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History of Araneology in Virginia

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ABSTRACT

At least from the 1600s to the present, spiders have been observed, collected, and studied in Virginia. This paper endeavors to outline the history of araneology in Virginia from its inception through the first decade of the 21st century, including researchers of spiders at Virginia institutions and those who have studied Virginia spiders.

Key words: araneology, history, spiders, Virginia.

INTRODUCTION

The study of spiders in Virginia has a venerable history, beginning in the 17th century and continuing to the present. Through the efforts of natural historians, entomologists, and ecologists, we know much about these important arachnids, but distributions and even the presence of some species in Virginia remain to be discovered. In the 20th and 21st centuries, quantitative, manipulative studies have increasingly replaced anecdotal observations, and spiders are used as model organisms to address ecological and evolutionary hypotheses.

17th Century

Perhaps the first person to collect spiders in Virginia was John Banister (1650-1692), an Englishman who arrived in Virginia in 1678. Banister was a careful observer; Lewis (1957) called science writers before Banister "historians rather than scientists." She judged that natural history in America actually began with Banister.

By 1680, Banister had composed a catalog of insects called *Collectio insectorum*. Spiders appeared under "*De Insectis Pedibus Octonis*"; harvestmen were called spiders; silverfish were called "stingless scorpions." As late as the time of Linnaeus, scorpions and spiders were placed with silverfish in the insect order Aptera (Ewan & Ewan, 1970).

Banister died when accidentally shot while botanizing on the Roanoke River in 1692, before seeing publication of his works on insects. He had been planning a *Natural History of Virginia* (Lewis, 1957). Instead, "Some Observations concerning Insects made by Mr. John Banister in Virginia, A.D. 1680" was published by Petiver (Banister & Petiver, 1701). Banister was the first to systematically describe any of the spiders of North America; not until between 1791 and 1802 did John Abbot draw the spiders of Carolina and Georgia (Ewan & Ewan, 1970).

Lack of proper attribution by Martin Lister (a 17th century physician and natural historian), who received Banister's specimens in 1680 and data for illustrations by Petiver, kept Banister's Virginia specimens from inclusion in Linnaeus's (1758-1759) *Systema Naturae* (Ewan & Ewan, 1992). Petiver's illustrations were sources for Linnaeus in his establishment of binomials (Ewan & Ewan, 1970). Since spiders were very much a side line to Banister's botanizing and Linnaeus did not knowingly use his collections, it is not surprising that Bonnet (1945) and others were not aware of Banister's contribution.

18th Century

Benjamin H. Latrobe (1764-1820), an Englishman who immigrated to Virginia in 1795-96, was considered the first professional architect in the U.S. and designed the Capitol in Washington (Library of Congress, 2009). His published journal (Latrobe, 1905) is a good example of the nature writing of that time. In it, Latrobe wrote extensively about a spider wasp and a spider near Fredericksburg that he manipulated to see how they would behave. He also opened the mud cells of some wasps and recorded the colors and sizes of the

paralyzed spiders within (no mention is made of any names for the spiders).

19th Century

Between Banister and the early work of Nathan Banks (1868-1953), it is difficult to find records of any Virginians who studied spiders. Banks was a student of John H. Comstock at Cornell University. A New Yorker by birth, he lived in Falls Church, Virginia and published on local spiders (among other taxa) while employed at the USDA in Washington (1890-1916). During this time he published a revision of Marx's 1889 catalog of Nearctic spiders (Banks, 1910). Banks moved to the Museum of Comparative Zoology at Harvard University, where he continued to publish on spiders until at least 1930. He described a number of new species of spiders (Bonnet, 1945), but none of his titles on spiders were specific to Virginia. Exceptionally prolific, Banks authored over 440 technical papers from 1890-1951 and had eight children.

James Henry Emerton, who wrote widely on spiders, including a book on the common spiders of the United States (Emerton, 1902), published a paper on cave spiders, including some in Virginia (Emerton, 1875). In Fountain Cave (Augusta Co.), he found "one young spider allied to *Tegenaria*" and in Weyer's Cave (Rockingham Co.) a species of *Linyphia* with normal eyes; he noted that some specimens of the latter species had colors as bright as those of spiders of the same family from cellars or shady woods.

Increasingly in the 20th and 21st centuries, cave animals are endangered, and several more recent papers include spiders of Virginia caves. John R. Holsinger at Old Dominion University has published several papers on cave faunas, including spiders. A list of all identified spiders that have been found in caves in Virginia (obligate and accidental) can be found in Holsinger & Culver (1988). A new review paper will include additional obligate cave spider records (Holsinger et al., *in press*).

In 1888, when the Virginia State Agricultural Experiment Station was established by an Act of Congress, serious work on insects was initiated in Virginia (French, 1950), but because spiders are not crop pests, they have never been studied as much as insects.

20th Century to Present

Between November 1936 and March 1937, there was a flurry of notes in *Science* by various authors concerning the distribution of the black widow spider (*Latrodectus mactans*). D. C. Lowrie began the conversation by saying that the black widow had not been officially recorded in eight states, including Virginia (Lowrie, 1936). G. W. Jeffers countered, "This must come as a surprise to the naturalists of the state," since the black widow was so prevalent that nobody bothered to mention it (Jeffers, 1936). B. J. Kaston returned that the black widow was first recorded from Hog Island in Virginia by J. H. Emerton in 1875 and was also recorded "as abundant in the Norfolk area by L. D. Anderson and H. G. Walker, and from various localities by C. R. Willey. Moreover, Dr. Bogen (Bogen, 1926) cites cases of arachnidism …" (Kaston, 1937). In the same issue, H. A. Allard stated that he had found black widows in four places in Virginia within the last two years (Allard, 1937). R. L. Taylor, who was in the Department of Biology at the College of William and Mary, remarked sarcastically, 'If by "officially recorded," publication in a scientific periodical is meant …' and documented a June 1936 paper in the *Quarterly Review of Biology* (Taylor, 1937). Lowrie must not have seen this document before he submitted his note in November of that year. Taylor continued, "With respect to Virginia, it was rather surprising to find it said that there was no official record from this state since the black widow is common to abundant in most of the state" and cited papers on bites in the *Virginia Medical Monthly*. Additionally, he said, the 1934-1935 *Proceedings of the Virginia Academy of Science* included a paper read by Elizabeth Burger, a graduate student at William and Mary, which included the incidence of arachnidism in Virginia. Taylor continued, "One spring day, Miss Burger and the writer took 50 individuals [black widows] … from the stones of a rock-banded curbing 35 x 2 feet in area" [in the vicinity of Williamsburg] (Taylor, 1937). Elizabeth Burger (Jackson)'s unpublished Master's thesis focused on the black widow spider (Jackson, 1935).

During the latter part of the 20th century until the present, a number of researchers, faculty, and graduate students in Virginia have studied Virginia spiders. However, many spider distributions in the state remain unknown.

Richard L. Hoffman (1927-2012), Curator Emeritus of Recent Invertebrates at the Virginia Museum of Natural History (VMNH) in Martinsville, was a native Virginian who devoted most of his life to the natural history of Virginia and the southern Appalachians, while being the leading authority on the world's millipeds. Hoffman's collection of spiders at the VMNH is the largest in the state, and he kept records of all Virginia spider species based on published literature and this collection. He published 485 scholarly books and papers and over 50 popular articles on millipeds,

amphibians, reptiles, worms, mollusks, arachnids, beetles, and true bugs; described more than 600 new taxa, including a species of *Hypochilus* from Virginia and West Virginia (Hoffman, 1963); and had nearly 50 taxa named in his honor (Roble & Mitchell, 2009). Among his numerous publications on spiders were lists of Virginia purse-web spiders (Atypidae), anyphaenids (Anyphaenidae), ground spiders (Gnaphosidae), and grass spiders (*Agelenopsis*) (e.g., Hoffman, 1992, 2000, 2002, 2009, 2010); removal of *Theridion montanum* (Theridiidae) from the Virginia faunal list (Hoffman, 1996a); a description of the type locality and distribution of *Xysticus emertoni* (Thomisidae) (Hoffman, 1996b); and addition of new species such as *Araneus saevus* (Araneidae), *Arachosia cubana* (Anyphaenidae), *Anahita punctulosa* (Ctenidae), and *Drassyllus rufulus* (Gnaphosidae) to the Virginia fauna (e.g., Hoffman, 1997, 2006; Hoffman et al., 2006; Roble & Hoffman, 2012).

Due to the difficulty in maintaining collections of spiders in alcohol, rather than dry, as for insects, some museums do not accept donations of private collections. Thanks to the interest of Richard Hoffman, the VMNH, established in 1988, houses thousands of spiders from Virginia. Soon after the Museum opened, Bill Shear, who was chairman of its Board of Directors, donated his personal spider collection of over 900 vials containing about 300 species (Hoffman, 1991). Shear's collection was mainly from outside Virginia, but Hoffman embarked upon an ambitious effort, in concert with the Virginia Division of Natural Heritage, to sample arachnids across the state. He expected to gather about 800 species of arachnids from Virginia. Thousands of mega-arachnids (not mites) were collected prior to 1991; these yielded a number of new state records and range extensions (Hoffman, 1991). Many more spiders were added to the VMNH collection up until Hoffman's death in June 2012.

At the Ninth International Congress of Arachnology in Panama in 1983, James E. Carico (1937-2009) of Lynchburg College proposed a "new" American spider family, the Trechaleidae (Carico, 1986b). He published revisions of genera in that family as well as in the Pisauridae (e.g., Carico, 1973, 1976, 1993, 2005a; Da Silva et al., 2008), studies on the behavior and anatomy of spiders in these families (e.g., Carico & Holt, 1964; Carico, 1986a; Bruce & Carico, 1988; Costa-Schmidt et al., 2008), and descriptions of new genera (e.g., Carico, 2005b). Carico served terms as President of the American Arachnological Society and Editor of its publication, *The Journal of Arachnology*.

James O. Howell completed his Master's thesis at Virginia Tech on "Spiders of alfalfa with notes on the biology of *Tetragnatha laboriosa* Hentz" (Howell, 1969). With his advisor Robert L. Pienkowski, he wrote the classic paper in the Journal of Economic Entomology, "Spider populations in alfalfa, with notes on spider prey and effect of harvest" (Howell & Pienkowski, 1971). The introduction in this paper is credited with showing that experimental studies of spiders in American agriculture were mostly absent at that time (Bell, 2005). The study itself used a D-Vac® to sample the litter and upper soil and 500-sweeps of a 15-in diameter net to take spiders on the alfalfa at one-week intervals during the warm months (monthly during the colder months) from March 1967 to June 1968. Several samples were taken at three-hour intervals during a twenty-four hour period to assess time of day on sampling efficiency. Temperature and humidity readings were taken. Over 4,000 spiders in 15 families and 124 species were collected. The attention to environment, season, and time of day effects, scope of the sampling, and addition of laboratory feeding tests to address what the spiders were actually eating in the alfalfa mark this paper as one of the most thorough of the early studies of spiders in crop fields.

In an example of the observational approach to studying spiders, Laura Elsa Sabath collected an individual *Gea heptagon* from her web in a lawn in Portsmouth, Virginia, put her into a terrarium, and observed the spider until she died (Sabath, 1969). Sabath's motivation was to study a spider that was not currently being used by other experimenters, and one that, although widespread, had not been studied extensively. She made observations on rapid change of the spider's color after it fell to the ground when disturbed, web spinning, feeding, the egg sac, and spiderlings.

J. P. McCaffrey and R. L. Horsburgh of Virginia Tech's Shenandoah Valley Research Station studied spiders in Virginia apple orchards and used limb beating as a sampling method for collecting spiders on apple trees. They documented that the proportions of hunting spiders in current vs. abandoned orchards were similar in most cases. The spider species exhibited niche separation on different parts of the trees; the authors thought that this might facilitate suppression of insect pests (McCaffrey & Horsburgh, 1980). Another study evaluated time of day and season as factors in sampling results using limb beating. *Clubiona* spp., which are nocturnal, were captured significantly more often at 0300 h, while salticids and total spiders were collected more during 0900 and 1800 h. Limb beating was deemed a satisfactory method for collecting both web-building and hunting spiders, but spiderlings of some (*Philodromus*) were not captured efficiently by this method (McCaffrey et al., 1984).

C. L. Steitenroth (with Norm Horner at Midwestern

State University) published an account of 18 genera and 30 species of jumping spiders of the Virginia Peninsula (Steitenroth & Horner, 1987). The study produced records of five species new to the state.

William A. Shear of Hampden-Sydney College has published more than 200 papers and book chapters, primarily relating to classification and evolution of arthropods, and is the co-author or editor of two books, including *Spiders: Webs, Behavior and Evolution* (Shear, 1986). His paleontological studies began in 1980; more recently he returned to taxonomy and to a new direction in ecological chemistry. He has published notes in *Banisteria* on a leptonetid and a pholcid new to Virginia (Shear, 2007; Clark & Shear, 2010) and was chief scientific consultant, script editor, and on-camera participant for the film, "Ultimate Guide: Spiders," broadcast on 9 July 2001 on the Discovery Channel.

A paper published by Shear and colleagues on a fossil spider from New York extended the fossil record of non-araneomorph spiders back to the Devonian (Selden et al., 1991). A later paper including a fossil Virginia spider from the Triassic was published by Nicholas C. Fraser of the VMNH and co-workers (Selden et al., 1999). These specimens represented the oldest known fossil araneomorph spiders and extended the fossil record of that group back significantly. Shear and colleagues also published papers on fossil evidence of the origin of spider spinnerets, which are considered the defining adaptation of spiders (Shear, 1989; Selden et al., 2008). In the 2008 study, fossil evidence was combined with developmental genetic studies to clarify how use of silk may have evolved in spiders.

Brent Opell's research at Virginia Tech is an example of the modern experimental, quantitative approach to studying spiders. Early studies of Virginia *Hyptiotes* (Uloboridae), for example, showed that web production of early instars is independent of container size (Opell, 1982). Opell also has published a revision and a checklist of American Uloboridae (Opell, 1979; 1983). His research currently focuses on spider systematics and integrative biology using morphological and molecular characters and phylogeography (Opell Lab, 2009). These studies have produced numerous papers on the viscous capture threads of orb weavers (e.g., Opell & Hendricks, 2009). These and other studies on spider morphology, behavior, genetics, and evolution (e.g., Opell, 1984, 1990, 1998, 2010; Opell & Bond 2001; Opell et al., 2007) are of broad interest to spider systematists and ecologists.

Michael W. Beck and Edward F. Connor of the University of Virginia and Blandy Experimental Farm conducted a study examining the importance of covariance in traits related to foraging, between developmental stages of the crab spider *Misumenoides formosipes* (Beck & Connor, 1992). They found that prereproductive weight and fecundity were highly correlated to carapace width. Growth of spiders fed *ad libitum* in the laboratory was unrelated to size, which suggested that size in the field was related to prey-capture success. Small females (measured by carapace width) did not reproduce, although they constituted a significant proportion of the population. The authors emphasized examining stage-specific constraints in order to understand the effects of foraging on reproductive success.

While at Virginia Commonwealth University, Stephen R. Johnson studied spiders of early successional stages of a barrier island (Hog Island) that is part of the Virginia Coast Reserve. He found that spider diversity and density differed more between sites than between shrub species (*Baccharis halmifolia* and *Myrica cerifera*) (Johnson, 1996).

Steven M. Roble of the Virginia Department of Conservation and Recreation's Division of Natural Heritage recorded a range extension to Virginia for *Gasteracantha cancriformis* (Roble, 1994). Roble often collaborated with Richard Hoffman, co-authoring several papers on spiders (and other taxa) new to the Virginia fauna (Hoffman & Roble, 2012 [three wolf spiders]; Roble & Hoffman, 2012 [*Drassyllus rufulus*]).

The author of this paper published a preliminary list of the spiders of the Great Dismal Swamp (Abraham, 2000), as well as a list of the spiders found during the Potomac Gorge Bioblitz (Abraham, 2008). Although other faunal lists for the Great Dismal Swamp date from much earlier, Abraham's list is the first for the spiders of the Swamp. The list includes 14 families, 43 genera, and 56 species. Likewise, the list of Potomac Gorge spiders, albeit incomplete, is the first specific to that area (although many spiders had previously been collected in and around the Washington, D.C. area). The Potomac Gorge Bioblitz list included 37 species in 29 genera and 12 families.

Anne Danielson-Francois, Christine A. Fetterer, and Peter D. Smallwood (the latter two authors are from the University of Richmond) published a paper on body condition and mate choice in *Tetragnatha elongata* (Danielson-Francois et al., 2002). They found that males preferred longer, heavier females with higher body condition. This study may have been the first to show the influence of body condition on mate choice in spiders. Smallwood had previously published a study on web site tenancy in this species that challenged a model of risk-sensitive foraging and emphasized the importance of considering multiple scales in ecology (Smallwood, 1993).

Rachel E. Mallis and Lawrence E. Hurd at Washington and Lee University studied ground-

dwelling spider assemblages in the Science Park at their institution with pitfall traps (Mallis & Hurd, 2005). They collected 50 species from six sites, but found no correlation between spider assemblages and successional stage of the habitat. They thought that spider community composition is generally unpredictable, due to stochastic colonization and specific resource requirements following immigration.

While at the University of Virginia, Lily Ahrens and Johanna M. Kraus (Kraus is now at Washington and Lee University) reported on wolf spider movements along a pond edge at Mountain Lake Biological Station, near Pembroke, Virginia using mark-recapture. In contrast to previous studies, in this study wolf spiders (*Pardosa* spp.) moved little in time or space, although the short-term (summer) and small spatial scale (meters) of this study may have had an impact (Ahrens & Kraus, 2006).

At the 2008 Virginia Academy of Science meetings, Marc A. Milne, then a graduate student of Deborah Waller at Old Dominion University, presented on nectar feeding by spiders of three families: Linyphiidae, Lycosidae, and Agelenidae. His dissertation concerned spiders associated with the purple pitcher plant (*Sarracenia purpurea*) in Virginia and North Carolina (Milne, 2010). From this research he published a paper on the purple pitcher plant as a spider oviposition site (Milne, 2012).

Already in 1990, the lack of support for taxonomic arachnology was lamented (Coddington et al., 1990). The situation is not as dire for spiders as for other arachnid groups, but few young scientists enter the field due to a lack of open, funded positions (Coddington et al., 1990). There is yet much remaining to be discovered about spiders in Virginia, as well as the rest of the world, in 2013, and conservation of these important predators is not well served by the lack of information. Virginia is lucky to have the VMNH, the Division of Natural Heritage, and the extant individuals mentioned above to carry on the study of the state's spiders, but new recruits and funding are necessary if complete information on the presence and distribution of spiders in Virginia is to be obtained.

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