of the state because it is found from very small streams (preferred habitat) to medium-sized rivers. I am aware of at least 20 additional counties in Virginia where *C. maculata* has been documented, including Accomack County on the Delmarva Peninsula. Carle (1988) tallied more than 100 sites in the state for this species. It has the longest flight period of the genus (Montgomery, 1947), extending from at least 21 May through 6 October in Virginia. The breeding behavior of the species has been studied more extensively than that of any other North American damselfly (Alcock, 1983; Forsyth & Montgomerie, 1987; Waage, 1979, 1984; and numerous references in Bick & Bick, 1980).

Hetaerina americana (Fabricius, 1798)

The ruby-spot has been known from Virginia for nearly a century (Williamson, 1903), and is much more common here than the following species. Johnson (1973a) reported *H. americana* from twelve counties, all but one (Prince George) being in the northern or western parts of the state. Matta (1978) did not include it in his list for southeastern Virginia, but DNH staff have recently found it along the Nottoway River on the Greensville-Sussex County line. Additional new county records (Albemarle, Augusta, Botetourt, Carroll, Grayson, Page, Rockbridge, and Rockingham) confirm that it is widespread in the northern and western regions of the state. This species has an extended flight period (Montgomery, 1947). In Virginia, it ranges from at least 31 May to 4 November. This attractive species is typically found along large streams and rivers with moderate to fast current. Males are easily recognized by the presence of a ruby spot near the base of their clear wings. The head and thorax are metallic red and the abdomen is metallic green.

Hetaerina titia (Drury, 1773)

This is a southern species which is uncommon in Virginia. It has been known from the state for nearly a century on the basis of specimens collected along the Clinch River in Tazewell County (Williamson, 1903). Gloyd (1951) later captured it in Henrico County. Johnson (1973a) reported only these two Virginia localities in his geographic distribution study of this species. The USNM has more recent specimens from the New River in Carroll and Grayson counties in southwestern Virginia. Chris Hobson and I have collected *H. titia* along the Nottoway River straddling the Brunswick-Dinwiddie County line in the southeastern part of the state. Frank Carle (pers. comm.) has also found this species along the Nottoway River. Both species of *Hetaerina* can be found along the Clinch, New, and Nottoway rivers in Virginia. The flight period of *H. titia* in the northern part of its range is considerably shorter than that of *H. americana* (Montgomery, 1947), being restricted to the fall months. Virginia collection dates known to me range from 18 August to 23 September.

LESTIDAE

This family is represented in Virginia by two genera and ten species. All of the *Lestes* species are typically

associated with standing water, particularly ponds. *Archilestes* also prefers still or slow-moving water, especially willow or alder-lined sections of small streams (Usinger, 1956). The members of this family are commonly referred to as spreadwings, owing to the fact that their wings are partially spread when at rest, which is atypical of most damselflies. Only two species appear to be common in Virginia.

Archilestes grandis (Rambur, 1842)

Kennedy (1977) published the first Virginia records for this large species, which has spread eastward across the continent in the past half century. The first Virginia specimen was collected in Charlottesville in October, 1947 by Richard Hoffman (Kennedy, 1977; R. L. Hoffman, pers. comm.). The only additional Virginia records listed by Kennedy were from Fairfax and Montgomery counties. Carle (1988) listed three sites for the state, presumably referring to these same records. Chris Hobson and I recently discovered a population of *A. grandis* in Scott County. This species has a fall flight period, the range of dates of Virginia specimens being 20 August to 14 October (Kennedy, 1977).

+*Lestes congener* Hagen 1861

This is a small boreal species which approaches the southern limits of its range in Virginia. The continental range map prepared by A. F. Beatty and G. H. Beatty (1971) seems to indicate that *L. congener* is widespread in the state, but the scale of their map makes this difficult to ascertain. With the exception of this map, I am not aware of any previously published records for this species from Virginia. Carle (1988) was not aware of any Virginia records, although Richard Hoffman first collected it in the state (Alleghany County) in 1952 (material in INHS). The USNM and DNH collections reveal that it has since been recorded (all USNM specimens are post-1971) from the following counties: Augusta, Bath, Caroline, Clarke, Highland, and Scott. Tarter (1976) listed only two county records (Preston and Raleigh) for West Virginia. Tennesen (1979) mentioned the capture of a single male in Alabama, but it has not been reported from the Carolinas (Huggins & Brigham, 1982). The flight period of this species is primarily during the fall months (Montgomery, 1948). The collection dates of mature specimens taken in Virginia range from 11 September to 23 October. This species was common at the Augusta County site on 21

October, suggesting that some individuals may survive into November. This appears to be the latest emerging damselfly in Virginia. However, the USNM has a teneral male from Clarke County that was collected in a Malaise trap during the period of 15-24 June, indicating that some individuals emerge in mid-summer. The preferred habitats of *L. congener* are small ponds and vernal pools.

Lestes disjunctus Selys 1862

Both of the recognized subspecies inhabit Virginia. The nominate form has a northern distribution which barely extends into the state. It is known from Bath, Giles, Highland, and Prince William counties. I observed this subspecies in abundance on 6-7 September in the Locust Springs area of northwestern Highland County. Its flight period extends from mid-summer into the fall. Virginia specimens seen by me were collected between 3 July and 12 September. *Lestes disjunctus australis* Walker 1952 has a more southern distribution and is widespread in Virginia. I collected one male in the Locust Springs area on 19 June, suggesting that the two subspecies may be syntopic at this site, with the nominate form predominating. The flight period of *L. d. australis* in Virginia is much longer than that of *L. d. disjunctus*, extending from early April (4-15 April Malaise-trapped specimens in USNM) through at least 5 October. The preferred habitat of both subspecies is vegetated ponds.

**Lestes dryas* Kirby 1890

This metallic green species has a northern distribution, occurring in Asia and Europe as well as North America (Walker, 1953). Its range barely extends into Virginia. Carle (1988) listed one record for the state, but I am not aware of the county or date of this collection. The nearest published records are from Bell County, Kentucky (Resener, 1970); Baltimore, Maryland (Fisher, 1940); and Mineral and Ritchie counties, West Virginia (Tarter, 1976). The Kentucky county borders Lee County, Virginia, in the extreme southwestern corner of the state. *L. dryas* also occurs in Tennessee (Walker, 1953). The flight period typically spans the summer months (Donnelly, 1992; Walker, 1953). The preferred habitats are bogs and small ponds (Donnelly, 1992).

Lestes eurinus Say 1839

This is a large northern species which is near the south-

ern limit of its range in Virginia. The species was first reported from the state by Dunkle (1983), although it had been collected as early as 1974 by Frank Carle. It seems to prefer mountain ponds in Virginia, including some that are man-made in origin. The North Carolina population studied by Lutz (1968) inhabited a small impoundment. I am aware of records from the following counties in Virginia: Alleghany, Amherst, Augusta, Giles, Highland, Prince William, Rockingham, and Scott. *L. eurinus* has a relatively short flight period in early summer (Montgomery, 1948). Virginia collection dates range from 25 May to 2 August, although the majority of the specimens have been taken in July. This species is easily distinguished from its congeners in Virginia by its large size and amber-yellow wings.

Lestes forcipatus Rambur 1842

This species was originally reported from the state more than a century ago (Calvert, 1890). However, because it is easily confused with both subspecies of *L. disjunctus*, particularly *L. d. australis*, it is possible that these specimens were misidentified. Walker (1952, 1953) provided several characters for separating these three taxa. *L. forcipatus* seems to be somewhat local in occurrence in Virginia. Carle (1988) knew of nine sites in the state. The only USNM records are recent collections from Clarke County. DNH records are limited to several sites in the Shenandoah Valley region of Augusta County. This species flies during the summer and fall months (Montgomery, 1948). The few Virginia records available to me range from 25 May to 21 October. I found only one female on the latter date at a site where this species was abundant on 26 September.

Lestes inaequalis Walsh 1862

This species also seems to be uncommon in Virginia. Carle (1988) listed only three records for the state. All USNM specimens were collected in 1914 in Arlington and Fairfax counties. Donnelly (1961) indicated that he did not find *L. inaequalis* in this area during his surveys. I have found it at several ponds and swamp edges in Accomack, Caroline, Prince George, and Surry counties. Other DNH records are from Fairfax and Isle of Wight counties. All of the above counties are in the Coastal Plain or extreme eastern edge of the Piedmont, although the range map prepared by A. F. Beatty & G. H. Beatty (1971) indicates a statewide distribution for this species.

The flight period in Virginia extends from at least 2 June to 25 August. Males are easily identified by the fact that their inferior appendages are conspicuously longer than the superior ones.

Lestes rectangularis Say 1839

This species is widespread in Virginia, probably occurring in every county of the state. It has an exceptionally long abdomen. The flight period is relatively long, spanning the summer and fall months (Montgomery, 1948). In Virginia, it extends from at least 25 May to 30 September.

**Lestes vidua* Hagen 1861

This southern species reaches its northern range limit in Virginia, where it is apparently very rare. The USNM collection contains a female specimen obtained by Donald R. Davis, current curator of microlepidoptera, at an unspecified location in Virginia Beach on 21 September 1974. The capture site was probably in either Fort Story or Seashore State Park (D. R. Davis, pers. comm.). This is the only Virginia record of this species known to me. Matta (1978) did not find *L. vidua* in the southeastern corner of the state. This species is very similar to *L. disjunctus australis* (Dunkle, 1990). The eyes and face (labrum) are purple in *L. vidua* males but blue in those of *L. d. australis*. The preferred habitat is grassy ponds (including temporary ones), where these two species often occur syntopically in Florida (Dunkle, 1990).

Lestes vigilax Hagen in Selys 1862

This species seems to be somewhat uncommon in Virginia. The USNM contains only older specimens from the City of Suffolk that were reported by Gloyd (1951), and very recent material from Prince William County. Matta (1978) recorded *L. vigilax* from Sussex County. Carle (1988) listed only five sites for the state, but DNH staff have recently found it in abundance at about two dozen acidic beaver ponds in Caroline County. I have also encountered this species at ponds and small lakes in Augusta, Cumberland, Dinwiddie, Giles, Highland, and Sussex counties, as well as in a swamp that straddles the Greenville-Sussex county line. The flight period in Virginia ranges from at least 25 May to 21 October. Dunkle (1990) indicated that this species prefers acidic environments.

COENAGRIONIDAE

This family is represented in Virginia by six genera and 36 species. The various species utilize a wide variety of aquatic habitats. Members of the genus *Enallagma* are commonly known as bluets, although several of the species found in Virginia possess little or no blue coloration. This genus accounts for one-third of the total number of species known from the state.

Amphiagrion saucium (Burmeister, 1839)

This dainty reddish species is rather local in occurrence, typically being associated with boggy seepage habitats. Adults fly close to the ground, usually remaining in or near the shelter of grasses and sedges. Published records for Virginia are in Gloyd (1951), Donnelly (1961), and Matta (1978). Carle (1988) tallied 12 Virginia sites. Richard Hoffman has collected the species in Albemarle, Alleghany, Bedford, and Dickenson counties. I have taken it in Grayson, Highland, and Montgomery counties. The USNM has specimens from Arlington, Fairfax, and Highland counties. These records indicate that *A. saucium* is widespread (but local) in the state. I have found it in two seepage headwater streams (both at 4800 feet, or 1463 m) near the base of Mount Rogers, the state's highest peak (5729 feet or 1746 m). This species has a relatively long flight period in Virginia, as indicated by my personal collection dates, which range from 10 May to 1 September. The latter is apparently among the latest capture dates for *A. saucium*, as it exceeds published dates in Carpenter (1991), Donnelly (1961, 1992), Fisher (1940), Garman (1927), Kormondy (1958), Montgomery (1944), Paulson & Jenner (1971), Walker (1953), White & Morse (1973), and White et al. (1983). The only reference that I have found which reports a later record is Beatty et al. (1969). Their flight period graph does not show any September records, but indicates that one to several individuals of this species have been found in early October in Pennsylvania.

Argia apicalis (Say, 1839)

This is a common stream, river and pond-dwelling species of widespread occurrence in Virginia. It has been known from the state for more than a century (Calvert, 1893) and probably occurs in a majority of its counties. The flight period spans the summer and early fall months (Montgomery, 1944). In Virginia, it extends from at least

30 May to 23 September. Females exhibit several color morphs (Dunkle, 1990).

Argia bipunctulata (Hagen, 1861)

This species is very local in occurrence, preferring open (sunny), boggy seepage habitats (Dunkle, 1990). Its small size and color pattern are much more similar to several species of *Enallagma* than they are to its congeners in the state. Adults fly close to the ground. Published records for *A. bipunctulata* in Virginia apparently are limited to those of Shiffer (1985b) and Roble & Stevenson (1994), although the only USNM specimens were collected in Essex County nearly a century ago (1899). Carle (1988) was aware of six Virginia sites. Chris Hobson and I have collected this species at eight sites in Accomack, Caroline, and Scott counties, indicating that it is apparently widespread (but very local) in Virginia. The elevations of these sites range from sea level to 2900 feet (884 m). Several of the populations that we discovered appear to be quite small, possibly containing fewer than 50 adults. My personal collection dates range from 8 July to 4 October. The latter date is apparently rather late for this species because it exceeds published dates in Donnelly (1961), Dunkle (1990), Paulson & Jenner (1971), Shiffer (1985b), Soltesz (1991), and White et al. (1983). The nearest published dates known to me for *A. bipunctulata* are in Williamson (1934). He collected this species on 28-29 September and 3 October in Georgia. The latest record in the USNM is for a male collected on 29 September in Hyattsville, Maryland.

Argia fumipennis violacea (Hagen, 1861)

This common species is typically associated with flowing water of some sort, including streams, small rivers, and pond or lake outlets (e.g., beaver dams). It is widely distributed in Virginia, ranging from Accomack County on the Eastern Shore to Lee County in the extreme southwestern corner, and probably occurs in every county of the state. It has been known from Virginia for more than a century (Calvert, 1893). The flight period of this species spans the summer and early fall months (Montgomery, 1944). In Virginia, it extends from at least 14 May to 4 October.

Argia moesta (Hagen, 1861)

This common species prefers swift-flowing streams and

rivers. Adult males typically perch on rocks in mid-stream. It has been known from the state for nearly a century (Williamson, 1903, reported as *Argia putrida*) and is widely distributed. Carle (1988) listed 28 sites. The flight period spans the summer and early fall months (Montgomery, 1944). In Virginia, it extends from at least 14 May to 24 September. Females exhibit two color morphs (brown and blue).

Argia sedula (Hagen, 1861)

This species is typically associated with small to medium-sized rivers. It has been known from the state for nearly a century (Williamson, 1903) and is relatively common. Carle (1988) was aware of 13 sites. Its flight period in Virginia extends from mid-June to mid-October (Donnelly, 1961).

Argia tibialis (Rambur, 1842)

This rather common species is typically associated with small to medium-sized rivers. I have also collected it at a beaver pond, as well as Lake Drummond in the Dismal Swamp (also USNM records). Carle (1988) reported 13 sites for this species in Virginia. The flight period spans the summer and early fall months (Montgomery, 1944). In Virginia, it extends from at least 30 May into September (Donnelly, 1961). Females exhibit two color morphs (brown and blue).

Argia translata Hagen in Selys 1865

This species inhabits ponds, lakes, and slow streams with shady borders (Walker, 1953). I have also found it along small to medium-sized rivers, particularly those with gravelly substrates. *Argia translata* has been known from Virginia for nearly a century (Williamson, 1903). It ranges south into South America (A. F. Beatty & G. H. Beatty, 1971). This is a common, late-season species in the vicinity of Washington, D.C. (Donnelly, 1961). Carle (1988) knew of 15 Virginia sites, but USNM records are limited to Bath and Fairfax counties. I have collected *A. translata* in Augusta, Bath, Page, Rockbridge, and Smyth counties. It appears to be restricted to the northern and western counties of Virginia. Matta (1978) did not report this species from the southeastern portion of the state. The flight period in Virginia extends from at least 8 July to 15 September. I found *A. translata* on 29 July along the South Fork of the Shenandoah River in Page County in

association with *Argia apicalis*, *A. moesta*, *A. sedula*, *Enallagma exsulans*, and *Hetaerina americana*.

Chromagrion conditum (Hagen, 1876)

This species is widespread but rather local in occurrence, preferring spring-fed or boggy ponds and streams. Howe (1921) and Donnelly (1961) reported this species from Great Falls. Matta (1978) found *C. conditum* in Sussex County, and Richard Hoffman has collected it in Alleghany County. Carle (1988) listed 12 sites for the state. USNM records are from Clarke, Dickenson, Fairfax, Floyd, Highland, and Washington counties. DNH records are from Augusta, Caroline, Lee, and Scott counties. The blue and black males are easily recognized by the presence of a bright yellow spot on the side of the thorax. Females have a similar but paler mark. The flight period of this species is quite early, extending from at least 25 April to 1 July in Virginia.

Enallagma aspersum (Hagen, 1861)

This species is widespread and relatively common in Virginia. It has been known from the state for more than a century (Calvert, 1890). Tim Vogt (pers. comm.) discovered an enormous population (approximately 3000 adults estimated) on 25 May 1991 at a sinkhole pond in Augusta County. The flight period in Virginia extends from late April or early May (29 April–9 May, Malaise-trapped specimen in USNM) until at least 26 September. The preferred habitat is ponds.

Enallagma basidens Calvert 1902

This is a Midwestern species which has spread eastward during the past half century (Cannings, 1989; Dunkle, 1990; Huggins, 1978b). It was first reported from Virginia by Donnelly (1961) and is now apparently fairly well established in the state. Carle (1988) listed 12 sites. Voshell & Simmons (1978) recorded *E. basidens* at the Lake Anna reservoir within a year of its creation. USNM records are limited to recent collections in Shenandoah County. I have collected this species in Augusta, Grayson, and Prince William counties. The flight period extends from late spring to early fall (Montgomery, 1942). Capture dates in Virginia range from at least 5 June to 21 October. Dunkle (1990) stated that females exhibit three color morphs.

Enallagma civile (Hagen, 1861)

This species is widespread and abundant in Virginia, probably occurring in every county. It has been known from the state for more than a century (Calvert, 1893). *E. civile* has a very extensive range, stretching from southern Canada to northern South America (Dunkle, 1990). It inhabits a wide variety of ponds. Daigle (1991) reported that its presence can be indicative of very low oxygen levels and possible organic pollution. It has a prolonged flight period (Montgomery, 1942). Flight dates in Virginia range from at least 8 May to 21 October.

**Enallagma cyathigerum* (Charpentier, 1840)

This is a northern circumpolar species which inhabits North America, Europe, and Asia (Donnelly, 1989; Montgomery, 1942). It has the widest distribution of any New World *Enallagma* (Needham & Heywood, 1929) and is the type species of the genus. The nominate subspecies is found in Canada and the northern United States, barely extending into Virginia. The subspecies *E. c. vernale* Gloyd 1943 (synonymized by Donnelly (1989) but still considered a full species by many odonatologists) may eventually be found in the state. The flight season of *E. c. cyathigerum* is limited to a brief period in early to mid-summer (Montgomery, 1942). All Virginia records known to me are from extreme northwestern Highland County: George Washington National Forest, Locust Spring Picnic Area beaver ponds, 3-4 July 1971, O. S. Flint, Jr., 1 male (USNM); 1 July 1972, C. M. and O. S. Flint, Jr., 1 male (USNM); 19 June 1992, S. M. Roble, 3 males, 1 female (DNH). Frank Carle (pers. comm.) has also collected it at this site. The preferred habitat is marshy ponds.

+ *Enallagma daeckii* (Calvert 1903)

This elongate southern Coastal Plain species appears to be uncommon in Virginia. Carle (1988) listed only three sites for the state and the USNM lacks Virginia specimens. I have collected it at nine sites in Accomack, Caroline (mostly), and Prince George counties between 31 May and 12 August. I observed nearly 300 adults at one site on 8 July. Dunkle (1990) stated that the preferred habitats in Florida are swamps, shady ponds, and vegetated stream backwaters. Most of my sites are acidic beaver ponds with limited canopy cover. The nymph was described fairly recently (Huggins, 1984), but the breeding

behavior remains unknown (Dunkle, 1990). I found mating pairs of *E. daeckii* during the late morning and early afternoon hours on 2, 8, and 28 July, but did not observe oviposition. The pairs were resting on emergent or shoreline vegetation, including various grasses, bur-reed (*Sparganium* sp.), and lizard's tail (*Saururus cernuus*).

Enallagma divagans Selys 1876

This species is widespread and fairly common in Virginia. Published records include Donnelly (1961) and Matta (1978). Carle (1988) was aware of 22 sites, but USNM records are limited to Great Falls (Fairfax County) and Lake Drummond in the Dismal Swamp (City of Suffolk). The only DNH collections (both obtained by Chris Hobson) are from Caroline and Lee counties. The flight period is apparently limited to a brief span in early summer (Montgomery, 1942). Virginia records range from 14 May to 24 June.

Enallagma doubledayi (Selys, 1850)

This species ranges in the coastal states from Massachusetts to Florida and west to Louisiana (Carpenter, 1991; Dunkle, 1990). It has also been reported from Kentucky and Ohio (Montgomery, 1967; Resener, 1970). Although Needham & Heywood (1929) state that this is one of the most common damselflies in the southern United States, it appears to have a spotty distribution in Virginia. Carle (1988) listed 11 sites, but the USNM lacks specimen records. Matta (1978) failed to find *E. doubledayi* in the southeastern portion of the state. The only published record for Virginia is in Gloyd (1951). She reported that a male was collected on 15 April in Blacksburg, Montgomery County. The only DNH specimen is a male that I obtained on 9 August in Augusta County. The color pattern of adult males is very similar to that of *E. civile*, but the postocular spots and anal appendages are diagnostic.

Enallagma dubium Root 1924

This is a southern Coastal Plain species which appears to be uncommon in Virginia. It ranges from Delaware to Florida and west to Texas and Oklahoma (Dunkle, 1990). The burgundy color of the adults is quite unusual for the genus. The species is somewhat difficult to detect in the field owing to its phantom-like appearance in flight. *E. dubium* was first reported from Virginia by Gloyd (1951),

who found it on 14 September 1934 near the Dismal Swamp in Nansemond County (now City of Suffolk). Matta (1978) failed to find this species in southeastern Virginia. Carle (1988) listed five sites and indicated that the preferred habitat is cypress swamps. The USNM lacks Virginia specimens. Chris Hobson and I have recorded *E. dubium* at five sites in Caroline County, all of which are acidic beaver ponds. Our collection dates range from 24 June to 27 September. Dunkle (1990) reported that adults generally retreat from the water by late afternoon.

Enallagma durum (Hagen, 1861)

This species is a coastal inhabitant, where it can often be found in abundance in brackish ponds and marshes. It has been known from Virginia for more than a century (Calvert, 1893). I am aware of records from Fairfax, Mathews, and Westmoreland counties, as well as the cities of Norfolk (Chesapeake), Suffolk, and Virginia Beach. *E. durum* is occasionally taken at inland freshwater ponds, as evidenced by recent specimens obtained by Nancy E. Adams of the USNM from Prince William Forest Park in Prince William County. The flight period in Virginia extends from at least 17 April to 19 October.

**Enallagma ebrium* (Hagen, 1861)

This is a northern species which barely reaches Virginia. Carle (1988) listed two sites for the state. It has been collected in Highland County (F. L. Carle, pers. comm.). I am not aware of any additional records from Virginia. The nearest published records are from Hickman County, Kentucky, and Baltimore County, Maryland (Fisher, 1940; Resener, 1970). The species was not listed for West Virginia by Tarter (1976). The flight period is early to mid-summer (Montgomery, 1942). I lack specific dates for Virginia specimens.

Enallagma exsulans (Hagen, 1861)

This species is typically found along rivers, although it occasionally inhabits shores of lakes and large ponds. It is widespread in Virginia, where it has been known for nearly a century (Williamson, 1903). Carle (1988) listed more than 50 sites. Its flight period extends from late spring to early fall (Montgomery, 1942). Virginia records known to me range from 14 May to 23 September.

Enallagma geminatum Kellicott 1895

This species is widespread but somewhat local in occurrence. It typically flies just above the water surface of ponds, particularly those with abundant stands of water lily. At a distance, males closely resemble those of *Ischnura kellicotti* in size and color. Both species often rest on water lily leaves. Its flight period extends from spring to fall (Montgomery, 1942). Capture dates in Virginia range from 30 April to 19 September.

Enallagma hageni (Walsh, 1863)

This is a northern species of very limited distribution in the mountains of western Virginia. It was first reported from the state by Dunkle (1983), although it had been collected as early as 1951 by Richard Hoffman. Virginia records are limited to Alleghany, Giles, Highland, and Washington counties. The flight period in the state extends from at least 12 June to 12 September. Males are nearly identical in color pattern to those of *E. ebrium* and very similar to those of *E. cyathigerum* (Walker, 1953). The anal appendages are diagnostic and can be used to distinguish all three species. Needham & Heywood (1929) stated that this is one of the most abundant damselflies in the northeastern United States and Canada.

+*Enallagma pallidum* Root 1923

This is a southern species that was originally discovered in Maryland (Root, 1923). It ranges north to Delaware, south to Florida, and west to Mississippi (Dunkle, 1990), but has not been previously reported from Virginia. The typical habitat is swampy lake shores (Dunkle, 1990). This species most closely resembles *E. daeckii*. It appears to be very rare in Virginia. I am aware of only one record for *E. pallidum* in the state: City of Suffolk, Feeder Ditch near Lake Drummond, Dismal Swamp, 26 May 1938, M. Davis-Ries, 4 males, 4 females (all teneral). This record may be listed in Davis (1938), and is the basis of Carle's (1988) lone site. The specimens are in the entomological collection of Virginia Polytechnic Institute and State University (F. L. Carle, pers. comm.). This is the only species included in the present checklist which has not, to my knowledge, been collected in the state during the past quarter century.

Enallagma signatum (Hagen, 1861)

This species is widespread and common in Virginia, inhabiting a variety of lakes, ponds, reservoirs, and slow-moving portions of rivers. It is semicrepuscular in its activity pattern. Males exhibit an orange and black color pattern. Dunkle (1990) reported that mature females in Florida are of three color varieties (blue, green, and orange). Teneral adults of both sexes are blue. Most of the females that I have noted in the field in Virginia were pale yellow. This agrees with the descriptions of females from Canada and Massachusetts (Carpenter, 1991; Walker, 1953). The flight period of *E. signatum* in Virginia ranges from at least 15 May to 27 September.

Enallagma traviatum Selys 1876

This species appears to be somewhat uncommon in Virginia. Although the published range map in Donnelly (1973) lacks Virginia records, it suggests that both of the currently recognized subspecies may occur in the state. The nominate subspecies occurs east of the Appalachians and *E. t. westfalli* Donnelly 1964 is found to the west (Donnelly, 1973). The Virginia records of Donnelly (1961) and Matta (1978), as well as my collections from Caroline and Prince Edward counties, undoubtedly refer to the nominate form. USNM specimens from Breaks Interstate Park in Dickenson County along the Kentucky border were recently determined as belonging to this subspecies also (R. C. Glotzhober, pers. comm.). Carle (1988) listed 12 sites under the name *E. t. westfalli*, but I do not know any of these locations nor have I had an opportunity to evaluate the subspecific status of these specimens.

The distribution of *E. traviatum* in southwestern Virginia is worthy of further study because this may be a zone of contact between the two subspecies. The flight period is early to mid-summer (Montgomery, 1942). Virginia collection dates range from 26 May to 9 July.

+ *Enallagma vesperum* Calvert 1919

This species is undoubtedly more common in Virginia than the relatively few available records suggest. Its crepuscular habits reduce the likelihood of its collection at an occupied site. Carle (1988) was aware of 11 sites from the state. The only USNM records are of old specimens from Great Falls. I have found *E. vesperum* in

Caroline County in the company of *E. geminatum* and *Ischnura kellicotti* at several beaver ponds with abundant water lilies. The flight period spans the summer and early fall months (Montgomery, 1942). Virginia collection dates range from 14 May to 12 August.

+ *Enallagma weewa* Byers 1927

This is a southern Coastal Plain species which ranges north to New Jersey, but appears to be rare in Virginia. Carle (1988) listed only one record for the state, but I do not know the county (presumably in southeastern Virginia) or date of this collection. I am not aware of any additional records from Virginia. This species prefers slow, shady streams and rivers, where it typically hides in shaded vegetation beyond the banks (Dunkle, 1990). Reported flight dates in other states are 25 February to 7 November in Florida (Dunkle, 1990), 21 April to 5 October in South Carolina (White et al., 1983), and 8 May to 4 October in North Carolina (Paulson & Jenner, 1971). Soltesz (1991) found it between 19 June and 27 August in Cape May County, New Jersey.

Ischnura hastata (Say, 1839)

This delicate little damselfly has been known from Virginia for more than a century (Calvert, 1890). It is locally common and widespread, probably occurring in every county of the state. However, its small size (this is the smallest species in the state), slow flight, and tendency to fly low to the ground render it somewhat inconspicuous in the field. I have found it in a wide variety of habitats, ranging from oligotrophic seepage wetlands to eutrophic brackish marshes. Daigle (1991) reported that its presence can be indicative of very low oxygen levels and possible organic pollution. *I. hastata* has one of the longest flight periods of any damselfly in the state, extending from at least 5 April to 30 October. It has been recorded between late March and mid-December in North Carolina (Paulson & Jenner, 1971). *I. hastata* ranges south into northern South America (Dunkle, 1990). Females change color as they mature, from predominately orange as juveniles to bluish black as adults. Until recently, this species was placed in its own genus (*Anomalagrion*) because males are unique among Zygoptera in that their forewing stigma does not touch the leading edge of the wing. Most odonatologists now regard this as a subgeneric character.

+ *Ischnura kellicotti* Williamson 1898

This southern species appears to be uncommon and local in Virginia. Carle (1988) knew of only one locality for the state, and the USNM lacks Virginia specimens. I have recorded it at six sites in Accomack, Caroline, and Dinwiddie counties. It is typically associated with ponds containing abundant populations of water lilies. Adults fly low over the water and perch on the lily pads. Successful capture usually requires wading or canoeing into a pond until you are in a stand of water lilies and then submerging your net while attempting to collect the adults (Calvert, 1898). The larvae reportedly live on the stems and undersides of water lily leaves (Huggins & Brigham, 1982). As noted previously, males are easily confused with those of *Enallagma geminatum* at a distance because of their similar size, coloration, and behavior. Females exhibit two color forms (orange and blue). I have observed *I. kellicotti* in Virginia between 31 May and 8 September.

Ischnura posita (Hagen, 1861)

The nominate subspecies is probably the most abundant and widely distributed damselfly in Virginia, undoubtedly occurring in every county of the state. It inhabits a wide variety of aquatic habitats, ranging from oligotrophic to eutrophic. Daigle (1991) reported that its presence can be indicative of very low oxygen levels and possible organic pollution. Males and juvenile females are easily recognized by the presence of an exclamation mark-like pattern on the thorax. Mature females become bluish gray and mostly lose this pattern. *I. posita* has a prolonged flight period (Montgomery, 1944). In Virginia, it extends from late March or early April to October. The USNM collection contains a male specimen that was collected in a Malaise trap between 26 March and 8 April. I have observed this species as late as 4 October, but suspect that it flies for at least several additional weeks.

Ischnura prognata (Hagen, 1861)

This is the largest and rarest species of *Ischnura* in Virginia. Juvenile females are predominately orange and black, becoming brown as they mature. However, the sides of the thorax are green in adult females. *I. prognata* is widespread but very local throughout its range in the eastern United States (Dunkle, 1990; Johnson & Westfall, 1970; White et al., 1983). The limited number of

records from Virginia suggest that it is rare in the state. The preferred habitats are shaded seepage areas and swamp edges (Dunkle, 1990). The species is difficult to detect in these habitats because of the poor light conditions and its phantom-like flight behavior (Dunkle, 1990). Hagen (1861) originally described *I. prognata* on the basis of a male from Berkeley Springs, Virginia, a locality which became part of Morgan County, West Virginia, upon secession of that state in 1861. Therefore, the inclusion of Virginia in range statements by Muttkowski (1910) and Needham & Heywood (1929) was in error. Tarter (1976) listed *I. prognata* only from Morgan County in his summary table for West Virginia. The current disposition of the holotype is unknown to me. It is not among the type material or many other Hagen specimens housed in the Museum of Comparative Zoology at Harvard University (P. D. Perkins, pers. comm.).

I am aware of only two subsequent records for *I. prognata* from within the current political boundaries of Virginia, neither of which have been published previously. A male specimen captured by Mary Davis-Ries on 25 May 1938 in Williamsburg is in the entomological collection of Virginia Polytechnic Institute and State University (F. L. Carle, pers. comm.). This record may be listed in Davis (1938), and is the basis of Carle's (1988) lone site. The most recent record dates from 12 July 1994 when I captured an adult female in a nearly dry bald cypress-tupelo swamp near Dendron in Surry County. Regrettably, the specimen escaped the following day as I was preparing to preserve it and was irretrievably lost. Despite two subsequent visits to this site during the following week, and five hours of intense searching, I was unable to secure a second specimen.

Ischnura ramburii (Selys, 1850)

This species is common in the coastal regions of the state where it is typically found in brackish marshes. I have collected or examined specimens from the coastal counties of Accomack, Lancaster, Mathews, Northampton, Northumberland, Westmoreland, and York, as well as the cities of Hampton and Virginia Beach. Chris Hobson and I have also collected it at several beaver ponds in Caroline and Fairfax counties. Carle (1988) tallied 17 sites for this species in the state and Matta (1978) reported it from Isle of Wight County and the City of Norfolk (Chesapeake). *I. ramburii* is very widespread in tropical America, ranging south to Chile (Donnelly, 1992; Dunkle, 1990).

Daigle (1991) reported that its presence can be indicative of very low oxygen levels and possible organic pollution. Females exhibit three color forms (Dunkle, 1990). The flight period in Virginia extends from at least 25 April to 14 October.

Ischnura verticalis (Say, 1839)

This species is very common and widely distributed in the northern and western counties of Virginia. It is apparently absent from the southeastern portion of the state, as there are no records in Matta (1978) or the DNH and USNM collections. *I. verticalis* inhabits a wide variety of freshwater habitats. It has a very long flight period (Montgomery, 1944), extending in Virginia from at least 6 April to 29 September.

+*Nehalennia gracilis* Morse 1895

All three species of *Nehalennia* which inhabit Virginia are small and delicate, with metallic greenish bodies. They fly low to the ground and are easily overlooked. All three are very local in occurrence, typically preferring boggy ponds. This species, which ranges from southern Canada to Florida, also inhabits grassy ponds (Dunkle, 1990). Carle (1988) listed only five sites for Virginia. The USNM lacks specimens from the state. The only DNH specimens were obtained by Chris Hobson on 16 June in Fairfax County. The unidentified *Nehalennia* reported from the North Anna River by Voshell & Simmons (1978) probably refers to *N. gracilis*. The USNM has a large series (> 100 specimens) collected in Hyattsville, Maryland, during 1915-17, with capture dates ranging from 18 May to 10 September.

Nehalennia integricollis Calvert 1913

The only published record from Virginia for this southern Coastal Plain species is that of Gloyd (1951). She collected a single male near the Dismal Swamp (City of Suffolk) on 14 September 1934 (reported as 17 September in Matta, 1978). Carle's (1988) lone site for the state is based on this same record. The USNM lacks Virginia specimens. Chris Hobson and I have collected *N. integricollis* at five sites in Caroline County, the range of dates being 1 June to 17 August. We observed only a handful of individuals at four of these sites; I found several hundred adults on 8 July at the fifth site. I have also discovered a small population of this species at one site in

the Shenandoah Valley region of Augusta County which harbors several Coastal Plain disjuncts among its flora and fauna. The reproductive behavior of *N. integricollis* remains unknown (Dunkle, 1990). I noted mated pairs during the late morning hours on 8 and 28 July at the site of the largest known Virginia population. They were hidden among grasses and sedges at the edge of this boggy pond. However, I did not have an opportunity to observe them at length and was unable to document oviposition.

+*Nehalennia irene* (Hagen, 1861)

This is a northern species which ranges south to the Carolinas (Brimley, 1938; Huggins & Brigham, 1982; White et al., 1983). Carle (1988) listed two sites for Virginia. The USNM has records from Highland (1971-72) and Prince William (1993) counties. My only encounter with *N. irene* in the state was on 19 June in the Locust Springs area of extreme northwestern Highland County, where it has also been collected by both O. S. Flint, Jr., and F. L. Carle. Flight dates in Virginia extend from at least 19 June to 16 July.

DISCUSSION

The diversity of Virginia's damselfly fauna is comparable to or greater than that reported for most other eastern states and provinces (Table 2). Furthermore, it equals the number of species known from Texas (Johnson, 1972) and exceeds by three the number reported from all of Canada and Alaska (Walker, 1953). Overall, slightly less than half of the North American damselfly fauna (listed at 119 species by Bick & Bick, 1980) is present in Virginia. Carle's (1991) figure of 61 species for the state apparently is erroneous, because it presumably includes numerous species of hypothetical status (listed in Carle, 1988). Each of the latter, plus one additional species, is discussed below. Two other species (*Lestes congener* and *L. vidua*) that were listed as hypotheticals by Carle (1988) have been confirmed for the state and were discussed in the accounts above.

Enallagma antennatum (Say, 1839) is a Midwestern species which has been recorded as far east as Massachusetts (USNM specimen), New York (Donnelly, 1992), and Pennsylvania (A. F. Beatty & G. H. Beatty, 1971). The USNM has a small series collected by B. Elwood Montgomery in June 1970 at the Frostburg Reservoir in Garrett County, Maryland. The species has also been reported from three counties in West Virginia (Tarter, 1976), with

Preston County being the nearest to the Virginia border. Roback & Westfall (1967) dubiously reported nymphs from two stations along the North Anna River in Louisa and Spotsylvania counties in Virginia. Until additional material from these or other sites in Virginia can be positively identified, I do not regard *E. antennatum* as a confirmed element of the state's fauna. In Canada, this species inhabits quiet streams and springy margins of small lakes (Walker, 1953). In New York, it prefers relatively open habitats, including some disturbed sites as well as large rivers (Donnelly, 1992, 1993).

Enallagma boreale Selys 1875 is a very wide-ranging northern species (see map in A. F. Beatty & G. H. Beatty, 1971) which has been reported from Tucker County in northeastern West Virginia (Tarter, 1976). It inhabits ponds and boggy or marshy lakes, and is very similar in size and color pattern to *E. cyathigerum* (Walker, 1953). This species should be sought in the mountains of western Virginia.

Enallagma carunculatum Morse 1895 is a northern transcontinental species (A. F. Beatty & G. H. Beatty, 1971) which was collected once (1914) in Hyattsville, Prince Georges County, Maryland (Donnelly, 1961). It has also been reported from three counties in central Kentucky, but is unknown in West Virginia (Resener, 1970; Tarter, 1976). *E. carunculatum* prefers lakes and rivers, although it occasionally inhabits ponds (Walker, 1953). It may eventually be found in the northern or western counties of Virginia.

Enallagma concisum Williamson 1922 and *Enallagma davisii* Westfall 1943 are southern Coastal Plain species which have been found as far north as North Carolina (Dunkle, 1990). The preferred habitat of both species is sand-bottomed lakes, where adults of *E. davisii* may be found only during early spring (Dunkle, 1990). Paulson & Jenner (1971) reported that *E. davisii* is the first *Enallagma* to emerge in North Carolina and has the shortest flight period of any damselfly in that state. In contrast, the flight period of *E. concisum* is prolonged (Dunkle, 1990). Matta (1978) did not find either of these species in southeastern Virginia. Of the hypothetical species discussed in this section, I believe that these two are the least likely to occur in Virginia.

Enallagma minusculum Morse 1895 is a Coastal Plain species which ranges from Nova Scotia and New Brunswick south to Long Island, New York (historic), with disjunct populations in southeastern North Carolina (Carpenter, 1991; Cuyler, 1968; Donnelly, 1992; Tennessen & Knopf, 1975). Cuyler (1968) reported that it

was abundant at the North Carolina sites. Matta (1978) remarked that suitable habitat (sandy ponds or lakes) for *E. minusculum* exists in southeastern Virginia, but to my knowledge it remains undiscovered in the state.

Enallagma sulcatum Williamson 1922 is a southern Coastal Plain species which ranges from Maryland to Alabama (Dunkle, 1990). However, it was not included in Carle's (1988) hypothetical list. The preferred habitat is grassy, sandy lakes (Dunkle, 1990). This species may occur in southeastern Virginia, but it was not found by Matta (1978) and I have no knowledge of any recent records.

Lestes unguiculatus Hagen 1861 is a wide-ranging species (A. F. Beatty & G. H. Beatty, 1971) which was collected once each in Prince Georges County, Maryland, and the District of Columbia 80 and 95 years ago, respectively (Donnelly, 1961). It has also been reported from Hardy County, West Virginia, and seven counties in central and western Kentucky, as well as from Tennessee (Resener, 1970; Tarter, 1976; Williamson, 1903). The West Virginia county borders both Rockingham and Shenandoah counties in Virginia. The flight period of *L. unguiculatus* spans the summer and early fall months (Montgomery, 1948; Resener, 1970). The preferred habitats are temporary or semi-permanent ponds in open environments (Walker, 1953). It seems likely that this species will eventually be found in northern or western Virginia.

Bick & Bick (1980) indicated that there was no published information on the reproductive behavior of twelve of the damselfly species confirmed from Virginia. Waage (1984, 1988) subsequently documented this in considerable detail for *Calopteryx dimidiata*, and Dunkle (1990) provided brief descriptions of reproductive behavior for six more of these species. The remaining five species for which published information is apparently still lacking are *Amphiagrion saucium*, *Argia bipunctulata*, *Enallagma daeckii*, *E. triviatum*, and *Nehalennia integricollis*.

The immature stages of all 53 damselfly species recorded from Virginia are now known, although several of them have not been formally described. Data in Walker (1953) and Johnson & Westfall (1970) indicate that the larvae of 39 of these species were known as of the latter date. Subsequent descriptions have appeared for five additional species (Huggins, 1978a, 1984; Tennessen, 1984; Westfall & Tennessen 1973). Paulson & Jenner (1971) collected hundreds of *Enallagma aspersum* larvae, but they did not describe them. However, this species, as well as *Argia bipunctulata*, *Enallagma weewa*, and *Ischnura*

prognata, was included in the illustrated larval keys of Huggins & Brigham (1982). Daigle (1991) provided illustrations of the gills, and a brief mention of key characters, for four additional species (*Enallagma dubium*, *Ischnura kellicotti*, *Nehalennia integrigollis*, and *Lestes vidua*). Detailed larval descriptions apparently are still lacking for all eight of these species. The immature stage of the single remaining species (*Lestes forcipatus*) is also known, but it has not been illustrated or described to my knowledge. Westfall & May (in prep.) will contain illustrated keys to the known North American damselfly larvae, including all of the Virginia species (M. L. May, pers. comm.).

SUMMARY

Fifty-three species of damselflies in three families and ten genera are confirmed from Virginia. Fourteen of these are reported here as apparent additions to the state's fauna. The first records of *Ischnura prognata* from within the current political boundaries of Virginia are also presented, while the original record for the state is shown to be in West Virginia. Eight hypothetical species are also discussed. Considerable opportunities exist for both professional biologists and amateur naturalists to add to our knowledge of the damselfly fauna of Virginia. In addition to seeking to document the hypothetical species, more effort is needed to identify new populations of uncommon or rare species that are already known from the state. Also, the reproductive behavior of several species remains unknown.

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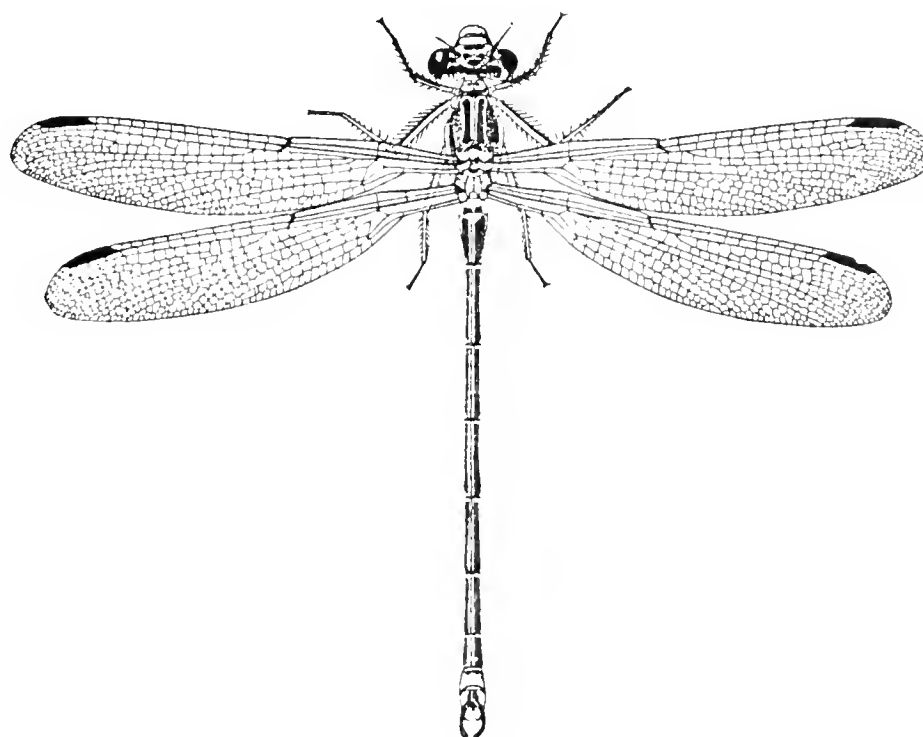


Table 1. Summary of primary collection and literature records reviewed in preparing this checklist. The sources are identified on the following page.

	1	2	3	4	5	6	7	8	9	10	11
CALOPTERYGIDAE											
<i>Calopteryx aequabilis</i> Say	-	-	-	-	-	-	-	-	-	-	-
<i>Calopteryx amata</i> Hagen	-	x	-	-	-	-	-	-	-	-	-
<i>Calopteryx angustipennis</i> (Selys)	x	x	x	-	-	-	-	-	-	-	-
<i>Calopteryx dimidiata</i> Burmeister	x	x	x	-	-	-	x	-	-	-	-
<i>Calopteryx maculata</i> (Beauvois)	x	x	x	x	x	x	x	x	x	x	-
<i>Hetaerina americana</i> (Fabricius)	x	x	x	-	-	-	x	-	-	x	-
<i>Hetaerina titia</i> (Drury)	x	x	-	-	-	-	+	x	-	x	-
LESTIDAE											
<i>Archilestes grandis</i> (Rambur)	x	x	x	-	-	-	+	-	-	-	-
<i>Lestes congener</i> Hagen	x	x	x	-	-	-	+	-	-	-	-
<i>Lestes disjunctus australis</i> Walker	x	x	x	-	x	-	+	x	-	-	-
<i>Lestes disjunctus disjunctus</i> Selys	x	x	-	-	-	-	-	-	-	-	-
<i>Lestes dryas</i> Kirby	-	-	-	-	-	-	-	-	-	-	-
<i>Lestes eurinus</i> Say	x	x	-	-	-	-	-	-	-	-	-
<i>Lestes forcipatus</i> Rambur	x	x	-	-	-	-	+	-	-	-	x
<i>Lestes inaequalis</i> Walsh	x	x	-	-	-	-	x	-	-	-	-
<i>Lestes rectangularis</i> Say	x	x	x	-	x	-	x	-	-	-	-
<i>Lestes vidua</i> Hagen	-	x	-	-	-	-	-	-	-	-	-
<i>Lestes vigilax</i> Hagen	x	x	-	-	x	-	+	x	-	-	-
COENAGRIONIDAE											
<i>Amphiagrion saucium</i> (Burmeister)	x	x	x	-	x	-	x	x	-	-	-
<i>Argia apicalis</i> (Say)	x	x	x	x	x	x	x	-	x	x	-
<i>Argia bipunctulata</i> (Hagen)	x	x	-	-	-	-	+	-	-	-	-
<i>Argia fumipennis violacea</i> (Hagen)	x	x	x	-	-	x	x	x	-	x	-
<i>Argia moesta</i> (Hagen)	x	x	x	-	-	x	x	x	x	x	-
<i>Argia sedula</i> (Hagen)	x	x	-	-	-	x	x	-	x	x	-
<i>Argia tibialis</i> (Rambur)	x	x	x	-	x	x	x	-	-	-	-
<i>Argia translata</i> Hagen	x	x	-	-	-	-	x	-	x	x	-
<i>Chromagrion conditum</i> (Hagen)	x	x	x	-	x	-	x	-	-	-	-
<i>Enallagma aspersum</i> (Hagen)	x	x	x	-	x	-	+	-	-	-	x
<i>Enallagma basidens</i> Calvert	x	x	-	x	-	-	x	-	-	-	-
<i>Enallagma civile</i> (Hagen)	x	x	-	x	x	x	x	x	x	-	-
<i>Enallagma cyathigerum</i> (Charpentier)	x	x	-	-	-	-	-	-	-	-	-
<i>Enallagma daeckii</i> (Calvert)	x	-	-	-	-	-	+	-	-	-	-
<i>Enallagma divagans</i> Selys	x	x	-	-	x	-	x	-	-	-	-
<i>Enallagma doubledayi</i> (Selys)	x	-	-	-	-	-	+	x	-	-	-
<i>Enallagma dubium</i> Root	x	-	-	-	-	-	-	x	-	-	-
<i>Enallagma durum</i> (Hagen)	x	x	-	-	x	-	+	-	-	-	-
<i>Enallagma ebrium</i> (Hagen)	-	-	-	-	-	-	-	-	-	-	-
<i>Enallagma exsulans</i> (Hagen)	x	x	-	-	-	x	x	-	x	x	-
<i>Enallagma geminatum</i> Kellicott	x	x	-	-	x	-	x	x	-	-	-
<i>Enallagma hageni</i> (Walsh)	x	x	x	-	-	-	-	-	-	-	-
<i>Enallagma pallidum</i> Root	-	-	-	-	-	-	-	-	-	-	-
<i>Enallagma signatum</i> (Hagen)	x	x	x	-	x	-	+	x	-	-	-
<i>Enallagma traviatum</i> Selys	x	x	-	-	x	-	x	-	-	-	-
<i>Enallagma vesperum</i> Calvert	x	x	-	-	-	-	-	-	-	-	-
<i>Enallagma weewa</i> Byers	-	-	-	-	-	-	-	-	-	-	-
<i>Ischnura hastata</i> (Say)	x	x	x	-	x	-	+	x	-	-	x
<i>Ischnura kellicotti</i> Williamson	x	-	-	-	-	-	-	-	-	-	-
<i>Ischnura posita</i> (Hagen)	x	x	x	-	x	-	x	x	-	-	-
<i>Ischnura prognata</i> (Hagen)	x	-	-	-	-	-	-	-	-	-	-
<i>Ischnura ramburii</i> (Selys)	x	x	x	-	x	-	+	-	-	-	-
<i>Ischnura verticalis</i> (Say)	x	x	x	-	-	-	x	x	x	-	-
<i>Nehalennia gracilis</i> Morse	x	-	-	-	-	-	+	-	-	-	-
<i>Nehalennia integricollis</i> Calvert	x	-	-	-	-	-	+	x	-	-	-
<i>Nehalennia irene</i> (Hagen)	x	x	-	-	-	-	+	-	-	-	-
Total number of taxa (54)	47	42	21	4	18	8	21	16	8	9	3

Table 2. Number of damselfly species recorded from Virginia and various other states or provinces in eastern North America.

State/province	No. of species	Source(s)
Carolinas	54 ^a	Huggins & Brigham (1982)
Connecticut	38	Garman (1927)
Florida	44	Dunkle (1990)
Illinois	40	Cashatt et al. (1987), Garman (1917), Montgomery (1967), Needham & Heywood (1929), Vogt & McPherson (1985)
Indiana	46	Montgomery (1942-48, 1967), Williamson (1917)
Kentucky	40	Montgomery (1967), Resener (1970)
Maryland	48	Donnelly (1961), Dunkle (1990), Fisher (1940), Johnson (1974)
Massachusetts	48	Carpenter (1991), Leahy (1976)
Michigan	42	Kormondy (1958), Montgomery (1967)
New Hampshire	35	White & Morse (1973)
New Jersey	47 ^b	Calvert (1903), Carle (1989), Soltesz (1991)
New York	55	Donnelly (1992, 1993)
North Carolina	51	Brimley (1938), Cuyler (1968), Paulson & Jenner (1971), Westfall (1942)
Ohio	48	Glotzhober (1994), Montgomery (1967)
Ontario	41	Walker (1941, 1953), Montgomery (1967)
Pennsylvania	53	G. H. Beatty & A. F. Beatty (1971)
Quebec	36	Hellebuyck (1993), Walker (1934, 1953)
South Carolina	44	White et al. (1983)
Virginia	53	This study
West Virginia	40	Cruden (1962), Tarter (1976)
Wisconsin	36	Montgomery (1967), Hilsenhoff (1981)

^aCombined total for North and South Carolina

^bPartial total

Table 1 Sources:

- 1 = Division of Natural Heritage records
 2 = National Museum of Natural History, Washington, D.C.
 3 = Richard L. Hoffman collections (most specimens are deposited in the Illinois Natural History Survey or Virginia Museum of Natural History)
 4 = Voshell & Simmons (1978); records of unidentified *Ischnura* and *Nehalennia* species are not included in the table.

- 5 = Matta (1978)
 6 = Roback & Westfall (1967)
 7 = Donnelly (1961) + = species recorded from the District of Columbia and nearby Maryland only
 8 = Gloyd (1951)
 9 = Byers (1951)
 10 = Williamson (1903)
 11 = Calvert (1890)

Phenological, Behavioral, and Biological Observations
 on a Giant Scale, *Neosteingelia texana* Morrison,
 in Blacksburg, Virginia
 (Homoptera: Coccinea: Margarodidae)

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According to Morrison (1928), nothing was available on the life history of *Neosteingelia texana* Morrison at that time. Because of its secretive life style, little remains known today; most of its life is spent under bark flakes of shagbark hickory (*Carya ovata*) and pecan (*Carya illinoensis*). This insect is considered a potential pest of pecan plantations in the southern United States (Miller, 1985). In addition, it is occasionally found on hackberry (*Celtis occidentalis*), maple (*Acer* sp.), ash (*Fraxinus* sp.), and sweetgum (*Liquidambar styraciflua*). It is known from Alabama, Florida, Georgia, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas and Virginia. In Virginia, adults come to the surface of the bark for a few days to mate during late September through early October. Apparently, weather conditions must be optimal for the two sexes to emerge at the same time. Other factors which may initiate the yearly appearance of this insect may be the release of an aggregate pheromone while under the bark, or the changing chemistry of the host plant sap at that time in the fall. Unfortunately, we have been unable to assess the latter two factors.

Observations were made on the emergence of this giant scale insect in 1969, 1970, and 1975, and correlated with local weather conditions. Based on these observations and the weather information, we can report that most of the insects appear on the surface of tree trunks in southwestern Virginia between 26 September and 6 October, apparently when air pressure is just over 30 millibars, at relative humidities between 55% and 70%, and at temperatures of 24° to 27° C in the sun (22° to 23° in the shade). Most insects normally emerge after 1000 EDT and remain active from noon through early afternoon, usually after a night with the minimum temperature between 10° and 16° C. Most observations

were made on old shagbark hickory trees in the Grove, across from the University President's House on the Virginia Tech Campus, where the majority of insects were found from ground level to about 7 feet (2 meters) high on the southeastern and southern side of the trunks.

The appearance of both sexes was also observed at Seashore State Park, Virginia. Here, in a warmer climate, the insects were active on the trunk of a maple tree (*Acer* sp.) on 9 October 1985. Farther south, the insects were swarming as late as 19 October (Georgia) and 31 October (Florida).

After emerging from the crevices of the trunk and from under peeling bark flakes, the females walk upward on the tree trunks and raise their abdomens in a semicircular fashion, probably to release their sex pheromones into the wind. The agile males mate repeatedly with each female. After mating, the females return under the loose bark flakes to lay their reddish-brown eggs inside cottony wax threads. This species probably needs more than one year for full development and should be studied further.

As there are no known published complete illustrations of this species, we include an illustration by the second author. Slide mounted specimens were 3.5 - 5.5 mm. in length and 1.5 - 2.0 mm. in width.

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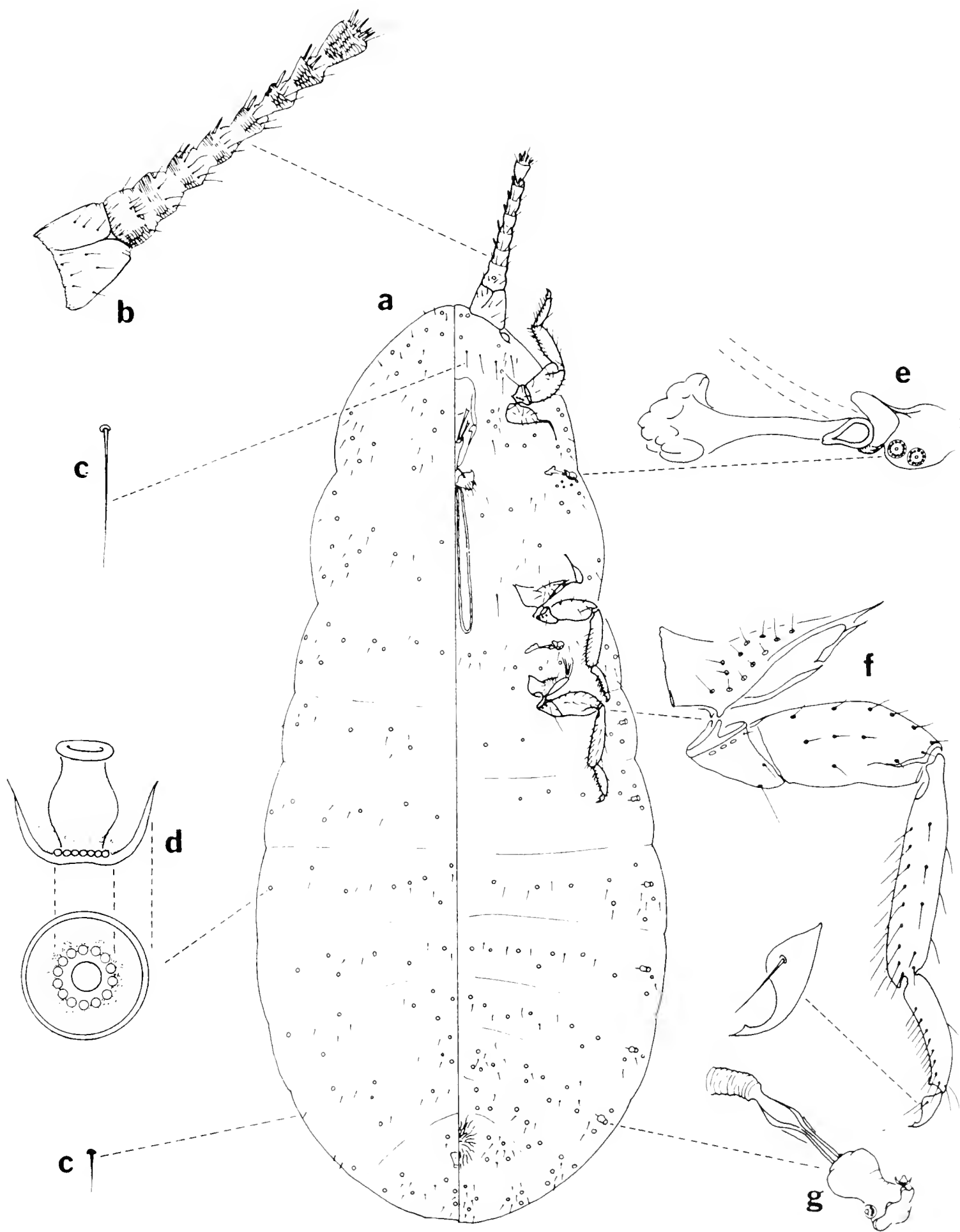


Figure 1. Adult Female *Neosteingelia texana* Morrison. (a) Dorsal (left) and ventral (right) views showing distribution of setae and pores, (b) antenna, (c) hairlike setae, (d) multilocular pore, (e) spiracle, (f) metathoracic leg, (g) abdominal spiracle.

An Experimental Investigation of Azalea Host Choice by the Leaf Beetle *Pyrrhalta rufosanguinea* (Coleoptera: Chrysomelidae)

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Rhododendron periclymenoides (Michaux) Shinnery (= *R. nudiflorum* [L.] Torrey) and *R. atlanticum* (Ashe) Rehder are native azaleas and belong to the section *Pentanthera*. Fourteen of the 15 North American species of this section have overlapping ranges in the eastern United States. The species of the section have been classified into species groups called alliances or complexes based on systematic assessments of morphological and cytological characters (Skinner & Camp, 1952; Li, 1957) or flavonoid chemistry (King, 1980). All of these studies treated *R. periclymenoides*, *R. roseum* (Loisel.) Rehder, and *R. canescens* (Michaux) Sweet as an alliance. *Rhododendron atlanticum* has been variously placed in other alliances depending on whether morphological or chemical data were emphasized, although it has been reported (Galle, 1967) to hybridize with *R. periclymenoides* wherever their ranges overlap.

A field survey of *R. periclymenoides*, and co-occurring ericaceous shrubs for *Pyrrhalta rufosanguinea* (Say), suggested that this leaf beetle is monophagous for *R. periclymenoides* (King, 1993). Field observations suggested that, in mixed populations, *P. rufosanguinea* is restricted to *R. periclymenoides* or its introgressants (King, 1993).

The first objective of this experimental study was to test the hypothesis that, when *R. periclymenoides* and *R. atlanticum* co-occur, the former is the preferred host for *P. rufosanguinea*. The second objective was to test the hypothesis that these leaf beetles will use *R. atlanticum* as an alternate host when it is the only *Rhododendron* species available.

Materials and Methods

A colony of leaf beetles was maintained on freshly collected *Rhododendron periclymenoides* foliage in an environmental chamber. Plants for the experiments were sampled from three populations of *R. periclymenoides* in

Caroline and Hanover counties, VA (King 2220, 2230, 2310) and from one population *R. atlanticum* in Henrico County, VA (King 2240). The locations of sites for beetle collections and methods for beetle colony maintenance are found in King (1993).

Leaf samples of each *Rhododendron* species were collected for feeding tests in the morning of the day each test was to begin. Although the leaf arrangement is alternate, leaves that develop from winter buds form a compact cluster at the end of a stem. A random foliage sample was 2-3 branches, each with several leaf clusters. The samples were sealed in plastic bags as they were removed from the plant, placed on ice in a cooler, and taken to the laboratory (ca 1 h). Only undamaged leaves from the foliage samples were used in the experiments. All feeding experiments were conducted in a growth chamber at 20° C with a 14 h photoperiod (400 foot candles) and 80-90% relative humidity. The duration of each feeding test was 24 h. The leaf beetles used in the feeding tests were taken at random from the laboratory maintained colony. No attempt was made to sort male and female beetles. The experimental design was modified from Villani & Gould (1985).

A paired choice feeding experiment was done in 10 tests from June 13 through June 22 with two tests each day. Feeding cages or arenas were one pint translucent plastic food containers with air holes. Plastic petri dish bottoms (60 mm diameter) were filled with distilled water, covered with parafilm, and placed in the bottom of each arena. Each arena contained two leaves from one plant of each *Rhododendron* species. There were five replicates of each arena. A total of 100 leaves of each species (taken from five plants of each species) was used in the experiment. Two beetles were placed in each arena. Prior to each test, the experimental beetles were fed for 24 h on leaves from the same *R. periclymenoides* plant and then starved for 8 h. This plant was not used in feeding tests.

The no choice feeding experiment included two tests (June 27-28). In this experiment, *R. atlanticum* was the experimental treatment and *R. periclymenoides* was the control. The feeding arenas were prepared as described for the paired choice tests except that there were only two leaves in each arena and both leaves came from the same plant. Five arenas each contained only leaves from *R. atlanticum* or *R. periclymenoides*.

In both experiments, the leaves were pressed and dried in a plant dryer at the end of each test. The dried leaves were taped to a sheet of paper and xeroxed. Leaf area and leaf area eaten were measured (mm^2) from the xeroxed leaves with a Zidas image analyzer. Each data point is the mean of two measurements. The results were expressed as percent leaf area eaten (%LAE) and as the number of leaves of each plant species sampled by the beetles. The data from the paired choice experiment were analyzed statistically by a Mann-Whitney U test and data from the no choice experiment by a chi-square test with Yates correction for continuity (Zar, 1984).

Results

In the paired preference test, beetles fed on 81% of the leaves of *R. periclymenoides* and 10% of the leaves of *R. atlanticum*. Mean %LAE was 3.53 ± 4.04 (0.00-30.50) for *R. periclymenoides* and 0.05 ± 0.18 (0.00-1.05) for *R. atlanticum*. The difference in mean %LAE between the two *Rhododendron* species is statistically significant ($U = 8904.00$; $P < 0.0001$).

In the no choice tests, beetles fed on all of the leaves of *R. periclymenoides* and one of the leaves of *R. atlanticum* ($N = 10$ for each species). Because of the small sample size, the data were analyzed with a chi-square test. The null hypothesis that the feeding data represented a 1:1 ratio was rejected at $P < 0.025$ ($X^2 = 6.400$; $df = 1$). In arenas in which only leaves of *R. periclymenoides* were present, the behavior of the beetles usually alternated between feeding and roaming freely about the container. In arenas in which only foliage of *R. atlanticum* was present, the beetles typically explored the leaves briefly and then moved to the top of the container and remained there for the duration of the experiment.

Discussion

The results of the paired choice experiment support my hypothesis that, in mixed populations of *Rhododendron periclymenoides* and *R. atlanticum*, *Pyrrhalta rufosanguinea*

feeds preferentially on leaves of *R. periclymenoides*. The extremely low levels of feeding on *R. atlanticum* leaves in the no choice tests, as well as in the paired preference experiment, suggests that it is unlikely *P. rufosanguinea* would use this *Rhododendron* species as a host. In no choice tests, the difference in behavior of the beetles in the arenas of the two *Rhododendron* species, in addition to low feeding levels, suggests that they are repelled by *R. atlanticum* foliage. The chemical and morphological factors affecting host choice by *P. rufosanguinea* are under investigation. In other *Rhododendron* species, glandular scales on leaves have been associated with insect resistance (Doss, 1984). The leaves of *R. atlanticum* are glandular while those of *R. periclymenoides* are not; however, there are a number of other morphological and chemical differences between the two species.

Although results of both feeding experiments in combination with my previous field observations strengthen the case for monophagy, the feeding experiments should be repeated with larger sample sizes, longer starvation periods prior to each test, longer feeding trials and additional plant species. Saxena & Schoonhoven (1982) showed that prior experience can influence subsequent host choice by some herbivores. In this study, all beetles were fed on leaves from a single *R. periclymenoides* plant prior to feeding tests. In preliminary trials conducted before the experiments reported here, the beetles did not feed on *R. atlanticum* leaves. Therefore, I made no attempt to maintain them on *R. atlanticum* foliage before the feeding tests. Given the morphological and chemical similarities within *Rhododendron* alliances and differences between them, I suggest that *P. rufosanguinea* is an alliance-specific rather than a species-specific herbivore.

Acknowledgements

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Diabrotica cristata, a Seldom-Collected Leaf Beetle, Found on Buffalo Mountain, Floyd County, Virginia (Coleoptera: Chrysomelidae)

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The galerucine chrysomelid *Diabrotica cristata* (Harris) belongs to the same group of the genus as the well-known *D. barberi* Smith & Lawrence, the northern corn rootworm, and *D. virgifera virgifera* LeConte, the western corn rootworm. Unlike those pest species, however, *D. cristata* is seldom encountered by the general collector and poorly represented in insect collections. This univoltine leaf beetle is widespread east of the Rocky Mountains, particularly west of the Mississippi in relict Midwestern prairies (Wiesenborn & Krysan, 1980; Yaro & Krysan, 1986; Krysan & Smith, 1987). Its distribution along the eastern seaboard tends to be highly localized, and little is known about specific habitat preferences except for its

occurrence in serpentine barrens of Maryland and Pennsylvania. Adults can be collected in serpentine barrens on inflorescences of grasses and forbs where they apparently feed on pollen. The larval host in eastern serpentine barrens was suggested to be little bluestem (*Schizachyrium scoparium* (Michx.) Nash) (Wheeler, 1988), but is more likely to be big bluestem (*Andropogon gerardii* Vitman), a perennial grass that serves as the larval host plant in Midwestern prairies (Yaro & Krysan, 1986; Krysan & Smith, 1987).

Herein *D. cristata* is recorded from Buffalo Mountain in southern Floyd County, Virginia, southeast of Willis. This monadnock, maximum elevation 1210 m, rises

abruptly above the Blue Ridge upland (Rawinski & Wieboldt, 1993). It is a well-known botanical site, but entomologists generally have devoted little attention to the diverse communities of this important natural area. A significant entomological discovery on Buffalo Mountain is the recently described mealybug *Puto kosztarabi* Miller & Miller, the only known eastern North American species of this Holarctic genus (Miller & Miller, 1993).

Adults of *D. cristata* were observed mainly on inflorescences of big bluestem on 27 August 1994. On Buffalo Mountain they were also found on inflorescences of *Liatris graminifolia* Willd. and *Solidago* sp. in the mafic glade vegetation classified as the *Andropogon gerardii* - *Liatris graminifolia* - *Senecio pauperculus* Alliance. This vegetation type is characterized by magnesium-loving and tolerant plants. The magnesium-rich glade soils of Buffalo Mountain are similar in calcium-magnesium ratios to those of serpentine barrens (Rawinski & Wieboldt, 1993). Previous Virginia records of *D. cristata* are Pimmit Run, Fairfax Co.; Nelson Co.; and Four Mile River and Kearny Station, counties unknown (Krysan & Smith, 1987). Additional specimens of this little-known leaf beetle should be looked for in habitats where big bluestem occurs. Relict prairie communities characterized by low calcium-magnesium ratios, such as Bluff Mountain in western North Carolina, might be expected to support populations of *D. cristata*. *Diabrotica cristata* is similar in size and habitus to the familiar northern corn rootworm but can be distinguished from other species of the genus by its uniformly dark (piceous) elytra. The color morph occurring in the East has the pronotum yellow, rufous, or dark (Krysan & Smith, 1987).

Acknowledgments

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cristata and accessioning voucher material, and R. L. Hoffman (Virginia Museum of Natural History, Martinsville) and S. Roble (Division of Natural Heritage, Virginia Department of Conservation and Recreation, Richmond) for accompanying me to Buffalo Mountain.

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Eastern Tiger Salamander (*Ambystoma tigrinum tigrinum*) Rediscovered in York County, Virginia

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Prior to the early 1970s, the basis for including the eastern tiger salamander (*Ambystoma tigrinum tigrinum*) in Virginia herpetofaunal checklists (Dunn, 1918, 1936; Burger, 1958) was a specimen in the National Museum of Natural History (USNM 9273) collected in September 1874 (no precise date available). Its locality was listed simply as "Virginia." It was not until 1973, almost a century later, that the first tiger salamanders with accurate locality data were discovered in the Commonwealth.

Funderburg et al. (1974) detailed the discovery of two tiger salamander egg masses in Jones Pond, 16 km west of Ashland, Hanover County, on 23 March 1973. The eggs were identified by David S. Lee, a field biologist experienced with the eggs and larvae of *A. tigrinum* in Maryland. Funderburg et al. (1974) reported that they been donated to the Natural History Society of Maryland. However, none have been found in this collection (R. W. Miller, pers. comm., 4 September 1994) and are presumed lost. David S. Lee (pers. comm., 3 October 1994) recalls identifying the eggs but cannot confirm their deposition in the Maryland collection. Thus, the occurrence of a tiger salamander population at Jones Pond in Hanover County remains unconfirmed.

Tirrell (1974) and Funderburg et al. (1974) each reported that two tiger salamanders had been found in a suburban garden under a tomato plant in Tabb, York County, on 13 October 1973. The larger of the two escaped, but the remaining individual was taken to the Peninsula Nature and Science Center (now the Virginia Living Museum) in Newport News, where it later died. It was preserved and deposited in the museum's vertebrate collection. The specimen (No. 73-50) is a young, probably immature male, 69 mm snout-vent length and 121 mm total length. Tiger salamanders are known to occur in only two other counties in the Virginia coastal plain: Isle of Wight (K.A. Buhlmann, pers. comm.) and Mathews (Pague & Buhlmann, 1991).

No additional specimens have been discovered in York County or adjacent counties despite field work conducted there by K.A. Buhlmann, C.A. Pague, and me between 1988 and 1994 (Division of Natural Heritage, 1990, 1992). No surveys have been conducted in the vicinity of Tabb, however. Several subdivisions exist in this area where there were none twenty years ago. Loss of wetland habitat has apparently been severe and the habitat around the original site appears to have been destroyed by urban developments (Pague & Buhlmann, 1991).

Nearly twenty years later, the Tabb tiger salamander story is repeated. On 21 May 1993, two *A. tigrinum* were discovered by a homeowner in his suburban backyard in Tabb, York County, only 0.8 km east of the 1973 collection site. They had been unearthed, presumably while the person was working in his garden. One salamander escaped, but the other, an immature? male (85 mm snout-vent length, 151 mm total length) which had been injured by a hoe, was taken to the Virginia Living Museum. It subsequently died and was given to Dr. Alan H. Savitzky for preservation. It is now catalogued in the Virginia Museum of Natural History's herpetological collection (VMNH 6654).

Amazingly, another specimen turned up at the same locality on 15 November 1993 (G. Mathews, pers. comm.). It was given to the Virginia Living Museum where it subsequently died on 1 February 1994; the specimen was unfortunately discarded.

Ambystoma tigrinum has been recognized as an endangered species by the Virginia Department of Game and Inland Fisheries since 1987 (Mitchell, 1991; Pague & Buhlmann, 1991). The recent discovery of three additional tiger salamanders, one presumably immature, in an area considered to have lost appropriate breeding habitat has conservation implications. Tiger salamanders are not yet extinct in this area, despite the increased urbanization

and the presumed loss of aquatic breeding sites. The population apparently continues to breed periodically and produce offspring, some of which reach metamorphosis. Thus, at least one local pool of water must remain as a useful breeding site for this species. The discovery of its location would be an important addition to our knowledge of this endangered species on the York-James Peninsula. The adult population may have declined since the discovery of this species in the early 1970s due to habitat loss, but some individuals appear to be surviving.

When should tiger salamanders and other subterranean vertebrates be considered extinct in a highly modified site? *Ambystoma tigrinum* is long-lived, reaching at least 20.5 years in captivity (Snider & Bowler, 1992). Adults may be able to withstand several years of poor breeding opportunities and survive for one to two decades in modified habitat. The discovery of an apparently immature individual suggests that the population in York County has enjoyed some recruitment via reproduction since the initial discovery in 1973. Thus, the assumptions (Pague & Buhlmann, 1991) that the site was completely degraded and the population had become extinct were not correct. Therefore, future assessments of the population status of *Ambystoma tigrinum*, as well as other long-lived, subterranean vertebrates, should be made with caution. A declaration of the extinction of a population of such animals in a degraded site should be made only after exhaustive field investigations have determined that no potential breeding ponds or other bodies of water allow successful reproduction. In addition, reasonable attempts must be made to search for adults over a period of several years. The rediscovery of *A. tigrinum* in York County also suggests that the site in Hanover County may still support this species.

It is clear that we know too little about the non-breeding ecology of this salamander. How far do adults and metamorphs disperse from the aquatic breeding sites? What is the average and maximum natural longevity? Can adults persist in areas for one or two decades without breeding? Can populations be maintained if reproductive success occurs only once or twice a decade? If such is the case, then much additional field work is needed to ascertain the current population status of the eastern tiger salamander in Virginia. This is especially true in the Hanover and York county sites because of the inadequacy of the available information.

Acknowledgments

I thank the Virginia Living Museum for donating the specimen to Alan H. Savitzky and to Dr. Savitzky for giving it to me for deposition in the Virginia Museum of Natural History. George Mathews, Jr. kindly measured the specimen in the Virginia Living Museum and provided the collection information for the 1993 and 1994 specimens. Robert W. Miller looked for the eggs in the Natural History Society of Maryland. David S. Lee searched the Funderburg collection, now in his possession, for tiger salamander eggs. Kurt A. Buhlmann, Richard L. Hoffman, David S. Lee, Robert W. Miller, and Steven M. Roble commented on the manuscript.

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An Unusually Colored Northern Water Snake (*Nerodia sipedon sipedon*) from Giles County, Virginia

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Phenotypic variation among snake populations is widespread, encompassing a wide range of colors and patterns, from completely albinistic to completely melanistic (Wright & Wright, 1957; Hensley, 1959; Dyrkacz, 1981). Albinism has been found to occur in six species of snakes in Virginia: *Carphophis amoenus* from Fairfax County (Allard, 1945), *Elaphe obsoleta* from Rockbridge County (Carroll, 1950) and Westmoreland County (Hensley, 1959), *Heterodon platirhinos* from Fairfax County (Anonymous, 1961), *Lampropeltis triangulum* from Montgomery County (Hensley, 1959), *Nerodia sipedon* from New Kent County (Hensley, 1959), and *Thamnophis sirtalis* from Fauquier County (Shively & Mitchell, 1994). Melanism has been documented in three species. Of the 98 eastern hognose snakes (*Heterodon platirhinos*) examined by Mitchell (1994), 20.4% were melanistic. Bulmer (1985) briefly reported on a population of melanistic northern water snakes (*Nerodia s. sipedon*) from the Virginia side of the Potomac River. Completely melanistic timber rattlesnakes are occasionally observed in the mountains of Virginia (Mitchell, 1994; W. H. Martin, III, pers. comm.).

On 12 June 1988, Richard L. Hoffman found an unusually colored, young adult male *Nerodia sipedon* in Big Walker Creek at White Gate, Giles County, Virginia.

The snake was noticed swimming slowly near the stream bed, among large stones and submerged stems of American water-willow (*Justicia americana*) in swift-moving water about 0.3 m deep. When picked up, at midbody, it made no attempt to bite, nor did it manifest typical *sipedon* aggressiveness at any time during the several days it was held captive. The specimen was photographed and released at the place of capture on 16 June 1988.

The description, based on color photographs, is as follows: dorsum - black and red pigment completely lacking; head light brown; upper and lower labials light tan and outlined in slightly darker brown; background color of dorsum of body light tan with yellowish tinge; anterior crossbands slightly darker brown but nearly indistinct; dorsal and lateral blotches almost indistinguishable from background body color; spaces between lateral blotches light orange tan; venter - uniform yellow, without typical half-moon pattern; eye light brown with dark brown to black pupil.

This pattern differs substantially from the normal pattern of dark brown to reddish brown dorsal crossbands and body blotches on a brown background on the dorsum, and a cream to yellow venter with numerous reddish-brown half-moon-shaped figures usually arranged in two rows (Ernst & Barbour, 1989; Mitchell, 1994).

The normal variant is typical of other specimens of this species known from Giles County. Other variations on the typical phenotype for populations in Virginia are described in Mitchell (1994). Wright & Wright (1957) noted that albinistic, erythristic, and melanistic specimens of *N. sipedon* are not uncommon but provided information only on albinos.

The phenotype described above can be considered nearly complete xanthism, in reference to the lack of all integumentary pigments except brown, orange, and yellow. Dark pigment is present only in the pupils of the eyes. This is the first report of such a variation in *N. sipedon* from Virginia. Partially xanthic phenotypes have been reported in *Thamnophis sirtalis* (Groves, 1966) and *Carphophis amoenus* (Simmons & Stine, 1961) from Maryland.

Acknowledgments

I thank R. L. Hoffman for giving me the opportunity to report on this specimen and Carl H. Ernst and William H. Martin III for reviewing the manuscript.

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Miscellanea

Book Reviews

Freshwater Fishes of Virginia, by Robert E. Jenkins and Noel M. Burkhead. 1994. American Fisheries Society, Bethesda, MD. xxiii + 1079 pages. \$85.00. Available from the Virginia Chapter of the AFS, c/o VDGIF, P.O. Box 996, Verona, VA 24482.

Despite its long occupation by people of European descent, Virginia has lagged substantially behind other states in having thorough published treatments of her flora and fauna. This treatise on the state's freshwater fishes fills a deep void. We now have one of the best and complete books on the freshwater fishes of any state in the country.

The book is large, 8.5 x 11 inches, and with the heavy, glossy paper weighs some 1.8 kg (4 pounds). The first 141 pages are devoted to history, descriptions of drainages, physiography, and fish habitats, a long discussion of biogeography, endangered fishes, special cases (fossils, introductions, erroneous species, hybridization), and how to study fishes. The bulk of the remainder, some 752 pages, are descriptions of each of the 210 freshwater fish species that occur naturally in the Commonwealth. Each account contains information on systematics, description (materials, anatomy, meristics, color in preservative and life, notes on larval descriptions, and a black and white photo), biology, habitat, distribution with detailed spot maps, and remarks. The distribution maps show all the drainages and many of the tributaries. There are keys to families, genera, and species, along with numerous illustrations and descriptions of fish anatomy. This is without a doubt the best source of fish identification available anywhere. A total of 86 pages contain the references cited and thus constitutes an important window into the ichthyological literature. Plates illustrate each species in color and each is accompanied by collection data and brief notes on sex and reproductive condition. Other plates illustrate a number of habitats. There is a glossary and an index to taxonomic names of fishes. But there is much more to this book than I have just described, such as discussions of the 1967 Clinch River fish kill, pollution effects, and photography. I especially enjoyed the history chapter and descriptions of the physical aspects of the state and the fish habitats.

The book is heavy on systematics, reflecting the chosen specialization of the senior author. The contribu-

tion to the systematics and biology of sculpins is substantial; indeed, three species described in the book do not yet have scientific names. Each species account contains information on prey, reproduction, and behavior but lacks data on population sizes and other aspects of their ecology. Much of the biological information is derived from studies performed outside of Virginia and taken from the literature. In many cases, I cannot tell whether the information pertains to Virginia populations or those in other states; the only way to find out is to look up the reference. I can't help but think that a great deal of life history and ecological data are available for Virginia populations of many species that were not incorporated into this book.

As a herpetologist, I was interested in which amphibians and reptiles were eaten by fish and which fish were prey of these animals. Because the index only listed fish names, I had to search each and every account to find this information. I am left with the impression that this book was written primarily for ichthyologists and fisheries biologists, as it is not very user friendly for some of us non-fish people.

Despite these minor complaints, I highly recommend this book to anyone who is seriously interested in Virginia's fishes. The price is a bit steep for lay persons and even for some professionals. However, the book should be in literally every library in the state. Furthermore, the Virginia Department of Game and Inland Fisheries should be commended for financially supporting this book project. The definitive treatise on the fishes of Virginia has now been published and it will be the cornerstone for all future research on the fishes in the Commonwealth.

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The Reptiles of Virginia, by Joseph C. Mitchell, 1994, Smithsonian Institution Press, xv + 368 pages, 63 color plates, 62 distribution maps. \$40.00 plus \$2.25 shipping and handling. Obtainable from Smithsonian Institution Press, Blue Ridge Summit, PA 17294-0900.

For many decades, the ambition to prepare a treat-

ment of the herpetology of Virginia was a kind of reef upon which many ships of good intention ran aground and broke up, leaving scarcely a trace. E. R. Dunn apparently was the first to cherish such a goal, and did manage to prepare two state lists (1918, 1936) which reflected the state of knowledge at two points in time, before succumbing completely to the lure of Neotropical taxa. In the middle 1940s the present reviewer embarked on the same course in the optimism of youth, preserving several thousand specimens and collecting distribution records from a number of museums before abandoning the enterprise in favor of arthropod taxonomy. Almost immediately - around 1951 - the challenge was taken up by Walter B. Newman, then a graduate student at VPI&SU, who persisted for several years before personal problems resulted in his relocation to Florida and untimely demise. In nearly the same time period, substantial progress toward some kind of comprehensive state treatment was made by W. Leslie Burger, but this initiative seems not to have survived his move from William & Mary to another position in Indiana.

After this near-decade of false starts, a real Renaissance of positive interest in Virginia herpetology was catalyzed with the formation of the Virginia Herpetological Society by Franklin J. Tobey in 1958. One of the charter members was Costello Craig of Bedford, who recruited his nephew, an enthusiastic young naturalist named Joseph C. Mitchell. Thus a fortuitous combination of the right time, place, and opportunity set the stage for the right person to accomplish what others had only attempted. While his predecessors had the qualities of knowledge and motivation, the additional, essential ingredient held by Joe Mitchell was that of perseverance, the determination to follow a dream to its fulfillment no matter how long or difficult the course.

And the book that eventually appeared, more than any accolades by reviewers, stands as its own witness of how successfully the dream was realized. Amidst a field of existing state reptile handbooks, each excellent in its own right, this one stands out as a model for future work of the genre. That it is authoritative and encyclopaedic goes without saying. An important innovation is the presentation of information relevant to a diverse audience (identified on the dust jacket as herpetologists, naturalists, science teachers, wildlife managers, and environmental consultants) rather than a narrow one. Most compromises are failures, pleasing no one, but this one succeeds, a tribute to the author's wide experience with a spectrum of naturalists, and insight into so many different levels of

need. As a professional herpetologist, teacher, and conservationist, he has interfaced with nearly everyone who wants to know more about reptiles.

The book follows a fairly traditional format: introductory chapters treat in considerable detail the history of herpetology in Virginia, the physical background of the state and the major natural communities that have developed (with elegant illustrations in color), techniques of study, notes about basic systematics and nomenclature, prevention of snakebite, and the conservational status of the local fauna. A set of well-illustrated keys (including one for juvenile snakes!) leads into the species treatments, in the sequence of turtles, lizards, and snakes. Each of the orders and families is introduced by a concise summary of structure, biology, and distribution. Species accounts follow the headings of Systematics, Description, Scutellation, Coloration & Pattern, Sexual Dimorphism, Juveniles, Confusing Species, Geographic Variation, Etymology, Distribution, Biology, Remarks, and finally, Conservation and Management.

There is an account of 15 species erroneously recorded, introduced, or otherwise alien to the native fauna; a glossary defining over 100 technical terms; and a 29-page (!) list of references cited in the text. What more could anyone want in or expect from a book?

Being interested in geographic distribution, I have paid special attention to the highly precise spot maps. There are few better ways to perceive what is and isn't known about local distribution than from a spot map. I was amazed how few species have been recorded from such big counties as Pittsylvania and its neighbor, Halifax. Is Southside Virginia really collector-unfriendly or just a bland region to be passed over en route to the mountains or the coast? A light representation in the coal-field counties is less surprising. Admittedly the streams there are badly trashed, but there is still a LOT of woodland habitat not yet ruined by strip-mining and clear-cutting. The paucity of records for the painted turtle in the Clinch, Powell, and Holston systems astonished me, knowing how much time Dr. Mitchell and his helpers have devoted to successfully seining and trapping other turtles in those streams. And the absence of records for the queen snake, *Regina septemvittata*, in the central western highlands is noteworthy, as that region has been as well collected as most other parts of the state.

Aside from the several poorly-represented areas, the maps reveal a number of interesting patterns of distribution. A substantial number of taxa (see maps 39, 40, 45, 47, 61) are confined to the Coastal Plain (or marginally

up onto the eastern Piedmont). Others are virtually excluded from the mountains, except where they have followed major stream valleys headward (cf. maps 29, 30, 32, 34, 37, 42) particularly when such "eastern" species show up also on the upper Tennessee headwaters (maps 48, 53, 59) paralleling the occurrence of sweetgum in Virginia. It is intriguing that so many of such species extend up to the Blue Ridge front but have not been taken in the Roanoke valley, topographically only a western lobe of the Piedmont.

In any event, we now have graphic evidence about where the holes are: places where even salvageable roadkills should not be passed over. Presumably the same lacunae exist for amphibian records, so Virginia naturalists can help to make more complete maps to appear in the forthcoming amphibian volume.

A reviewer seems expected to find some typos or some point or other with which he doesn't agree (perhaps to prove that he really went through the book carefully). I have found this a difficult course to follow, because of general satisfaction with both the substance of the content and the physical layout of the book.

Of course, one can't be faulted for wishing to see more of a good thing, so here are a few items on my personal want list, against possible future revisions:

I think it would be neat to have a chart, maybe in a "box", entitled "Turtles through field glasses" or something similar. It is true that the head and neck of most of our species are illustrated in color photos, but it would help in sorting out basking specimens (at a distance) to have a complete set of even diagrammatic sketches all together, B&W would do fine, of head and neck (and shell when pertinent) with the diagnostic features pointed out with an arrow or line (à la Peterson).

Regarding the maps, it would seem useful to represent different subspecies by different symbols (e.g., king snakes, Map 43, and ring-neck snakes, Map 36). The Virginia distributions of subspecies, and their intergradient areas, are discussed in the text, but one gets a better perception from different symbols, with intergrades shown by X symbols and their general area by shading.

And as regards physical composition of the product itself:

Format of headings and selection of type styles seem to favor subordinate side headings (in bold face) over major center heads (species names, &c.) which are set in a much lighter type face. A quick glance at a page often fails to pick up where one species account stops and another starts. The side headings for subspecies trinomials

seem ungenerously small, too (I admit to having a personal bias for subspecies, however). On balance the design and format are excellent: the type face is eminently readable and the pages have an open, clean appearance. The book is notably "browseable" and the fluent writing style invites the casual reader to pause to enjoy the less technical paragraphs. Typos are remarkably scarce, reflecting intense proof-reading efforts by author and the editorial staff. The only one I have found escaping such scrutiny is the occasional spelling of "Trichoptera" without the "h", hardly a matter of any consequence.

While the book is a long overdue milestone in Virginia natural history, its financial support during years of preparation by the "Nongame Program" of the Virginia Department of Game & Inland Fisheries reflects a significant change in values during the past several decades. Not too long ago the investment of donated public funds (derived largely from voluntary income tax checkoffs) to finance a book on reptiles would have been unthinkable. Now, at least a wide spectrum of naturalists will endorse with appreciation the wisdom of VDGIF's support and confidence.

A cadre of the authors' friends and colleagues, including this reviewer, have hovered on the fringes of the enterprise since its inception with barely contained impatience, offering whatever encouragement and material assistance they could. Their long wait has been more than amply rewarded. Now a second wait begins, as Joe Mitchell turns to Virginia's amphibians, certainly a more difficult group to treat. That he will rise to the occasion no one doubts, but still, *The Reptiles of Virginia* will be a hard act to follow.

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Obituary

†Horton Holcombe Hobbs, II

(1914-1994)

With the death on March 23rd, in his home at Falls Church, Virginia, of Horton Hobbs, the scientific community has lost the acknowledged premiere specialist on crayfish and related crustaceans, and the world is

bereft of a man for whom the phrase "gentleman and scholar" might well have been devised. Following several years of slowly declining vigor, Dr. Hobbs died in his sleep of heart failure after a normal day at home. He missed his 80th birthday by only three days.

Horton Hobbs entered the University of Florida in 1933 to major in music. When he complained, during his required course in general biology, of being given a substandard crayfish to dissect, he was given a dipnet and told to go out and get a fresh one. The act of catching one and observing it alive completely metamorphosed his interests, and a new career was started that day, one which would take him to the apex of his profession.

Following publication of his doctoral dissertation ("The Crayfishes of Florida") in 1942, Horton was invited to join the biology faculty of the University of Virginia in 1946, and immediately took up the study of the local crayfish fauna. In teaching he favored the old-fashioned, classical, field-oriented study of organisms as total entities, with emphasis on such basics as taxonomy, evolution, and structure. In the years that followed, he attracted and trained a long sequence of students at both master's and doctoral levels; many of these students in turn became teachers and produced a second generation of scholars trained in the Hobbsian mold. Some made major contributions to the knowledge of Virginia's natural history.

In the 1950s, the University's biology department followed a national trend and "went molecular". Fortunately, not long afterwards, the position of Chief Curator of Zoology became open at the U. S. National Museum, and Hobbs applied successfully for it, moving in 1961 to the house on Lake Barcroft where he lived thenceforth. Unfortunately, after a few years of mostly administrative work, cardiac problems developed and further exposure to stress became dangerous. The Smithsonian thereupon transferred Hobbs to the position of "Senior Scientist" which required only research duties. Here his productivity increased even more, and descriptive treatments of crayfish, shrimp, crabs, and ostracods proceeded at the rate of 5 to 10 papers annually. During this period he gradually completed his *opus magnum*, the spectacular "Crayfishes of Georgia" (1981, Smithsonian Contributions to Zoology 318: 1-549), in which the 66 native species are treated with astonishing detail and depicted with beautiful drawings. 43 years of collecting and study preceded publication of this masterpiece, which will probably never equalled by a similar faunistic work. I do not have at hand a complete list of his papers, but know that they exceed 80 on crayfish (several book length) and

over 30 on other taxa. Many were coauthored, and reflecting Hobbs' generosity were his minimal requirements for coauthorship: sometimes for no other reason than to reward the collector of a new species, or in appreciation of someone doing no more than inking his pencil drawings.

Among colleagues and even casual acquaintances, the commonly shared descriptors used to characterize Horton Hobbs were such terms as scholarly, charming, generous, considerate, courtly. The expression "quintessential Southern gentleman" has never been applied more aptly to any scientist or teacher of my acquaintance, nor been more merited. It was a turning point in my own life to come under Hobbs' influence when still a 3rd year student at U. Va., when we jointly decided that Diplopoda would be a good group for me to specialize on. It was my exceptional good fortune to be in effect his first student, in the year before bona fide graduate students began to show up. I became virtually a member of the family, given a key to the basement lab, treated to frequent meals, and allowed to look after the two young children when he and his wife Georgia went out for an evening. I perceived the Hobbsian life style as idyllic, and would have lived mine the same way, given the opportunity. In the years and decades that followed, I never saw any reason to revise that initial impression.

It would be difficult for me to recount all of his graduate students and their contributions on the biota of Virginia. Two of the first cadre were Perry C. Holt, whose doctoral work was on the branchiobdellid ecto-commensals of crayfish, and Marvin L. Bobb, whose task was a survey of the aquatic and semiaquatic bugs of the state. Holt spent some years at East Tennessee State University, then moved to VPI&SU where he completed his academic career and while there directed the graduate work of James E. Carico (pisaurid spiders), J. E. Lawson (pseudoscorpions), and Charles R. McGhee (opilionids). All of these people collected actively in Virginia. By an interesting twist of fate, I also "Ph.D.'ed" with Professor Holt (on the taxonomy of branchiobdellids) and thus became a Hobbsian graduate student once removed. Marvin Bobb returned to economic entomology, but his dissertation, updated, was published in 1974 as part 7 of "The Insects of Virginia" and has been widely cited. Jean E. Pugh conducted a faunistic-ecological study of the mayflies of the Piney River in Nelson County, turning up a new species in the process. Hugo James revised the *Cambarus longulus* group which is largely endemic to Virginia. Hobbs himself named several native species of

crayfish: *Orconectes virginianus* from the Chowan River system, *Cambarus wheeleri* from the Powell drainage in Lee County, and *Cambarus angularis* from the upper Tennessee basin but never got around to a state survey. He once told me he was working northward, and having covered Florida and Georgia had to write up South and North Carolina first. But field work! I cannot imagine a place in Virginia not represented in the USNM collection! It used to be a game for me to find an obscure species in some obscure place, and then check his geographic card file for Virginia records. So often he already had it from that county or even that same place. Somebody who aspires to write up a "Crayfishes of Virginia" will find virtually everything needed on the shelves at Washington.

Later in life, after retirement from the National Museum staff, Horton was advised to have a triple-bypass procedure performed. This was eminently successful, he described it to me as one of the best things that ever happened to him. And for another decade or two he continued, through his sixties and early seventies, to dipnet and seine stream crayfishes, and dig out the burrowers, all over southern and eastern United States. For some years he went in to work every morning (early!) and was solely in charge of the crayfish collection. Daily he thus conducted an extensive correspondence, reviewed manuscripts, entertained visitors, and still managed to push his projects forward. During the past two or three years, however, health problems became sequential and his stamina declined. Only one visit per week to the museum was possible. In 1989 he served the Virginia Museum of Natural History as one of the charter members of the Board of Trustees, but was forced to relinquish this position because the increasing severity of his wife's health problems made it impossible for him to bring her to meetings or leave her anywhere, unsupervised.

We had the honor of publishing what I am sure is the last paper he wrote (there may be others still in press): the description, coauthored with Raymond Bouchard, of *Cambarus angularis* in *Jeffersoniana* no. 5 earlier this year. By the end of 1993, his voice and handwriting had become notably feeble, yet the inked drawings which he produced were as precise and elegant as those from mid-career.

Horton Hobbs enjoyed other gifts. He was a natural musician, and could play on the piano (by ear!) any piece that he knew or was hummed or whistled for him. For some years he was the organist for his church in Charlottesville. Taking up oil painting one day, he produced

from the very first quite credible portraits of family members. From Smithsonian artist Carolyn Gast, he learned the technique of carbon dust rendition, and illustrated some of his papers with drawings of near photographic realism. And an honest capacity for enjoying life. During the Smithsonian years the Hobbs family went several times to Europe, and it is a measure of the man that he found Parisians (even waiters) to be friendly and courteous, surely an exceptional testimonial to someone who judged others by himself.

He is survived by his wife Georgia and two children, Nina Blount Hobbs Singleton, who is a successful businesswoman in Ardmore, Pa., and Horton H. Hobbs, III, professor of biology at Wittenberg University, who has followed in his father's footsteps by specializing in crustacean systematics. He is survived in a broader sense by the multitude of persons whose lives he touched and made better, as teacher, colleague, friend, or combination of all three.

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Reports

1. Results of the First Annual Meeting of the Virginia Natural History Society

The first annual meeting of the VNHS was held on 19 May 1994 at James Madison University, Harrisonburg, VA as a new section of the Virginia Academy of Science entitled "Natural History and Biodiversity." The following talks were presented:

The public's attitude toward snakes: preliminary survey results from park-goers. R. A. S. Wright.

Possible biodiversity implications: 1992-1993 Turkey Run Park herpetological survey. D. A. Lindholm.

Amphibian biodiversity and community structure in five forested habitats on Shenandoah Mountain, Virginia. J. C. Mitchell, K. A. Buhlmann, & C. A. Pague.

Mammal biodiversity and community structure in five forested habitats on Shenandoah Mountain, Virginia. J. F. Pagels, S. C. Rinehart, J. C. Mitchell, K. A. Buhlmann, & C. A. Pague.

Allozymic variation in mainland and insular populations of *Oryzomys palustris* and *Peromyscus leucopus*. J. L. Loxterman, N. D. Moncrief, R. D. Dueser, & J. F. Pagels.

Discovery of a Virginia "serpentine barren". T. J. Rawinski.

An exemplary fire-maintained ecosystem in the Virginia Piedmont. G. P. Fleming.

Evaluating effects of prescribed burning on an endangered plant: Peters Mt. mallow. C. Caljouw, M. Lipscomb, & S. Adams.

Distribution and ecology of stream-dwelling crayfishes in the Clinch River drainage, VA. P. S. Lookabaugh, P. L. Angermeier, & R. J. Neves.

Use of ponds to protect native freshwater mussels. J. W. Burrell & R. J. Neves.

The sucking lice (Insecta: Anoplura) of Virginia sciurids. R. P. Eckerlin & H. F. Painter.

Biological control of purple loosestrife. T. J. McAvoy, L. T. Kok, & W. T. Mays.

A butterfly survey at the Virginia Tech Horticulture Gardens. T. J. McAvoy, W. T. Mays, and B. Lyons.

Odonate fauna of Fort A. P. Hill. S. M. Roble and C. S. Hobson.

An instructional design model for the use of university research collections in undergraduate education. S. L. Sharp.

In addition, a well-attended open forum organized by Nancy Moncrief was held on applications and reporting procedures for collecting permits (for vertebrates). This session allowed people to vent their frustrations over the handling of the VA Dept. of Game & Inland Fisheries collection permit process.

Overall, the response was such a success that the VAS has made our section permanent. Its codification will hopefully send a message to others indicating that this area of science is as important in the "modern era" as any other.

Information on future meetings may be obtained

from the Section Secretary (and VNHS Vice-President) Dr. C. Barry Knisley, Department of Biology, Randolph-Macon College, Ashland, VA 23005 (804-752-7254). Information about the 1995 meeting to be held on 23 May at Washington and Lee University may be obtained from the Virginia Academy of Science, c/o Science Museum of Virginia, 2500 West Broad St., Richmond, VA 23220. Please make plans to attend.

2. Progress Report from the Departing President

Although it is my constitutional duty to give an annual report to the Executive Committee, I am doing this with great pleasure now to all members of the Society. Because my two year term ends this December, while I am saying goodbye to all members, I am also giving a report on the major accomplishments of the first two years of the infant life of the Society.

As you may recall from my last year's report (*Banisteria* 2:27), the Article of Incorporation and Bylaws of the VNHS were adopted on May 20, 1993. The other good news is that the Internal Revenue Service (IRS) approved on August 26, 1994 our exemption from federal income tax under section 501(a) of Internal Revenue Code as given in section 501(c)3. This means we are officially recognized by IRS as a publicly supported non-profit scientific organization. The ruling is retroactive from May 20, 1993, the date our (now called) Constitution and Bylaws were adopted. Thus, if any individual or organization gave a gift sum to the Society after May 20, 1993, this is now considered a tax-deductible item. Even if we do not have employees, we had to request an Employee ID number (54 - 1709985). It was also received this year in case you need it. We can use gifts to the Society and I am encouraging members and friends of our society to augment the very low membership fees with gifts, so that we could expand our programs and set up an emergency fund for future use. Contributions of up to \$250.00 are not required by the IRS to have a written substantiation by the Society to the donor.

Only Anne C. Lund, our able Secretary-Treasurer, Richard L. Hoffman, and I, know how much documentation (two applications each with 9 enclosures), and correspondence it takes to convince the IRS about one worthy cause with VNHS. The Society received from the IRS an advance ruling for a period of 5 years, ending December 31, 1997 when, within 90 days, we have to prove again our public support requirements to receive the final ruling. Because the IRS required it, we also had

to submit to the IRS five amendments to our Constitution. These are listed in section 4, p. 41, and need to be approved by the majority of the responding membership. Please return the ballot to Anne C. Lund.

All of you who are reading this report are familiar with the first four issues of *Banisteria*, which are considered important milestones in the scientific knowledge of the natural history of Virginia. Our two co-editors (Joseph C. Mitchell and Richard L Hoffman) should be congratulated for their special efforts as volunteers, to start the serial and to keep it going already for two years. Similarly, our thanks are due to the Associate Editors, the many reviewers of articles, and especially to Rick Boland, our Production Consultant, for his talents with *Banisteria*.

Anne Lund, who has served the Society for two years as our indispensable Secretary-Treasurer and also hosted our Executive Committee Meetings, deserves thanks. She kept us out of red ink to date, and hopes to continue so with your financial and moral support.

We are all indebted to C. Barry Knisley, Vice President and the Society's next President from January 1, 1995, for his work on the Constitution and Bylaws of the Society and for organizing and successfully conducting our first official Section Meeting "Biodiversity and Natural History" in conjunction with the Annual Meeting of the Virginia Academy of Sciences (VAS) in May this year. Because of the excellent attendance, our Section became a permanent Section of the VAS for the future. Please start planning now to attend the meeting next May and to give a paper.

The routine for the two yearly meetings of the Society was established: one in fall for the Executive Committee, and one in the spring for all the membership during our Section meeting at the Annual Meeting of VAS. To keep down the cost of mail balloting, we shall try to elect new officers at the latter general public meeting.

I would like to see more regional field trips organized by the Society, especially to ecologically unique areas and where the protection of the biota requires our attention. Also let's make heard our voice on the acute environmental issues facing Virginia. In this regard our Society, with Joseph Mitchell's initiative, sent a statement last August to the Norfolk District Corps of Engineers Office, asking suspension of the Department of the Army's National Permits for excavations and fill activities in the Grafton Plains area of Virginia. We also expressed favor of the development of a Special Area Management Plan that will help to protect the biological diversity of this unique

area.

Although our Society's letterhead was approved last year, the Society is still without a logo. Would our much talented members suggest one for consideration? Please send your sketches (they do not have to be artistically finalized) to Anne Lund before the end of the year. If there is no better idea and no true competition, I shall submit mine, that I designed and finalized with an artist, depicting the state bird, state insect, state tree, flowers, and the Virginia white-tailed deer.



As I asked the members of the VNHS leadership earlier, I am extending the same request to each member now: please bring in three of your friends, colleagues, or students as members of the Society. I already did my share; how about you? The cost of bulk mailing *Banisteria* to members will be drastically reduced if we could mail at least 200 copies at one time. Would you invite prospective members to submit an article free for printing in our refereed journal? We can print more articles in each issue without substantial increase in cost. We can use some articles in Geology, Ornithology, Limnology, and Mycology to enrich our coverage. If you have colleagues writing in these areas, would you please solicit their contributions? Is your institution's library a subscriber of *Banisteria*? If not, please request it. For \$30 per year, it is a bargain for libraries.

Last, but not least! It was a real pleasure for me to work with a dedicated group of volunteers. Persons who sacrificed their weekends to meet and work toward the initiation and establishment of the Virginia Natural History Society. Colleagues who would not accept

compensation for their services provided during the crucial first two years an excellent start for the Society. I feel good that I am able to leave in good hands the future of the Society. I also wish to all members success in promoting the study of Virginia and in educating the citizens of the Commonwealth about conserving their natural heritage.

Michael Kosztarab
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Blacksburg, VA 24061-0542

3. Report of the Secretary/Treasurer

The first business meeting of the Virginia Natural History Society as a section of the VAS was attended by 25 members and potential members of the Society. The topics of business included the call for papers and short reports to be published in the society's journal *Banisteria*. Ways to increase membership was also discussed. The group was informed that members of the VNHS did not have to be members of the VAS to attend the annual meeting, but such membership is encouraged. Members attending the section meeting will have to pay the registration fee, like everyone else. Members presenting papers in the VAS section known as Natural History and Biodiversity must also be members of the VAS. The VAS incurs some costs to set up the section for us and publish the abstracts in the Virginia Journal of Science. The VNHS will hold its annual business meeting during the day on which the section is scheduled.

During the 1994 business meeting, the Secretary/Treasurer reported that the VNHS had a balance on hand of \$2027.00. Membership dues of \$15.00 was almost completely used to pay for journal costs and mailing. There is little extra to cover other expenses and thus additional members and donations are desired.

As of the last week in September 1994, the membership is 130 strong. This includes several libraries within the state. \$2200.00 is on hand in the Treasury. Over half of this amount will be expended on the journal and mailing before the end of the year.

Anne C. Lund
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Hampden-Sydney, VA 23943

4. Amendments to the Constitution

In compliance with requirements of the IRS to obtain tax exempt status (see remarks in the President's statement above), the phraseology in several articles of the VNHS constitution has been slightly altered. The new text is given below:

Amendment 1. Change, in the title, the words "Articles of Incorporation" to "Constitution" and the same change in the first centered heading.

Amendment 2. Addition to Article V. Finances, of the Bylaws, Section 1, to begin with the following sentence: "The Society is organized exclusively for scientific purposes, including such purposes, the making of distributions to organizations under Section 501(c)(3) of the Internal Revenue Code (or the corresponding section of any future Federal tax code.)"

Amendment 3. Article V. Finances, Section 2, the entire paragraph to be replaced with the following text: "No part of the net earnings of the Society shall inure to the benefit of, or be distributable to its members, trustees, directors, officers, or other private persons, except that the Society shall be authorized and empowered to pay reasonable compensation for services rendered and to make payments and distributions in furtherance of Section 501(c)(3) purposes. No substantial part of the activities of the Society shall be the carrying on of propaganda, or otherwise attempting to influence legislation, and the Society shall not participate in, or intervene in (including the publishing or distribution of statements) any political campaign on behalf of, or in opposition to, any candidate for public office."

"Notwithstanding any other provision of these articles, the Society shall not carry on any other activities not permitted to be carried on (a) by an organization exempt from Federal income tax under Section 501(c)(3) of the Internal Revenue Code (or corresponding section of any future Federal tax code) or (b) by an organization, contributions to which are deductible under Section 170(c)(2) of the Internal Revenue Code (or corresponding section of any future Federal tax code)."

Amendment 4. Article V. Finances, Section 4. The text of this paragraph, starting with line six, to be replaced with the following text: "...has established its tax exempt status under Section 501(c)(3) of the Internal Revenue Code, or to the Federal Government or a state or local government for a public purpose. The specific non-profit organization or organizations to receive any remaining funds may be determined and approved by the

Executive Committee."

Amendment 5. Article IX. Amendments. Change "Articles of Incorporation" to "Constitution and Bylaws" in the title, in line 1 of section 1, and line 6 of Section 2.

Announcements

1. Kudos to President Kosztarab.

Dr. Michael Kosztarab, professor emeritus of the Department of Entomology, VPI&SU, and out-going President of the VNHS recently received the Association of Systematics Collections (ASC) Annual Award for Service. It was presented during the ASC Annual Banquet on 12 May 1994. This award is presented annually to an individual who has performed exceptional service to systematics collections and the systematics community. Dr. Kosztarab received the award for spending years working toward the establishment of a national biological survey in the United States, for organizing a biological survey effort at VPI&SU, and for starting a museum of natural history at the university. He was recognized for maintaining a positive and optimistic attitude in the face of many setbacks on the way to his goals. Past recipients of the ASC service award include Steven J. Gould, Peter Raven, and Edward O. Wilson. The officers, editors, and members of the VNHS congratulate Michael for his accomplishments and this prestigious award.

2. Appalachian Biogeography Symposium.

The first symposium on Appalachian Biogeography was held in 27-29 June 1968 and resulted in three volumes covering the flora, invertebrates, and vertebrates of the region. A second symposium designed to update this topic is being organized for 25-29 June 1995 by Ralph P. Eckerlin and others. Papers are being sought on botany, geology, invertebrate biology, paleobiology, paleoclimatology, physical geography, and vertebrate biology.

Those interested in presenting papers or posters should contact Dr. Eckerlin, Natural Sciences Division, Northern Virginia Community College, 8333 Little River Turnpike, Annandale, VA 22003-3796 (703-323-3234, FAX 703-323-3215) as soon as possible. The proceedings of the symposium will be published.

3. Forthcoming Meetings

Association of Southeastern Biologists - 19-21 April 1995, University of Tennessee, Knoxville. Contact Beverly Collins, Savannah River Ecology Lab, Aiken, SC 29802.

Virginia Herpetological Society - April 1995, weekend field trip site not selected. Contact Bob Hogan, P.O. Box 603, Troutville, VA 24175.

Virginia Society of Ornithology - 5-7 May 1995, Williamsburg, VA; in conjunction with the Wilson Society. Contact VSO, 520 Rainbow Forest Dr., Lynchburg, VA 24502.

VNHS - 23 May 1995, Washington and Lee University, Lexington, VA, with the Virginia Academy of Science.

4. New Publications of Interest

New systematics video - *Phylogenetics Systematics Video, Concepts and Application*. Copyright 1992 by E. G. Maurakis and W. S. Woolcott. Concepts and application of phylogenetic systematics are presented in a two-part 25-minute video. Part I describes the development of a cladogram. In part II, cladistics is applied to an ethological phylogenetic analysis of relationships among cyprinid minnows that breed over gravel substrates. Much of the work was done in Virginia. The video is accompanied by an instructor's manual. U.S standard video format (NTSC) and PAL/SECAM formats available. Contact Gene Maurakis, Science Museum of Virginia, 2500 West Broad St., Richmond, VA 23220 (804-367-6795).

New book: *Amphibians and Reptiles of Assateague and Chincoteague Islands*, by Joseph C. Mitchell and John M. Anderson, published in December 1994 by the Virginia Museum of Natural History. This book provides information on some of the islands' most secretive inhabitants, the amphibians and reptiles. Most of the frogs, salamanders, turtles, lizards, and snakes have occupied these islands since they were formed thousands of years ago. Each of the seven species of amphibians and eighteen species of reptiles can be readily identified using the keys, color photographs, and descriptions in this book. Many interesting aspects of their biology are summarized in

highly readable form. 128 pages, softcover, 6 x 9 inches, 27 color photos, \$14.95. Order from Publications Dept., Virginia Museum of Natural History, 1001 Douglas Ave., Martinsville, VA 24112 (phone 703/666-8631).

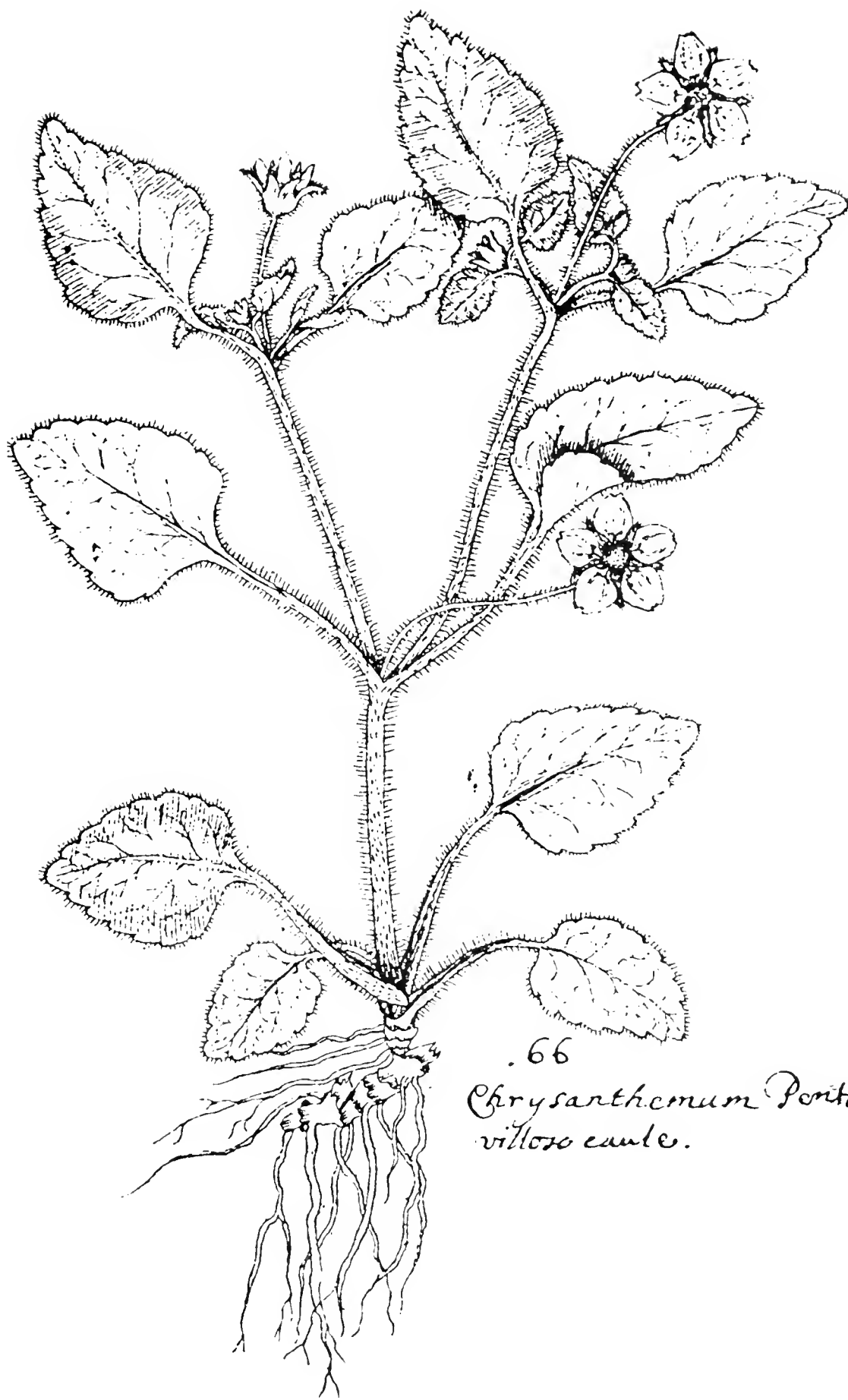
5. **Banisteria** is expanding the range of articles contained in its pages. The editors are especially seeking manuscripts on the biographies of people who have contributed to the natural history of Virginia. These articles could be exhaustive descriptions of the person's life and accomplishments, his or her contributions to the natural history of the Commonwealth, or a review of a particular phase in his or her life. Photographs and lists of publications are welcomed. There are few places where historical information about our colleagues is published and thus we envision that **Banisteria** could fill a long-standing void.

In addition, we are seeking book reviews from anyone who wishes to describe and critique books related in some way to the natural history of Virginia. We are also seeking essays on current issues or subjects pertaining to natural history. Essays can be of any length. The editors reserve the right to seek additional essays on the topic in question so that more than one view can be published. Letters to the editor are also welcomed.

Biographies, book reviews, essays, and letters to the editor should be sent to Joseph C. Mitchell, Department of Biology, University of Richmond, Richmond, VA 23173.

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Information on upcoming meetings, symposia, and other items of interest to members of the Virginia Natural History Society should be sent to the editors.



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Chrysanthemum Pentasetalon,
villosa caule.

Chrysogonum virginianum Linnaeus

Original drawing by John Banister. Figure 83 in folio in Hans Sloane's MS 4002 in the British Museum. Photocopy courtesy of Joseph and Nesta Ewan.

