

VIRGINIA MUSEUM OF NATURAL HISTORY
Board of Trustees Research and Collections Committee

Saturday, Nov. 21, 2020
9:00-9:45 a.m. via Zoom meeting

A G E N D A

- Call to order (Evans)
- Roll Call: Dr. Art Evans, Dr. Tom Benzing, Dr. Carole Nash, Lisa Moerner, Melany Stowe
- Approve August 2020 Research and Collections Committee meeting minutes (action item)
- Approve July-September 2020 acquisitions (action item)
- Consider Dr. Jackson Means' nomination as VMNH Research Associate (action item)
- Committee Guidance for online meetings (informational item, Benzing)
- Impact of COVID-19 on Research and Collections (discussion)
- Disposition of Guatemalan street art collection (informational, Keiper and Bassett)
- Article: Regional collections are an essential component of biodiversity research infrastructure (informational, Evans)
- Other business
- Adjourn (Evans)

The mission of the Virginia Museum of Natural History:

To interpret Virginia's natural heritage within a global context in ways that are relevant to all citizens of the Commonwealth.

**VIRGINIA MUSEUM OF NATURAL HISTORY BOARD OF TRUSTEES
MINUTES OF THE RESEARCH AND COLLECTIONS COMMITTEE MEETING
Aug. 15, 2020**

Present at the online meeting were Dr. Art Evans, Dr. Tom Benzing, Lisa Moerner, Dr. Carole Nash, Dr. Joe Keiper, Dr. Nancy Moncrief, Dr. Kal Ivanov, Dr. Adam Pritchard, Dr. Hayden Bassett, Zach Ryder, and Ben Williams. Committee member Melany Stowe was absent.

- Committee Chairman Dr. Art Evans called the meeting to order.
- The minutes were unanimously approved with the addition of an amendment that Dr. Carole Nash is willing to serve on the Research and Collections committee.
- Due to the meeting taking place online, the new acquisitions sign-off sheet is being distributed to committee members electronically. Ben Williams will submit the sheet to VMNH Registrar Jill Harris once all signatures have been collected. During the discussion of new acquisitions, Dr. Nancy Moncrief highlighted that the museum received an additional nine-banded armadillo collected in Virginia. These armadillos are apparently expanding their range into the southeast, according to Dr. Moncrief.
- In the category of other business, Dr. Art Evans said that he was impressed with the work that curators and staff have done with virtual outreach during the pandemic, and that he hopes those efforts will continue once things return to a new normal. He added that if there is anything the board can do to assist with those virtual efforts to please let him know.
- Dr. Art Evans introduced VMNH Assistant Curator of Archaeology Dr. Hayden Bassett, who will assume his new position on Aug. 31, and asked Dr. Bassett to speak about his career. Dr. Bassett said that he began his archaeology career at VMNH working under former Curator of Archaeology Dr. Elizabeth Moore as a high school intern. He received his undergraduate degree from the University of Virginia and attended the College of William and Mary for his Masters and doctorate. Dr. Bassett worked in Jamestown as a curator for a year and a half and has worked with the U.S. Navy for the last three years, conducting archaeological projects in Kenya, Djibouti, Somalia, Bahrain, Italy, Greece, and the Caribbean, among other locations. As a native of the Martinsville area, Dr. Bassett said that he is intimately familiar with the archaeological sites in the region and working on those sites is a “dream job.” He has already begun engaging with grant funding to hit the ground running and will begin excavations along the Smith River shortly after starting at the museum. He plans to excavate archaic through woodland era villages that thrived along the Smith over a period of 200 years, principally investigating why those villages flourished while similar agricultural societies in North Carolina saw decline during the same period. Dr. Bassett also has another grant in the pipeline that will allow for more substantial work along the Smith River from

the Philpott Dam to the Smith River Sports Complex. Additionally, Dr. Bassett said that he continues to work with the Department of Defense as part of a rebuilding program similar to the World War II era "Monuments Men." This will include occasional deployments of one to two weeks to preserve important archaeological sites overseas.

- Lisa Moerner moved to adjourn the meeting, and the vote was seconded by Dr. Carole Nash. All members approved the motion to adjourn during a roll call vote by Ben Williams.

JULY-SEPTEMBER 2020 VMNH ACQUISITIONS FOR APPROVAL BY BOARD OF TRUSTEES RESEARCH AND COLLECTIONS COMMITTEE

RIM* No.	Collector/Donor	Date at VMNH	VMNH Dept.	Quantity	Description	Method	To Be Accessioned
RIM 18-2020	Jackson Means	07/06/2020	RECENT INVERTEBRATE	54	unidentified ethanol-preserved ants	GIFT	YES
RIM 19-2020	Dr. Adam Pritchard	07/29/2020	PALEONTOLOGY	13	matrix with small fossil inclusions	FIELD	YES
RIM 20-2020	Jeffery Carpenter	08/03/2020	PALEONTOLOGY	1	1 jaw bone (in two pieces) snake (unknown species)	GIFT	YES
RIM 21-2020	Curt W. Harden	08/17/2020	RECENT INVERTEBRATE	44 vials	ethanol preserved invertebrates	GIFT	YES
RIM 22-2020	Ben Williams	07/22/2020	HERPETOLOGY	1	Rough Green Snake (<i>Opheodrys aestivus</i>)	SALVAGE	YES
RIM 23-2020	Liberty Hightower	07/28/2020	MAMMALOLOGY	1	white-tailed deer, fawn (<i>Odocoileus virginianus</i>)	SALVAGE	YES
RIM 24-2020	Liberty Hightower	07/25/2020	ORNITHOLOGY	1	American Crow (<i>Corvus brachyrhynchos</i>)	SALVAGE	YES
RIM 25-2020	Nancy D. Moncrief	08/20/2020	MAMMALOLOGY	6	Cotton Rat (<i>Sigmodon</i> sp.)	SALVAGE	YES
RIM 26-2020	Arthur V. Evans	09/16/2020	RECENT INVERTEBRATE	1457	pinned specimens	GIFT	YES
RIM 27-2020	Robert Ostrom	09/16/2020	RECENT INVERTEBRATE	1557	pinned specimens	GIFT	YES
RIM 28-2020	Dr. Adam Pritchard	09/16/2020	PALEONTOLOGY	19	~12 matrix blocks with shell molds and bones; and 7 shark teeth	FIELD	YES
RIM 29-2020	Michael Stevens	12/05/2019	PALEONTOLOGY	24	4 fish fossil skeletons and 20 Morrison fossil fragments	GIFT	YES
RIM 30-2020	Adam Pritchard	09/16/2020	PALEONTOLOGY	17	boulder with reptile bones; 16 matrix blocks with plant/small animal fossils	FIELD	YES

*RIM is an acronym for the Record of Incoming Material form

JULY-SEPTEMBER 2020 VMNH ACQUISITIONS FOR APPROVAL BY BOARD OF TRUSTEES RESEARCH AND COLLECTIONS COMMITTEE

VMNH Collections Committee and Executive Director have Approved Recent Acquisitions: RIM 18-2020 through RIM 30-2020

VMNH Board of Trustees Research & Collections Committee Review of Acquisitions: RIM 18-2020 through RIM 30-2020

Arthur V. Evans, Chair

(signature) Arthur V. Evans, Chair

Date

Thomas R. Benzing

(signature) Thomas R. Benzing

Date

Lisa C. Moerner

(signature) Lisa C. Moerner

Date

Carole L. Nash

(signature) Carole L. Nash

Date

Melany Stowe

(signature) Melany Stowe

Date

(signature)

Date

*RIM is an acronym for the Record of Incoming Material form

**VIRGINIA MUSEUM OF NATURAL HISTORY
RESEARCH AND COLLECTIONS ACTIVITIES**

**Report to the Board of Trustees
July-September 2020**

**Kaloyan Ivanov, Ph.D.
Associate Curator of Invertebrate Zoology**

- Drs. Keiper and Ivanov manuscript “Field observations of scorpionflies (Mecoptera: Panorpidae) and signal flies (Diptera: Platystomatidae) at animal carcasses” is (still) in press at Entomological News.
- Dr. Ivanov and VMNH Research Associate J. Gibson have two field notes in review at the Virginia Herpetological Society’s periodical *Catesbeiana*.
- Dr. Ivanov is co-teaching an online course at Hampton University with Dr. Shawn T. Dash.
- Dr. Ivanov participated in VMNH’s first “Drive-thru Dino Experience” on July 30 and interacted with more than 200 visitors.
- Dr. Ivanov took part, as a panelist and a participant, in the inaugural Virginia BioBlitz 2020 organized by the Virginia Academy of Sciences.
- Drs. Ivanov and Keiper completed consulting work on a forensic case and submitted final report concerning a litigation under the Endangered Species Act by the PETA Foundation.
- Dr. Ivanov and VMNH Research Associate Dr. Steven Roble completed editorial work on the newest addition to the museum’s “Insects of Virginia” series, which was published in mid-September.

Research & Collections

Drs. Keiper and Ivanov manuscript “Field observations of scorpionflies (Mecoptera: Panorpidae) and signal flies (Diptera: Platystomatidae) at animal carcasses” is currently in press at Entomological News. The release of the August issue of the journal has been delayed.

[Keiper, J. B. and K. Ivanov. 2020. Field observations of scorpionflies (Mecoptera: Panorpidae) and signal flies (Diptera: Platystomatidae) at animal carcasses. Entomological News 29(3), (in press)]

Dr. Ivanov and VMNH Research Associate J. Gibson have two field notes in review at *Catesbeiana*. The papers describe the diet of two uncommon Virginia toad species, the Eastern Narrow-mouthed Toad (*Gastrophryne carolinensis*) and the Oak Toad (*Anxyrus quercicus*), based on recently collected specimens from Sussex Co., VA. The papers provide additional information on the diet of these unusual species and the data suggest that ants play an important role in their diet in Virginia as they do elsewhere. The diet of these species in Virginia has not been previously studied.

[Ivanov, K. and J. D. Gibson. Field notes: *Gastrophryne carolinensis* (Eastern Narrow-mouthed Toad) Diet. *Catesbeiana*. (in review)]

Ivanov, K. and J. D. Gibson. Field notes: *Anxyrus quercicus* (Oak Toad) Diet. Catesbeiana. (in review)]

VMNH Collections Assistant Dr. J. Means, Dr. Ivanov, and B. Williams continued work on drafting a manuscript regarding the recent discovery of a second population of the rare Laurel Creek millipede *Apheloria whiteheadi* in Patrick Co., VA. Until present, the known global range of this threatened microendemic species comprised a very small area (< 1 km²) in the southern Blue Ridge Mountains.

VMNH Research Associate Curt Harden and Dr. Ivanov, with help from Biology Technician L. Hightower, continued work on a project examining the efficiency of subterranean traps for collecting hypogaeic invertebrate taxa (primarily ants and beetles). Recent work included the collection, sorting, processing, and identification of samples from Graham and Macon Cos., NC, and Patrick Co, VA. To date, 157 subterranean trap samples from North Carolina, Virginia, and West Virginia have been processed. The collected materials include 46 ant species and morphospecies from 25 genera and 6 subfamilies indicating that this technique is effective at sampling hypogaeic ants (and beetles), including rare species not captured by traditional methods. Results will be presented at the upcoming virtual meeting of the Entomological Society of America in November 2020. This research currently is being extended into a manuscript for publication.

Dr. Ivanov and L. Hightower continued work on the biology and natural history of the cavity-dwelling ant *Strumigenys rostrata*. Recent work included field collections and processing of colonies to fill-in existing data gaps, as well as measurements of immature stages, and laboratory dissections of reproductives. Additional work included the collection and processing of yellow and red pan trap samples from Martinsville, VA. The purpose of this component of the study was to catch the onset of the mating flight of this species which, based on preliminary findings, is suspected to occur between September and October. Unfortunately, no *S. rostrata* reproductives have appeared in the collected samples to date.

Drs. Ivanov and Moncrief, and L. Hightower continued work on a project aimed at assessing skeletal injuries in members of the tree squirrel genus *Sciurus*. Recent work included statistical analyses of data using binomial and multinomial approaches. The large dataset compiled by Dr. Moncrief allowed for hypotheses testing regarding the prevalence of breaks in the axial and appendicular skeletons of two North American species of *Sciurus* based on their locomotor mode, age, sex, and habitat preferences (urban vs. rural).

Dr. Ivanov summarized data on 271 ant records (46 taxa) from Northampton Co., VA as part of an ongoing project with Dr. S. Dash and colleagues on the ant diversity of Delmarva Peninsula.

Virginia Tech graduate student Morgan Malone and Drs. Taylor, Ivanov, and Schürch prepared and submitted an abstract to the upcoming virtual meeting of the Entomological Society of America. The study presents new data on the distribution of the invasive red imported fire ant, *Solenopsis invicta*, in Virginia.

During the last quarter, VMNH Collections Assistant Dr. Means has made a substantial progress towards updating, curating and inventorying VMNH's extensive Diplopoda (millipedes) holdings, one of North America's premier millipede collections.

Dr. Ivanov is currently working on the identification and curation of >400 Hymenoptera (ants, bees, and wasps) specimens as part of final reporting for the "James River Park System Insect Inventory" project conducted by VMNH Research Associate and Board of Trustees Member Dr. A. Evans. The goal of this study is to provide a comprehensive list of the insect fauna of the area using a wide variety of collecting approaches. A large fraction of the materials generated by this work will be donated to VMNH once the project is completed.

Dr. Ivanov processed, identified, and curated >300 recently collected and backlogged wasp specimens, the majority of which were incorporated into VMNH's invertebrate holdings. The remainder of the specimens (sorted to family) are currently temporarily housed in the Recent Invertebrates lab awaiting further processing. The identified materials represent 50 species of 16 different wasp families. Of these, 16 species are new to VMNH's collection.

Dr. Ivanov processed, identified (where possible), and curated 237 backlogged specimens from 8 insect orders, which were incorporated into the museum's invertebrate holdings.

Dr. Ivanov, with help from L. Hightower, identified (where needed), curated, and inventoried VMNH's holdings of the family Silphidae (carrion beetles and allies). The museum's 976 silphid specimens represent 13 species chiefly of Virginia origin.

L. Hightower, with help from Dr. Ivanov, inventoried and added to VMNH's collection 16 carrion beetles (Silphidae), 4 hide beetles (Trogidae), and 16 weevils and allies (Curculionoidea) from a recent donation by VMNH Research Associate Dr. A. Evans.

VMNH Collections Manager H. Cartmell, with help from Dr. Ivanov, completed the update and reorganization of VMNH's fluid-preserved Bivalvia (mussels, clams, and allies; 412 lots) and is currently working on organizing a backlogged loan of ~350 vials of opilionids (mostly *Leiobunum*) identified and returned to VMNH by Dr. J. Schultz (U of Maryland).

Dr. Ivanov satisfied a loan request concerning VMNH's invertebrate holdings: Atypidae (17 male specimens of *Sphodros atlanticus*, *S. coylei*, *S. niger*, and *S. rufipes*) to Dr. R. Fisher (U of Arkansas).

Dr. Ivanov oversaw the acquisition of 44 vials of ethanol-preserved invertebrates (mostly undetermined) from Georgia, Kentucky, North Carolina, South Carolina, Virginia and West Virginia donated by C. Harden; 53 undetermined ethanol-preserved ants and 1 undetermined ethanol-preserved bethylid wasp from Ivory Coast donated by Dr. J. Means; 1450 pinned determined beetles (Coleoptera), 4 pinned determined flies (Diptera), and 3 pinned determined true bugs (Hemiptera) chiefly of Virginia origin donated by Dr. A. Evans; and 1543 pinned determined bees, and 13 pinned undetermined wasps from Virginia donated by Virginia Tech student R. Ostrom (RIM 2020-18, -21, -26, -27).

Education & Outreach

Dr. Ivanov joined Dr. S. Dash as a guest instructor for Hampton University's BIO 408 Research Problems. This online course also involves a collaboration with UTEP Collections Manager Vicky M. Zhuang and undergraduate students from the University of Texas at El Paso. The main focus of the course is to hone students' skills in research, critical thinking, and scientific writing by focusing on a project aimed at examining the ant diversity of the Chihuahuan Desert.

Dr. Ivanov and museum staff participated in the museum's first "Drive-thru Dino Experience". The 3-hour event was attended by 217 children and adults from Virginia and North Carolina and offered a great opportunity to promote VMNH and the museum's research and education programs. (July 30)

Dr. Ivanov took part, as both a panelist and a participant, in the inaugural Virginia BioBlitz 2020 organized by the Virginia Academy of Sciences. The event took place across the Commonwealth on September 26 and was open to interested individuals of all ages and backgrounds. The goal of the event was to explore the biodiversity of the state while promoting discovery, education, citizen science, and conservation. The event generated >18,000 records and added 344 species to an already impressive list of taxa (6,297 species compiled from existing iNaturalist records before the onset of the event) over the course of a single day.

Drs. Ivanov, Keiper, Moncrief, Pritchard, and Bassett participated in an online meeting regarding planning for the upcoming Fall Wayne Theatre Signature Speaker Series in Waynesboro, VA.

Dr. Ivanov recorded an episode for VMNH's newly launched "Ask and Expert" series. The six episodes recorded to date, have focused on topics ranging from "How many legs do centipedes and millipedes have?" to "How much gold is in the Earth?" Since its inception on July 17, 2020, the series has generated over 5,500 views on VMNH's FB page including Dr. Ivanov's segment on "How do insects get their wings" (1000 views). This effort is part of the museum's ongoing initiative to better engage museum patrons through series of online events.

Dr. Ivanov gave a tour of VMNH's invertebrate lab and research collections to visitors from Holland, MI and a VIP Behind-the-Scenes Museum Experience from a successful bid at Carlisle School's "A Global Experience" auction by M. Vaughn (Martinsville, VA).

This quarter, Dr. Ivanov responded to numerous insect and plant identification and information requests to individuals from Bassett, Lynchburg, Martinsville, Richmond, Rocky Mount, and Stuart (VA), Oak Ridge (NC), Cleveland and Dayton (OH), Kingsport (TN), and elsewhere. The majority of the requests were submitted to VMNH's FB page by museum patrons.

Exhibits

Dr. Ivanov and museum staff participated in an online follow-up meeting regarding early planning stages for VMNH's upcoming "Flight" exhibit to open at the museum in late 2021 and is currently working on specimen selection and text development. (September 22)

Dr. Ivanov is working on specimen selection and on drafting text for the invertebrate portion of exhibits to be featured at the museum's upcoming Jean S Adams Education Pavilion.

Dr. Ivanov assisted Dr. H. Bassett and J. Davenport in selecting invertebrate and vertebrate specimens for VMNH's ongoing "Wild Watershed Fly Tying Contest". The VMNH is hosting this contest to find the best examples of hand-tied fly fishing flies to be included alongside mounted specimens, critical to trout diet, in the museum's updated Wild Watersheds exhibit.

Media

Dr. Ivanov's interview with H. Kozelsky on the biology and diversity of fig wasps (Agaonidae) was featured in the Martinsville Bulletin article "Take a taste of these figs". (September 8)

Dr. Ivanov posts on the diet of the Eastern Narrow-mouthed Toad, *Gastrophryne carolinensis*, and the Oak Toad, *Anxyrus quercicus*, on new acquisitions in the museum's invertebrate collection, and the recent discovery of the invasive little fire ant, *Wasmannia auropunctata*, in Virginia were featured on the museum's FB page.

Professional Service

Drs. Ivanov and Keiper completed consulting work on a forensic case and submitted a final report concerning a litigation under the Endangered Species Act by the PETA Foundation. The case concerns the death of a young lion (at a roadside zoo) featured in the Netflix documentary "Tiger King."

Dr. Ivanov completed necessary paperwork regarding the newly announced full-time temporary Myriapodologist position at VMNH. The position is intended to complement the Associate Curator of Recent Invertebrates in conducting research, inventorying and databasing specimens, writing reports and scholarly articles, and performing field and laboratory work with a strong focus on millipedes.

Dr. Ivanov served as a peer reviewer for manuscripts submitted to *Banisteria* and *Diversity* (completed July 30 and September 25).

Dr. Ivanov and VMNH Research Associate Dr. Steven Roble completed editorial work on the newest volume of the museum's "Insects of Virginia" series. Originally produced by Virginia Tech, the series was adopted by VMNH in 1993. The work of Dr. Oliver Flint, Jr. and colleagues, which was published in mid-September, is the first comprehensive guide to the mecopteran (scorpionflies and allies) fauna of Virginia. The 33 species covered in the guide represent the richest known mecopteran fauna in North America,

north of Mexico. This work is the 16 fascicle in the series, and the first one to be published since 2006.

Nancy D. Moncrief, Ph.D.
Curator of Mammalogy

- Dr. Moncrief is working with several colleagues on three manuscripts. The topics are as follows: 1) armadillos in Virginia, 2) skeletal injuries in two sympatric species of tree squirrels, and 3) mammals that occur on the Virginia barrier islands.
- Dr. Moncrief worked with Ms. Cartmell to identify and catalog a large collection of taxidermied birds that were donated to VMNH.
- Dr. Moncrief continued working with other VMNH staff members to write text and select specimens for a permanent exhibit about watersheds and for a special exhibit about flight.

Research and Collections

Dr. Moncrief is preparing three manuscripts as follows:

- 1) "Armadillos in Virginia" with Mr. Michael Fies, who is a Wildlife Biologist in the Virginia Department of Wildlife Resources, to be submitted to the peer-reviewed journal *Southeastern Naturalist*, and will report details of the first specimens of nine-banded armadillos from Virginia, which are housed in the VMNH Mammal Collection;
- 2) "Skeletal injuries in two tree squirrels" with VMNH Associate Curator of Recent Invertebrates Dr. Kal Ivanov, VMNH Biology Research Technician Ms. Liberty Hightower and Dr. Alfred Mead, who is on the faculty of Georgia College, will provide details about skeletal injuries in eastern fox squirrels and eastern gray squirrels and will also be submitted to *Southeastern Naturalist*;
- and 3) "Mammals of the Virginia barrier islands" with VMNH Research Associates Dr. Raymond Dueser and Dr. John Porter, both whom are at the University of Virginia, will be submitted to the peer-reviewed journal *Northeastern Naturalist*, and is an annotated checklist of mammals that live on Virginia's barrier islands and adjacent Eastern Shore mainland.

Dr. Moncrief continued working with Biology Research Technician Ms. Liberty Hightower, VMNH Collections Manager Ms. Haley Cartmell and VMNH Registrar Ms. Jill Harris to conduct and coordinate VMNH review activities prior to installation of a new collections management software system (Proficio) and migration of the VMNH collections databases to that software.

Dr. Moncrief worked with Ms. Cartmell to identify and catalog a collection of 110 taxidermied birds that were donated to VMNH. Thirty-one different species (including 29 ducks and other waterfowl), all native to Virginia, are represented. These specimens will be used in exhibits and outreach programming.

Professional Service and Other Duties

Dr. Moncrief currently is serving a two-year term (ends December 2020) as President of the Virginia Natural History Society (VNHS), and she is serving (with Dr. Ivanov) a four-year term (ends December 2022) as Co-Treasurer of that organization. As part of her duties as Co-Treasurer, she recorded dues payments for new and renewing members, and she processed requests and payments for back issues of the VNHS journal *Banisteria*.

Scientific Programs, Exhibits, and Other Activities

Dr. Moncrief contributed content for, and answered questions about mammals in Virginia for the VMNH facebook page.

Dr. Moncrief participated in the statewide Virginia Biolblitz with Dr. Ivanov, Ms. Hightower, and VMNH Administrator of Science Mr. Ben Williams.

Dr. Moncrief is working with VMNH Paleontology Research Technician Ms. Lucy Treado to create interactive elements for a permanent exhibit about watersheds and the Dan River basin. She is working with VMNH Education Manager Ms. Christy Deatherage to select specimens and draft text for this display.

Dr. Moncrief is also working with VMNH Assistant Curator of Paleontology Dr. Adam Pritchard and Ms. Deatherage to select specimens, draft text, and create interactive elements for a special exhibit about flight. She and Dr. Pritchard are collaborating to explore powered flight and gliding by vertebrates, especially birds, mammals, and reptiles.

Adam Pritchard, Ph.D.
Assistant Curator of Paleontology

- Dr. Pritchard completed and formatted his monograph description of the anatomy of *Weigeltisaurus jaekeli*, a reptile from the Permian Period of Germany with gliding adaptations. The paper will be submitted to the journal *PeerJ* in Q3 2020. The monograph will be the first detailed account of the anatomy of Weigeltisauridae, the oldest-known vertebrate lineage with gliding adaptations.
- Led by collaborator Xavier Jenkins of Arizona State University, Dr. Pritchard collaborated on a manuscript accepted for the *Journal of Vertebrate Paleontology* entitled “Using manual ungual morphology to predict substrate use in the Drepanosauromorpha and the description of a new species.” The paper describes a series of fossil reptile claws from the Triassic Period of Arizona with unique adaptations akin to modern-day digging mammals.
- Dr. Pritchard and technician Lucy Treado re-opened the preparation laboratory with new social distancing, mask-wearing, and sanitation guidelines. Current preparation projects include a fish skeleton from the Triassic Period (~220 million years old) of Hanover County and a whale rib and giant snake vertebra from Caroline County.
- Dr. Pritchard worked with registrar Jill Harris on updating reDiscovery paleontology records and integrating information from older Paradox files.
- Dr. Pritchard worked with VMNH administration and Hanover County resident Barbara Dickinson to secure permission to collect Triassic age fossils on private land.
- Dr. Pritchard organized a socially distanced visit from College of William & Mary geologist Rowan Lockwood and an undergraduate student visiting the invertebrate paleontology collections, specifically clam fossils from the Cretaceous-Paleogene transition.
- Dr. Pritchard responded to information requests regarding VMNH holdings:
 - Specimen #s and data from theropod tracks by Alex Hastings (Science Museum of Minnesota) and Bernard Means (Virginia Commonwealth University).
 - Status and anatomical information on a partial whale skull from Virginia by Alex Hastings (Science Museum of Minnesota).
 - Specimen #s, data, and photography from Solite Quarry *Tanytrachelos* specimens by Paul Olsen (Columbia University).
 - Cromhall Quarry reptile vertebra image request from Jennifer Olori (State University of New York, Oswego).

Research & Collections

Dr. Pritchard submitted his monograph description of the anatomy of *Weigeltisaurus jaekeli* to the journal *PeerJ* in Q3 2020. The paper has been reviewed and will require only minor revisions for publication, which he will address in the first weeks of Q4. The monograph will be the first detailed account of the anatomy of Weigeltisauridae, the oldest-known vertebrate lineage with gliding adaptations.

Led by collaborator Xavier Jenkins of Arizona State University, Dr. Pritchard published a paper for the *Journal of Vertebrate Paleontology* entitled “Using manual ungual morphology to predict substrate use in the Drepanosauromorpha and the description of a new species.” The paper describes a series of fossil reptile claws from the Triassic Period of Arizona with unique adaptations akin to modern-day digging mammals.

Dr. Pritchard presented research projects to the Annual Meeting of the Society of Vertebrate Paleontology between October 11–17, 2020. The meeting was held online. Dr. Pritchard presented an oral presentation on the weigeltisaurid skeleton that was the focus of his recently submitted manuscript. He also participated in a presentation on the claws of drepanosaurs (a group of extinct arboreal reptiles) led by graduate student Megan Sodano of Virginia Tech.

Dr. Pritchard secured permissions from landowners in Ashland, Virginia to begin excavations at a Triassic-aged fossil site on private land. The first dig occurred on September 14 and 15, producing a large sample of fossil plants and a boulder containing sandstone and a small vertebrate skeleton. The project is ongoing.

Dr. Pritchard secured a permit from the United States Forest Service to prospect for fossils in the Washington and Jefferson National Forest in Scott County, Virginia. The site was brought to his attention by VMNH director Dr. Joe Keiper, who noticed a small vertebrate jaw at the site several years earlier. Dr. Pritchard and technician Lucy Treado visited the site on October 28 and 29. They did not find the original jaw element, but they found productive rock layers containing a large variety of fossil plants. Subsequent visits to the area are planned.

Dr. Pritchard arranged a socially distanced collections visit for amateur paleontologist Michael Stevens (Richmond, VA), who studied Triassic fossils during his visit. He also presented collections to amateur paleontologists Jeffrey and Elize Schroeder (Chesterfield, VA), who sought identification of a fossil elephant tooth.

Education and Outreach

Dr. Pritchard produced seven additional educational videos for VMNH social media outlets in Q3 2020, released on a roughly biweekly schedule. Each has been viewed over 200 times on the VMNH Facebook page.

Dr. Pritchard developed table content for and participated in the Dinosaur Drive-Thru experiences for the VMNH. These events, presenting a series of six dinosaur fossil display tables, were held in Martinsville, Virginia (July 13, 2020) and Waynesboro,

Virginia (October 10, 2020). These events served a mix of adults and children totaling 217 and 235 participants respectively.

Dr. Pritchard presented a socially distanced 'Science Talks' lecture at the Wayne Theater in Waynesboro, Virginia on October 13, 2020. The lecture focused on the fossil record of the Shenandoah Valley and the unique possibilities offered by the VMNH-Waynesboro project.

Dr. Pritchard participated in a Reddit Ask Me Anything event for the Society of Vertebrate Paleontology on October 14, 2020 (https://www.reddit.com/r/askscience/comments/jayj2c/we_are_scientists_from_the_society_of Vertebrate/). The event was viewed over 4,900 times and received over 400 questions.

Dr. Pritchard presented a Zoom lecture on the evolution of lizards during the Age of Dinosaurs for an undergraduate course at Virginia Tech on October 20, 2020.

Dr. Pritchard assessed seven inquiries from the Virginia public regarding fossil identifications.

Media

Dr. Pritchard was interviewed by science journalist Riley Black for a *National Geographic* article on the early evolution of dinosaurs. His comments appear in the article "How the world's deadliest mass extinction actually helped the rise of dinosaurs," published September 11, 2020.

Professional Service

Dr. Pritchard completed reviews of articles for the journals *Palaeodiversity* and *Proceedings of the Royal Society B*.

Hayden Bassett, Ph.D.
Assistant Curator of Archaeology

VMNH Assistant Curator of Archaeology Dr. Hayden Bassett began his position with the museum on August 31, 2020. In his first two months, he has focused his efforts on laying the groundwork for the VMNH's Smith River Survey, coordinating receipt of two related grants, publishing a peer-reviewed article and submitting another, and participation in several academic conference presentations.

Research & Collections

Dr. Bassett received a \$7,620 grant from the Virginia Threatened Sites program to conduct archaeological fieldwork in Henry County, VA (Stanleytown area). This state grant will allow the VMNH to complete archaeological excavations on a known archaeological site in advance of construction in the area. The site has yielded several of the county's oldest artifacts, extended back to the Paleoindian period (c. 10,000 B.C.). The site likewise has later components, including a possible Late Woodland (AD 1200-1450) village.

Dr. Bassett received a \$100,000 grant from the Emergency Supplemental Historic Preservation Fund (ESHPPF) for the VMNH to complete archaeological fieldwork along the Smith River in Henry County over the next two years. This federal grant will fund the Smith River Survey (SRS), a two-year archaeological survey of the Smith River Valley (Patrick and Henry Counties) to assess the integrity of Virginia Indian archaeological sites, and selectively renew excavations to add to our understanding of this region. This funding will allow Dr. Bassett to hire two field technicians for the project, purchase equipment, conduct Ground Penetrating Radar, and perform new excavations. The goal of the Smith River Survey is two-fold: 1.) assess the integrity of archaeological sites in light of recent flooding events, and 2.) perform new, research-driven excavations to complement old (1960s/70s) data with data produced from modern methods/techniques. Note: VMNH Receipt of this grant has not been released to the public. VMNH is currently awaiting press-release approval from the National Park Service.

In September, Dr. Bassett met with the Smith Mountain Gap Archaeological Project team to discuss the forthcoming funding from Appalachian Power for a VMNH exhibit, a book produced by VMNH, and additional fieldwork. The current status of the funding is that it has been earmarked and is forthcoming. Dr. Bassett and collaborators will continue the Smith Mountain Gap Archaeological project fieldwork in second week of November 2020.

Dr. Bassett and VMNH's new staff archaeologist Madeleine Gunter Bassett presented their recent findings from the Smith River in a paper titled, *Laying the Groundwork for the Smith River Survey: A Geospatial Analysis of Archaic through Late Woodland Settlement Patterns in the Upper Dan River Drainage*, at the Archaeological Society of Virginia's 2020 conference (held virtually on Oct 24). A video presentation of the paper is available at <https://vimeo.com/471240165>

Dr. Bassett and staff archaeologist Madeleine Gunter Bassett submitted two abstracts to present on their preliminary work on the Smith River Survey. These virtual presentations will be made at the following national academic conferences: the Annual Meeting of the Society for Historical Archaeology (Jan 2021), and the Annual Meeting of the Society for American Archaeology (April 2021).

Dr. Bassett completed the analysis from an archaeological survey he and staff archaeologist Madeleine Gunter Bassett completed in advance of construction of the Lily Pad RV Park and Campground in Stanleytown, VA. The two discovered a Virginia Indian campsite dating to the Late Woodland period (AD 1200-1450), and will be publishing their findings in the *Quarterly Bulletin of the Archaeological Society of Virginia*, and working with the landowner to interpret the site for the public.

Dr. Bassett completed edits on a peer-reviewed paper, now in press with the *Journal of African Diaspora Archaeology and Heritage*. The journal article (DOI: 10.1080/21619441.2020.1840834), with publication in early November 2020 under his VMNH affiliation, reports on Dr. Bassett's archaeological study of 18th-century plantation infrastructure, and its impacts on enslaved people. The study utilized Space Syntax analysis (a mathematical approach based on graph theory) to identify intentional design flaws in the layout of plantations, which, Bassett argues, were meant to confine, channel, bottleneck, and otherwise control the mobility of enslaved people. The paper's larger anthropological implications were developed around an argument detailing the manner in which small groups control and exert power over a majority through material infrastructures.

Dr. Bassett submitted a manuscript, now under review, to the peer-reviewed journal *World Archaeology*. The manuscript, "Dwelling Spaces in Tropical Places: An Archaeology of Inequality among Enslaved Households in Plantation Jamaica," identifies the human appropriation of environmental conditions to impose unequal social relations. The article is being considered for a special issue of *World Archaeology* on "Inhabiting Tropical Places."

Dr. Bassett begun phase I of the Army Monuments Innovation Lab (AMIL) at VMNH. This lab, located at the VMNH, will support the research and training needs of the US Army "Monuments Men" program. As of this reporting, the US Army is reviewing a preliminary MOU between the Army and the VMNH to formalize the AMIL. Informally, the VMNH has begun support efforts for the Army. This includes training detailed in the "education and outreach" section of this report, and "no-strike" list development for cultural sites in select parts of East Africa.

Dr. Bassett and Ben Williams conducted a field inspection of a possible rockshelter site used by Virginia Indians in Patrick County, VA. This field inspection led to the discovery and registration of a new archaeological site with the state. Preliminary results from this inspection suggest that the rockshelter was used by Virginia Indians during the Guilford-phase of the Middle Archaic period (5000-3500 BC). This finding adds to the 12 other known rockshelter sites in Patrick County, VA.

Dr. Bassett identified and registered a new archaeological site in the Bassett Forks area of Henry County, VA. A member of the public sent the VMNH a photo of a projectile point (spear head) they found on their property. Dr. Bassett identified the point, and

conducted an archaeological survey of the property. This led to the discovery a hunting camp dating to the Morrow Mountain phase of the Middle Archaic (5500-5000 BC). The site is now registered with the Commonwealth of Virginia as a VMNH discovery. Dr. Bassett responded to curatorial requests from the Virginia Department of Historic Resources to locate and inventory certain collections held at the VMNH. These efforts allowed the VDHR to develop new archaeological protection measures in Warren County, VA.

Dr. Bassett is currently working on an artifact loan to the Science Museum of Virginia for their Native Waters exhibit.

Education and Outreach

As a member of the US Army's/Smithsonian's new wave of Monuments Men, Dr. Bassett provided Monuments Men training to a group of 20 US Army officers deploying to East Africa. The training was conducted remotely from the Virginia Museum of Natural History. Dr. Bassett trained Army officers to recognize historic buildings, monuments, museums, archives, and archaeological sites in Somalia and Djibouti, so as to avoid impacts during their operations. One of Dr. Bassett's research areas is East Africa. We expect the US Army to continue to request this type of training from the VMNH.

Dr. Bassett began working with a Ph.D. student from William & Mary. He anticipates this grad student shadowing him throughout portions of the Smith River Survey, with the goal of educating the student on how to run a large-scale archaeological project from beginning to end.

In September, Dr. Bassett presented a public lecture titled, *The Virginia Indians of Martinsville and Henry County*, to the Lunch and Fellowship (LAF) group of Henry County. The lecture was well received and generated several new local VMNH memberships.

In September and October, Dr. Bassett spoke at two VMNH welcome receptions. Receptions were attended by members of the Martinsville/Henry County community. From September to October, Dr. Bassett worked with Dr. Kal Ivanov and VMNH Exhibits and Publications Manager Jessica Davenport to develop a fly tying contest for the museum's Wild Watersheds exhibit. The ongoing (Oct 1 – Nov 13) public contest requests hand-tied fly fishing flies from the public, that mimic trout-diet insects found in the Smith River. The winning flies will be placed on exhibit next to the insect specimens they seek to mimic. Additionally, Dr. Bassett coordinated a virtual fly-tying event for the contest. He partnered with Project Healing Waters (a non-profit dedicated to the physical and mental rehabilitation of wounded/disabled veterans through fly fishing), who hosted the VMNH event to its members. Approximately 125 veterans and volunteers participated in the event, and were encouraged to submit their tied flies to the VMNH Wild Watersheds contest.

Dr. Bassett joined other VMNH staff in Waynesboro to host the VMNH Drive-through Dino Experience, and manned the Dinosaur Footprints station.

Dr. Bassett responded to five public requests for identification of artifacts, all of them from Virginia.

In October, Dr. Bassett responded to three requests for Information on VMNH collection holdings: 1.) for collections from Warren County; 2.) regarding the Claremont collection from Surry County; and 3.) a collection of Late Woodland (AD 1200-1450) shell beads from Henry County.

Professional Service

Dr. Bassett reviewed a grant proposal "Art + Science for Geospatial Innovation Research Program," for the US Army Geospatial Center RDT&E Grant.

In September, Dr. Bassett participated in the VDOT Public Comment meeting regarding the environmental impacts of the 220 Extension right of way through Henry County. Dr. Bassett identified two major concentrations of Virginia Indian archaeological sites that would be impacted.

In October, Dr. Bassett participated in the Council of Virginia Archaeologists (CoVA) meeting (the authoritative professional assembly for archaeology in the Commonwealth) to discuss new state legislation and new efforts with tribal engagement of VA's recognized tribes.

In October, Dr. Bassett was consulted by members of the Archaeological Society of Virginia for his expertise in Geospatial Analysis. He provided his technical services to professionals seeking to map and generate geostatistics on the state-wide distribution of certain types of archaeological sites, in relation to Virginia's topography and rivers/streams.

Research and Collections

Jill K. Harris, Registrar

Thirteen (13) collections acquisitions were recorded for 3,151 individual specimens and 44 vials. The majority of these specimens were added to the invertebrate zoology collection, with the remaining specimens added to the paleontology and vertebrate zoology (mammal, herpetology, bird) collections.

One (1) outgoing loan was recorded for 3 vials of recent invertebrate specimens. These specimens were loaned from the VMNH invertebrate zoology collection to the Musee Royal de L'Afrique Centrale, in Belgium.

The museum registrar, Jill K. Harris, edited data for ~20,543 electronic catalog records, within the collections management software.

Haley Cartmell, Collections Manager

Curators and staff modified/updated 25,394 existing records and added 328 new records to the VMNH collections databases, Rediscovery (for biological and archaeological collections) and EGEMS (for physical geological and paleontological collections).

Curators and staff continue preparations for upgrading the collections database software, which includes reviewing the draft versions of the new Proficio software's data entry screens. Ms. Harris is compiling all comments and acting as "point person" to direct changes by the Proficio software developers.

Ms. Cartmell has processed one (1) load of collections materials through the CO2 bubble during the months of July, August, and September. Future operations of the CO2 bubble are temporarily on hold due to malfunctioning equipment. This equipment is currently out for repairs and operations are expected to resume in late fall.

PEOPLE SERVED DATABASE printed 11/2/2020
Summary

# of Activities	TYPE OF ACTIVITY	PROFESSIONALS AND 13+ STUDENTS	K-12 STUDENTS	K-12 TEACHERS	PUBLIC			TOTAL #	
1	Conference presentations (A)	25	0	0	0			25	
1	Meetings chaired (B)	2	0	0	2			4	
5	Review documents/manuscripts (B)	5	0	0	0			5	
0	Requests for information about collections (C)	0	0	0	0			0	
0	Visiting researcher (C)	0	0	0	0			0	
0	Collections tours (D)	0	0	0	0			0	
3	Lab Tours (D)	0	6	0	7			13	
2	Receptions	9	0	0	30			39	
30	Responses to requests for information about specimens at VMNH (D)	6	0	0	24			30	
1	Lectures and presentations at VMNH (D)	0	143	0	74			217	
1	Technical consultations (B, D, & E)	0	0	0	35			35	
0	Display table with specimens	0	0	0	0			0	
1	Off-site education programs	0	0	0	0			0	
2	Lectures Not at VMNH (E)	0	0	0	24			24	
0	Off-site presentations (E)	0	0	0	0			0	
3	Field trips/Field Work	4	5	1	8			18	
50	TOTALS	0	0	0	0			410	

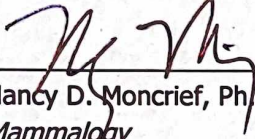

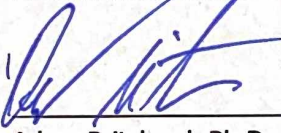

TOTAL # INDIVIDUALS SERVED

410

**NEW APPLICATION
AS RESEARCH ASSOCIATE**

Jackson Means

I have reviewed the information submitted for Jackson Means (Kal Ivanov, Sponsor) and have indicated his/her recommendation as a Research Associate for the Virginia Museum of Natural History.

Curator	Date	Recommend	Do Not Recommend
 Nancy D. Moncrief, Ph.D. <i>Mammalogy</i>	29 Oct 2020	<input checked="" type="checkbox"/>	<input type="checkbox"/>
 Kal Ivanov, Ph.D. <i>Recent Invertebrates</i>	Mar. 6 2020	<input checked="" type="checkbox"/>	<input type="checkbox"/>
 Adam Pritchard, Ph.D. <i>Paleontology</i>	3/8/20	<input checked="" type="checkbox"/>	<input type="checkbox"/>
 Hayden Bassett, Ph. D. <i>Archaeology</i>	22 Oct. 2020	<input checked="" type="checkbox"/>	<input type="checkbox"/>

26 February 2020

Statement by Dr. Kal Ivanov in support of Dr. Jackson Means' appointment as a Research Associate at the Virginia Museum of Natural History

Dear Drs. Keiper, Pritchard, and Moncrief,

I am nominating Jackson Means for appointment as a Research Associate of the Virginia Museum of Natural History. Dr. Means holds a Ph.D. in Entomology from the Virginia Polytechnic Institute and State University. His expertise includes biogeography, evolution, systematics, and conservation of millipedes with a focus on Appalachian taxa.

I have known Jackson for nearly five years and I have come to admire his intimate knowledge of millipedes and wide-ranging familiarity with insects and other invertebrates. During the course of his Ph.D. work, he has deposited numerous invertebrate specimens at the Virginia Museum of Natural History and he will undoubtedly continue to do so during the course of his professional career. His dissertation work on the millipedes of the southern Appalachian Mountains has included examination, identification, and curation of numerous specimens from VMNH's millipede collection. Dr. Means has published results of his research in peer-reviewed journals and is currently continuing revisionary work on the Twisted Claw millipedes in the family Xystodesmidae.

Dr. Means has expressed interest in continuing to use VMNH's invertebrate collections for his specimen-based research, and he and I have discussed several potential joint research projects that would use material from VMNH's collections as well as new material obtained through fieldwork. In addition, Dr. Means and I are in the process of establishing a functional genetics lab at VMNH, which will allow for the use of molecular data in research and education at the museum, and provide a facility for researchers and students working with genetic material.

I have no doubt that VMNH would benefit from Jackson's expertise, curatorial efforts, and fieldwork all of which contribute directly to the museum's mission.

Sincerely,

Kal Ivanov Ph.D.
Associate Curator
Virginia Museum of Natural History
Department of Recent Invertebrates
21 Starling Ave., Martinsville VA 24112

Letter of Interest

Virginia Museum of Natural History Research Associate

2/29/20

To Whom It May Concern:

I have worked in diplopod taxonomy and systematics at Virginia Tech for nearly six years, and throughout the entirety of that time I used collections materials loaned from the Virginia Museum of Natural History. I published three peer-reviewed manuscripts as part of my PhD, and am preparing to submit an additional three, including a revision of the genus *Nannaria*, a project Dr. Richard Hoffman was working on at the time of his death. All of these papers were helped or made possible by the VMNH collections. Now that I have finished my PhD program I look forward to continuing to work closely with the VMNH and the myriapod collections housed there. The Research Associate position would further enable my research and the generation of publications vital to our understanding of myriapod systematics and the history of this poorly-understood taxon.

Thank you for your consideration,

Jackson Means, PhD

Jackson Means, PhD
Department of Entomology
Virginia Tech
Blacksburg, Virginia



Email: mjacks4@vt.edu
Phone: 434-996-5912

Education

- **PhD in Entomology**, Virginia Tech, Blacksburg Virginia. Fall 2018.
 - Dissertation: Biodiversity, conservation and mimicry rings of Appalachian millipedes
- **MS in Life Sciences with a Concentration in Entomology**, Virginia Tech, Blacksburg, Virginia. Spring 2014.
 - Thesis: Development of a Precision Mite Management Program for the Control of the Ectoparasite *Varroa destructor* in Colonies of *Apis mellifera*
- **BA in Environmental Studies**, Denison University, Granville Ohio, Spring 2009.
Minor in Biology.

Teaching Experience (#: Semesters)

Design and Analysis of Agricultural Experiments (1)

- Graded examinations and assignments
- Provided guidance and assistance to students throughout the course

Information Systems & Research in Life Sciences (1)

- Graded examinations and assignments
- Provided guidance and assistance to students throughout the course

Introduction to Insect Biology (4)

- Head Graduate Student Teaching Assistant
- Presented and updated all laboratory lectures
- Graded examinations and assignments
- Provided guidance and assistance to students throughout the course
- Created evaluations
- Lab topics include the anatomy, taxonomy and systematics of Hexapoda, collection, preservation and curation of arthropods and the identification of all 29 orders of Hexapoda.

Bees and Beekeeping (4)

As Head Graduate Student Teaching Assistant (3)

- Graded examinations and assignments
- Presented lectures
- Provided guidance and assistance to students throughout the course
- Led laboratory activities

As Instructor of Record (1)

- Presented and updated all lectures
- Graded examinations and assignments
- Provided guidance and assistance to students throughout the course

- Created evaluations
- Oversaw a graduate teaching assistant
- Managed a budget
- Led laboratory activities, including the construction and establishment of honey bee hives, the monitoring and maintenance of hives from winter through spring, the observation of winter clustering behavior, the extraction and bottling of honey and the scouting and control of honey bee pests.

Completed the *Future Professoriate Certificate* at Virginia Tech (Fall, 2018)

- Coursework in pedagogy to prepare future faculty with the tools to create new models and methods in the classroom

Undergraduate Mentorship

2018 – 2019	Kathryn Williamson
2017 – 2018	Grant Schiermeyer
2016 – 2017	Joe Montemayor
2015 – 2017	Patricia Shorter
2014 – 2015	Nina Zegler and Katy Lawler

Research Interests

- Systematics and taxonomy of millipedes
 - Species description and revisionary taxonomy
 - Mapping species distributions and color patterns of the millipede family Xystodesmidae
 - The role of convergence in morphological and molecular phylogenetics
 - Phylogeography of species with high environmental specificity
 - Disentangling species complexes
 - Future Research: The identification of key habitats for the protection of overlooked, understudied and relictual taxa, the promotion and training of taxonomy and the exploration of patterns and drivers of diversity
-

Peer-reviewed Publications

- Marek PE, Means JC and Hennen DA. 2018. *Apheloria polychroma*, a new species of millipede from the Cumberland Mountains (Polydesmida: Xystodesmidae). *Zootaxa* 4375 (3): 409 – 425. DOI: 10.11646/zootaxa.4375.3.7.
- Means JC, Marek PE. 2017. Is geography an accurate predictor of evolutionary history in the millipede family Xystodesmidae? *PeerJ* (10), art. no. e3854. DOI: 10.7717/peerj.3854.
- Means JC, Francis EA, Lane AA and Marek PE. 2015. A general methodology for collecting and preserving xystodesmid and other large millipedes for biodiversity research. *Biodiversity data journal*, (3), art. no. e5665. DOI: 10.3897/BDJ.3.e5665.

Manuscripts in preparation:

- Means JC, Hennen DA and Marek, PE. 2020.** Generic relationships within the millipede tribe Apheloriini, with new species descriptions (Polydesmida: Xystodesmidae) (to be submitted February 2020).
- Means JC, Hennen DA and Marek, PE. 2020.** Discovery of two clades within the millipede genus *Nannaria*, and a revision of the genus, Part 1 of 2 (Polydesmida: Xystodesmidae) (in preparation).
- Means JC and Marek, PE. 2020.** A color atlas of the US Xystodesmidae (in preparation).
- Hennen DA, Means JC and Marek, PE. 2020.** Discovery of two clades within the millipede genus *Nannaria*, and a revision of the genus, Part 2 of 2 (Polydesmida: Xystodesmidae) (in preparation).

Poster and Oral Presentations

- Means J. 2018. Biodiversity, conservation and mimicry rings of Appalachian millipedes. PhD dissertation defense given to the Department of Entomology at Virginia Tech. Blacksburg, VA. December 13.
 - Means J., D. Hennen and P. Marek. 2018. Molecular phylogenetics of the Twisted Claw millipedes (Polydesmida: Xystodesmidae). Presentation given at the 2018 Virginia Natural History Society meeting. Martinsville, VA. October 13.
 - Means J., D. Hennen and P. Marek. 2018. A taxonomic revision of the millipede genus *Nannaria* Chamberlin, 1918 (Diplopoda: Polydesmida: Xystodesmidae). Presentation given at the 2018 Society for Systematic Biologists meeting. Columbus, OH. June 1-4.
 - Marek P. and J. Means. 2018. Evolution of bioluminescence in Sierra luminous millipedes (Polydesmida, Xystodesmidae). Poster presented at the 2018 Society for Systematic Biologists meeting. Columbus, OH. June 1-4.
 - Means J., D. Hennen and P. Marek. 2017. Discovery of two monophyletic clades within the Appalachian millipede genus *Nannaria* Chamberlin, 1918 (Diplopoda: Polydesmida: Xystodesmidae). Presentation at the 17th International Congress of Myriapodology. Krabi, Thailand. July 23-26.
 - Means J. and P. Marek. 2016. Molecular phylogenetics of the rare Laurel Creek millipede, *Sigmoria whiteheadi* Shelley, in Virginia. Poster presented at the 2016 Virginia Tech Graduate Student Association Research Symposium. Blacksburg, VA. March 23.
 - Means J. and C. Brewster. 2013. Manipulating the spatial distribution of *Varroa* mites in hives of *Apis mellifera*. Presentation at: Entomology 2013. ESA 61st Annual Meeting. November 10-13; Austin, TX.
 - Means J. and C. Brewster. 2013. Development of a precision mite management program. Presentation at: The North Carolina Honey Bee Research Consortium 2nd Annual Meeting. February 16th; Winston-Salem, NC.
 - Means J. and C. Brewster. 2012. Spatial distribution of *Varroa destructor* and bee brood within colons of *Apis mellifera*. Presentation at: Entomology 2012. ESA 60th Annual Meeting. November 11-14; Knoxville, TN.
-

Invited Presentations and Guest Lectures

- Means, J. 2019. Color and Species Diversity in Cyanide Producing Appalachian Millipedes. Invited talk as part of the Second Thursday Science Talks at the Virginia Museum of Natural History. October 10. Martinsville, VA.
- Means, J. 2019. Color Atlas of Eastern US Xystodesmidae (Diplopoda: Polydesmida). Invited talk as part of the Breaking Ground: Research Highlights from ECPs and non-Academic Track Eastern Branch Members symposium at the Entomological Society of America Eastern Branch Meeting. March 11. Blacksburg, VA.
- Means, J. and D. Hennen. 2017. An introduction to Appalachian Millipedes. Invited class lecture presented at the 30th Annual Master Gardener College at Virginia Tech. June 24. Blacksburg, VA.
- Means, J. 2017. Spring Beekeeping and the Power of Pheromones. Invited lecture presented at the Mountain Empire Beekeepers Association February Meeting. February 23. Wytheville, VA.
- Means, J. 2016. Varroa Mite Sampling Techniques. Invited lecture presented at the Mountain Empire Beekeepers Association August Meeting. August 25. Wytheville, VA.
- Means, J. 2014. Honey Bee Colony Annual Cycle. Guest lecture presented at Virginia Tech: Bees and Beekeeping ENT 2254. March 27. Blacksburg, VA.
- Means, J. 2014. Honey Bee Thermoregulation. Guest lecture presented at Virginia Tech: Insect Behavior and Ecology ENT 6004. February 27. Blacksburg, VA.
- Means, J. 2013. Interesting Insects and Beneficial Bugs. Invited lecture presented as part of the Tall Oaks Talks at the Warm Hearth Community. December 6. Blacksburg, VA.
- Means, J. 2013. Insect and Plant Interactions. Guest lecture presented at Virginia Tech: Insect Biology ENT 3014. October 19. Blacksburg, VA.
- Means, J. 2013. A Hands-On Demonstration of Common Sampling Techniques for the Informed Treatment of *Varroa destructor* in Hives of *Apis mellifera*. A workshop I hosted for the New River Valley Beekeepers Association at the Prices Fork Research Center apiary. August 3. Blacksburg, VA.
- Means, J. 2013. Beginner Beekeeper Class: Inspection. Two classes taught for the Montgomery County Beekeepers Association at the Prices Fork Research Center apiary. April 13. Blacksburg, VA.
- Means, J. 2013. Major Arthropod Pests of the European Honey Bee, *Apis mellifera*. Beginning Beekeepers class hosted at the Catawba Sustainability Center. June 1. Catawba, VA.
- Means, J. 2013. The Varroa Mite and Other Common Pests of the European Honey Bee, *Apis mellifera*. Invited presentation presented at the Botetourt County Beekeepers Association monthly meeting. March 4. Fincastle, VA.
- Means, J. 2012. *Varroa destructor*: An Informational Session. Guest Lecture presented at the New River Valley Beekeepers Association monthly meeting. October 11. Christiansburg, VA.
- Means, J. 2012. Varroa Mite Sampling. Part of a two-day workshop hosted by Virginia Tech. September 15. Blacksburg, VA.

- Means, J. 2012. Buds, Bugs and Buddies. Master Gardener workshop on beneficial insects at The Thomas Jefferson Foundation Center for Historic Plants. April 28. Charlottesville, VA.
-

Outreach

- Falling Branch Elementary Annual Science Fair Judge. Spring 2014 – spring 2017. Judge grades K-5 science fair projects and provide positive feedback. Christiansburg, VA.
 - 4H Bug Camp presentation at Smith Mountain Lake. An Introduction to Insects. Introduce late elementary – middle school age children to the science of entomology through preserved and live specimens. June 25, 2013.
 - 4H Bug Camp presentation at Virginia Tech. Common Orders and Families of Insects. A lecture for high school aged campers on how to identify common orders and families of insects. June 18, 2013.
 - Virginia Junior Master Gardeners certification class, final session of insect section. 2012 – 2014, 2016 & 2018. A lecture on interesting insect, as well as live insects and a section of my personal collection for the kids to peruse.
 - Virginia Tech entomology department student tours. Summer 2011 – Summer 2018. Presentations given and interaction with students via live and pinned specimens.
 - Virginia Tech entomology's annual Bugfest. 2011 – 2018.
 - Management of a display of my personal pinned insect collection (18 Cornell drawers)
 - The Luminous Cave: introduce visitors to bioluminescence and fluorescence in arthropods.
 - Insect Structures: A display featuring microscopes with different insect structures (lepidopteran wings, dipteran eyes, etc.).
-

Awards

The James McDonald Grayson Award (PhD level). 2018. Presented by the Virginia Tech Entomology Department. Awarded to the outstanding graduate student for overall achievement.

The Kosztarab Scholarship for Distinguished Achievement in Systematics (PhD level). 2018. Presented by the Virginia Tech Entomology Department. Awarded to the outstanding graduate student for excellent work in the fields of taxonomy and systematics.

Clarence and Gladys Hill Travel Scholarship. 2017. Presented by the Virginia Tech Entomology Department. Awarded to graduate students for travel to conferences or for research.

Alwood Extension Award. 2015. Presented by the Virginia Tech Entomology Department. Awarded to the outstanding graduate student for extension and outreach.

The James McDonald Grayson Award (Masters level), 2015. Presented by the Virginia Tech Entomology Department. Awarded to the outstanding graduate student for overall achievement.

The Kosztarab Scholarship for Distinguished Achievement in Systematics (Masters level), 2014. Presented by the Virginia Tech Entomology Department. Awarded to the outstanding graduate student for excellent work in the fields of taxonomy and systematics.

The Dodson Travel Fund Award, 2013. Presented by the Virginia Tech Entomology Department. Awarded to graduate students for travel to conferences or for research.

Reginald H. & Phyllis G. Nelson Award, 2013. Presented by the College of Agriculture and Life Sciences at Virginia Tech. Tuition scholarship awarded to the outstanding graduate student for academic achievement.

Dow Hokie Spirit Scholarship, 2011. Presented by the College of Agriculture and Life Sciences at Virginia Tech. Tuition scholarship awarded to the entomology graduate student who embodies the spirit of Virginia Tech.

Interviews

- Marek, P., Means, J. and D. Hennen. 2018. August 10. Why do millipedes have so many legs?! (ft. Joe Hanson). Interview with Anna Rothschild for Anna's Science Magic Show Horray! hosted by the Washington Post. Blacksburg, VA. <https://bit.ly/2L8DiBh>
 - Marek, P., Means, J. and D. Hennen. 2018. January 31. Up close with the first and only millipede lab in the United States. Interview with Vittoria Traverso for Atlas Obscura. Blacksburg, VA. <https://bit.ly/2wdX1u4>
 - Means, J. and P. Shorter. 2017. July 2. Tracking the 'xysto whisperer'. Interview with Robby Korth for The Roanoke Times. Floyd, VA. <https://bit.ly/2L5y1L1>
 - Marek, P., Means, J. and D. Hennen. 2016. March 16. Virginia Tech bug man is 'always looking at the ground'. Interview with Robby Korth for the Roanoke Times. Blacksburg, VA. <https://bit.ly/2vQBDM3>
-

Affiliations

- The International Congress of Myriapodology (ICM)
- Entomological Society of America (ESA)
- Society of Systematic Biologists (SSB)
- North American Colleges and Teachers of Agriculture (NACTA)
- WB Alwood Society (Virginia Tech entomology graduate student organization)
 - Active member: Fall 2011 – Fall 2018
 - Events Coordinator: Spring 2016 – Spring 2017
 - Fundraising Chair: Spring 2015 – Spring 2016
 - President: Spring 2014 – Spring 2015

- Tour Coordinator: Spring 2012 – Spring 2013
-

Regional Collections Are an Essential Component of Biodiversity Research Infrastructure

ANNA K. MONFILS, ERICA R. KRIMMEL, JOHN M. BATES, JENNIFER E. BAUER, MICHAEL W. BELITZ, BLAKE C. CAHILL, ALYSSA M. CAYWOOD, NEIL S. COBB, JULIA B. COLBY, SHARI A. ELLIS, DIANNA M. KREJSA, TODD D. LEVINE, TRAVIS D. MARSICO, TERESA J. MAYFIELD-MEYER, JESS A. MILLER-CAMP, ROY M. (GIL) NELSON, MOLLY A. PHILLIPS, MARCIA A. REVELEZ, DAWN R. ROBERTS, RANDAL A. SINGER, AND JENNIFER M. ZASPEL

Natural history collections (NHCs) archive and provide access to biodiversity records by preserving biological, paleontological, and geological specimens and their associated data. Worldwide, there are thousands of NHCs curating over 2 billion specimens that represent over a million taxa (Mehrhoff 1997). Varying considerably in size and scope, NHCs are united in curating specimens and data in support of biodiversity research. Larger collections have been reviewed and identified as being important to biodiversity research (Miller 1991), whereas smaller regional collections, which make up the vast majority of NHCs, have not received the recognition they merit for their contributions to biodiversity research infrastructure. In the present article, we make a case for the critical importance of smaller regional collections in creating the Global Museum and the Extended Specimen Network (Bakker et al. 2020, Lendemer et al. 2020).

Defining collections on the basis of size is problematic as it implies relative value, is arbitrary in its designation, and varies widely by taxonomic discipline. The American Society of Mammalogists reported in its most recent periodic survey that small collections (fewer than 10,000 specimens) formed 79% of all mammal collections and 88% of mammal tissue collections in the Western Hemisphere (Dunnum et al. 2018). Likewise, in a survey of

US arthropod collections, Cobb and colleagues (2019) found that 70% are small (fewer than 100,000 specimens) or medium (between 100,000 and 1,000,000 specimens) in size, and in a survey of mollusk collections based in the United States and Canada, Sierwald and colleagues (2018) found that 66% are very small (fewer than 9000 specimen lots) or small (between 9000 and 29,999 specimen lots). This pattern holds for plant collections as well, where Cahill and colleagues (2019) determined that 90% of US herbaria are small (at most 175,000 specimens). When examined across taxonomic disciplines, regardless of the designated size cutoff, “small” collections represent the majority of the individual NHCs. These small collections do not have a small collective impact, and a more representative name is needed. Given the number and broad distribution of these collections, and the emphasis on local collecting efforts and biogeographic expertise, we propose the term *regional collection* as a better descriptor and more fitting name for the “small” collections.

Regional collections contribute unique specimens that fill critical gaps in our taxonomic, geographic, and temporal understanding of global biodiversity. Regardless of taxonomic focus, when researchers map specimen data on continental scales, regional collections bridge critical geographic gaps (National Research Council 2014,

Dunnum et al. 2018, Sierwald et al. 2018, Cahill et al. 2019, Cobb et al. 2019, Marsico et al. 2020). In their review of arthropod collections, Cobb and colleagues (2019) found that regional collections curated unique specimens, and that these specimens best represented local diversity. Overall, regardless of the size of the arthropod collection, each individual NHC provided the majority of the specimens collected within a 50-kilometer radius of the institution. When Marsico and colleagues (2020) investigated herbarium specimens in eight states, on average 89% of specimens in regional collections represented unique occurrence records. In that study, regional herbaria were disproportionately representative of local flora. While regional collections only accounted for 12.5% of the total herbarium specimens in an individual state, when reviewing locally relevant specimens within a state (i.e., rare, introduced, and common native), 30% of those specimens were housed in regional herbaria. To look at the impact of data from regional herbaria, Glon and colleagues (2017) ran species distribution models with and without specimen data from regional collections. The regional collections contributed far fewer specimens, but those specimens represented unique information, and the addition of regional collections data resulted in more refined and robust predictions of ecological

niche. Sometimes a single specimen in a regional collection can lead to an important discovery. Dooley and colleagues (2019) defined a new species, *Mammot pacificus*, on the basis of a critical specimen from the Diamond Valley Lake fossil collection. This highly specialized collection of mastodon bones was excavated during the construction of a local reservoir and subsequently housed locally in a small museum. This regional collection is the impetus for a revised taxonomy of Pleistocene mastodons in North America. Collections from regional NHCs also influenced Belitz and colleagues (2018) in their investigation of potential causes for the decline of the critically endangered Poweshiek skipperling butterfly (*Oarisma poweshiek*). In this study, the authors found 40% of the historical entomological records in regional collections. Across taxonomic disciplines, regional collections provide critical geographic resolution for fine scale questions of diversity and unique occurrence records documenting species and distributions.

A discussion on the importance of regional collections must include the valuable role they play in promoting taxonomic, local, and indigenous knowledge. Researchers associated with regional collections represent a significant portion of the scientific community and workforce and contribute meaningfully to biodiversity research. The large number and distributed nature of regional collections provides critical access points to engage local and indigenous communities and, in turn, to disseminate proximate and contextual understanding of biodiversity. The 2019 IPBES Global Assessment Report emphasizes using local and indigenous knowledge to inform our understanding of regions, ecosystems, and biodiversity and was the first IPBES report to make specific reference to the importance of local and indigenous communities in pursuing conservation of biodiversity (Diaz et al. 2019). Reaching out and engaging on a local level is a critical step NHCs can take to address longstanding inequities caused in part by

a history of colonialism and ongoing systemic racism. Regional collections provide opportunities to acknowledge and incorporate the contributions of local and indigenous communities, improve the inclusivity of our NHCs, discover and democratize biodiversity data, and engage the diversity of our collections professionals and researchers.

The sustainability of biodiversity research is strengthened by the global network of NHCs linking specimens, associated data, and researchers in a dynamic community of practice. The general importance of regional collections to this network has been acknowledged in several summative reports addressing the future of NHCs (see Lendemer et al. 2020 and the references therein); this bears repeating as we look to the future of collections and consider next steps in the global digitization of NHC data. Regional collections provide the majority of access points to NHCs around the world, fill critical gaps in specimen coverage, and foster a distributed network of human expertise that has the potential to increase representation and diversity in our community. We are in a fast-paced and vibrant era for NHCs as biodiversity research and collections are at the leading edge of digital data mobilization, open data and open science initiatives, and biology reintegration and transdisciplinary collaboration. Now is the time to renew efforts to engage our entire community of collections and collections professionals in ways that leverage the diversity of expertise, scope, size, and institutional structure among NHCs. We are stronger, more creative, and more resilient as a community, and we enhance our collective research capacity, when we include regional collections in building a global network of NHCs.

Acknowledgments

This article originated from a symposium and writing workshop held at the 2019 meeting of the Society for the Preservation of Natural History

Collections in Chicago, Illinois. The authors would like to thank the Biological Collections Network for their generous support of this symposium and writing workshop (grant no. NSF DBI 1441785).

References cited

- Bakker FT, et al. 2020. The Global Museum: Natural history collections and the future of evolutionary science and public education. *PeerJ* 8: e8225.
- Belitz MW, et al. 2018. Aggregated occurrence records of the federally endangered Poweshiek skipperling (*Oarisma poweshiek*). *Biodiversity Data Journal* 6: e29081.
- Cahill B, Thiers BM, Monfils AK. 2019. Research contributions and digitization progress in regional herbaria. Paper presented at the 34th Annual meeting of the Society for the Preservation of Natural History Collections; 30 May 2019, Chicago, Illinois.
- Cobb NS, Gall LF, Zaspel JM, Dowdy NJ, McCabe LM, Kawahara AY. 2019. Assessment of North American arthropod collections: Prospects and challenges for addressing biodiversity research. *PeerJ* 7: e8086.
- Diaz S, et al., eds. 2019. Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. <https://doi.org/10.5281/zenodo.3553579>.
- Dooley AC, Scott E, Green J, Springer KB, Dooley BS, Smith GJ. 2019. *Mammot pacificus* sp. nov., a newly recognized species of mastodon from the Pleistocene of western North America. *PeerJ* 7: e6614.
- Dunnum JL, McLean BS, Dowler RC, the Systematic Collections Committee of the American Society of Mammalogists. 2018. Mammal collections of the Western Hemisphere: A survey and directory of collections. *Journal of Mammalogy* 99: 1307–1322.
- Glou HE, Heumann BW, Carter JR, Bartek JM, Monfils AK. 2017. The contribution of small collections to species distribution modelling: A case study from Fuireneae (Cyperaceae). *Ecological Informatics* 42: 67–78.
- Lendemer J, et al. 2020. The Extended Specimen Network: A strategy to enhance US biodiversity collections, promote research and education. *BioScience* 70: 23–30.
- Marsico TD, et al. 2020. Small herbaria contribute unique biogeographic records to county, locality, and temporal scales. *American Journal of Botany* 107, in press.
- Mehrhoff LJ. 1997. Museums, research collections, and the biodiversity challenge. Pages 447–464 in Reaka-Kudla ML, Wilson DE and Wilson EO, eds. *Biodiversity II: Understanding and Protecting Our Biological Resources*. Joseph Henry Press.

Miller SE. 1991. Entomological collections in the United States and Canada. *American Entomologist* 37: 77–84.

National Research Council. 2014. *Enhancing the Value and Sustainability of Field Stations and Marine Laboratories in the 21st Century*. National Academies Press.

Sierwald P, Bieler R, Shea EK, Rosenberg G. 2018. Mobilizing mollusks: Status update on mollusk collections in the U.S.A. and Canada. *American Malacological Bulletin* 36: 177–214.

Anna K. Monfils (monfi1ak@cmich.edu) and Blake C. Cahill are affiliated with the Department of Biology and the Institute for Great Lakes Research at Central Michigan University, in Mount Pleasant. Erica R. Krimmel is affiliated with iDigBio in the Institute for Digital Information and Scientific Communication, at Florida State University, in Tallahassee. John M. Bates is president of the Natural Science Collections Alliance and

curator of birds and head of life sciences at the Field Museum, in Chicago, Illinois. Jennifer E. Bauer is affiliated with the Florida Museum of Natural History, at the University of Florida, in Gainesville, and is currently at the Museum of Paleontology at the University of Michigan, in Ann Arbor. Michael W. Belitz and Shari A. Ellis are affiliated with the Florida Museum of Natural History, at the University of Florida, in Gainesville. Alyssa M. Caywood and Julia B. Colby are affiliated with the Department of Zoology at the Milwaukee Public Museum, in Milwaukee, Wisconsin. Neil S. Cobb is affiliated with the Biodiversity Outreach Network in Phoenix, Arizona, and with Northern Arizona University, in Flagstaff. Dianna M. Krejsa is affiliated with the Angelo State Natural History Collections, at Angelo State University, in San Angelo, Texas. Todd D. Levine is affiliated with the Department of Life Sciences at Carroll University, in Waukesha, Wisconsin. Travis D. Marsico is affiliated with the Department of Biological Sciences at Arkansas State University, in Jonesboro. Teresa J. Mayfield-Meyer is

affiliated with the Museum of Southwestern Biology, at the University of New Mexico, in Albuquerque. Jess A. Miller-Camp is affiliated with the Dept. of Earth and Atmospheric Sciences, Indiana University, Bloomington. Roy M (Gil) Nelson and Molly M. Phillips are affiliated with iDigBio, in the Florida Museum of Natural History, at the University of Florida, in Gainesville. Marcia A. Revelez is affiliated with the Natural Science Research Laboratory at Texas Tech University, in Lubbock. Dawn R. Roberts is affiliated with the Chicago Academy of Sciences and the Peggy Notebaert Nature Museum, in Chicago, Illinois. Randal A. Singer is affiliated with the Museum of Zoology at the University of Michigan, in Ann Arbor. Jennifer M. Zaspel is treasurer of the Natural Science Collections Alliance and is affiliated with the Department of Zoology at the Milwaukee Public Museum, in Milwaukee, Wisconsin.

doi:10.1093/biosci/biaa102