

MUSEUM OF
NATURAL
HISTORY

2017 Annual Report



Auburn University Museum of Natural History

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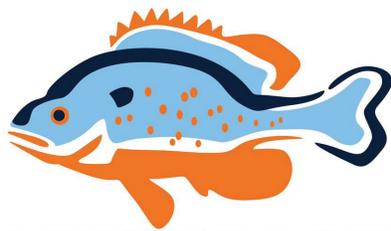
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MUSEUM OF NATURAL HISTORY

Auburn University Museum of Natural History

The mission of the Auburn University Museum of Natural History is to conduct biodiversity research, preserve and document our region and planet's biodiversity, and to lead and promote activities related to natural history education and outreach for Auburn University and all citizens of the state of Alabama. Our vision is to emerge as the primary repository for all natural history collections currently maintained at Auburn University and to function as a center of excellence for biodiversity research, education, and outreach. We will capitalize on strengths of the biodiversity heritage collections in our care and the vast organismal knowledgebase of the curators and staff to establish a gateway through which all segments of society can come discover the natural sciences and appreciate the relevance of biodiversity to human health and quality of life. We will preserve and document the rich natural heritage of Alabama while concurrently creating opportunities for students and teachers from regional schools, the general public, students at Auburn University, and researchers to explore our planet's biodiversity. We seek to inspire an appreciation of nature and the environment so that we might better conserve it for future generations.

Location

AU Museum of Natural History
Biodiversity Learning Center
Auburn University

Alabama Natural Heritage ProgramSM
1090 South Donahue Drive
Auburn University, AL 36849

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AUMNH: (334) 844-9234
ALNHP: (334) 844-4462

Websites

Auburn University
Museum of Natural History:
aumnh.org

www.facebook.com/AUMNH

ALNHP:
www.alnhp.org

Affiliated Websites

NatureServe
www.natureserve.org

From the Director:

The Auburn University Museum of Natural History launched its new graphic element this year with design coming from the Auburn University Office of Communications and Marketing. It is based on the Orangespotted Sunfish (*Lepomis humilus*). The Orangespotted Sunfish is one of our smaller bream, and it is found in quiet pools of small creeks to large rivers in the Alabama and Tennessee River systems. The extravagant colors of the nuptial males are not exaggerated in the design, and they evoke the colors of Auburn.

2017 found us continuing strong in research. We added major grants from the US National Science Foundation and Environmental Protection Agency. The NSF grant is exploring the impact of the 2015 drought on stream fishes. The drought hit strongly in some of the most biodiverse regions of the southeastern US, and right where we had already completed some important pre-drought surveys. The EPA grant will establish reference wetlands for the state, and we will survey the plants and animals in some of the higher quality wetlands to determine what should be the gold standard for the many types of wetland in the state.

The museum's insect collection saw a couple of major events this year, we added Dr. Melissa Callahan as the Collection Manager of Terrestrial Arthropods and Nathaniel Hardy as Curator of Entomology and the collection exceeded a quarter of a million specimens computerized (maybe we are halfway to completion). The aquatic and marine invertebrate collection also grew tremendously as we have begun to incorporate Dr. Kenneth

Halanych's Antarctic collections into the museum. To round out invertebrates, we also added Ash Bullard as Curator of Parasites.

In outreach, we have continued to expand our efforts with new programs at the Davis Arboretum, the Veterinary School Open house, and catering to younger groups with our Junior Curator Camps. We also embarked on our first major display thanks to Tiger Giving Day. Soon (hopefully) we will finish a display for AUMNH's dinosaur egg, the only dinosaur egg found east of the Mississippi River. Work continues on the egg itself, and a paper will soon be published that will let us all know what the animal is.

We did lose two members of our staff this year to other positions. Dr. Brian Helms, collection manager of aquatic and marine invertebrates, took a faculty position at Troy State University in Troy, Alabama, and Dr. David Steen of the Natural Heritage Program took a position at the Georgia Sea Turtle Center on Jekyll Island on the Atlantic Coast. I would like to thank them both for their years of service.

To start off 2018, we submitted an NSF grant in August to fund compactorized shelving for the alcohol collections (fishes, amphibians and reptiles, and aquatic and marine invertebrates), and we recently found out that we will be receiving the money! So, we will soon be doing a lot of collection shifting, and we will have space to grow all of our collections for likely the next ten years or more.

Jonathan Armbruster

Director, Auburn University Museum of Natural History



Primary funders (in alphabetical order)

Alabama Department of Conservation and Natural Resources, Division of Wildlife & Freshwater Fisheries

Black Warrior Waterdog and Flattened Musk Turtle Status Survey using Environmental DNA (eDNA)
 Distribution, Abundance, and Health Assessment of the Gopher Tortoise (*Gopherus polyphemus*) in Alabama
 Gopher frog survey
 Hellbender survey
 Indigo snake monitoring
 Reintroduction of the Eastern Indigo Snake onto Conecuh National Forest

Alabama Department of Conservation and Natural Resources, State Lands Division

Environmental Science and Art - AUMNH Outreach at Wehle

NatureServe

Jean Lafitte National Historic Park Vegetation Reference point Establishment and Mapping Project

National Science Foundation

RAPID: Aquatic refuge and recovery in the face of drought in a biodiversity hotspot

U.S. Army Garrison - Redstone

Planning Level Survey of Redstone Arsenal for At-risk Species and Ecologically Significant Communities

U.S. Environmental Protection Agency

Establishment of Wetland Reference Sites in Alabama

U.S. Fish and Wildlife Service

Preliminary Status Assessment of *Hamamelis ovalis*, Mississippi Witch-Hazel
 Preliminary Status Assessment of *Nuphar ulvacea*, West Florida Cowlily
 Preliminary Status Assessment of *Rhynchospora crinipes*, Hairy-Peduncled Beakrush
 Range-wide Status Assessment of *Hexastylis speciosa*, Harper's Heartleaf
 Range-wide Status Assessment of *Lindera subcoriacea*, Bog Spicebush
 Recovery of Price's potato-bean (*Apios priceana*) at Sauta Cave National Wildlife Refuge, Alabama - Year 3
 Status Assessment of *Spigelia gentianoides*, Gentian Pinkroot, in Alabama
 Turkey Creek Musk Turtle

U.S. Forest Service

Black Warrior Waterdog and Flattened Musk Turtle, Streak Sorus Fern & Kral's Water Planta Studies in the Bankhead National Forest, Alabama
 Inventory of *Hamamelis ovalis*, *Nuphar ulvacea*, and *Rhynchospora crinipes* on Conecuh and Tuskegee National Forests
 Monitoring of Alabama Streak-sorus Fern on Bankhead National Forest

AUMNH COLLECTIONS

John D. Freeman Herbarium

Accessions/Acquisitions/Exchanges/Loans

The herbarium contains over 80,000 specimens of vascular plants, mosses, liverworts, lichens and fungi from all over the world. Exchange specimens and acquisitions have added greatly to the broad diversity and growth of the collections. The herbarium received 260 specimens on exchange or as gifts and sent out 2 loans of 37 sheets. Approximately 200 specimens were sent

from Auburn as exchange or gifts to other institutions. The George Andrews Forestry Lab (USFS) herbarium was acquired and five herbarium cabinets containing ~3500 specimens were relocated to the Freeman Herbarium during the summer. A modest teaching collection of ~630 sheets, of primarily aquatic plants, was also obtained this year from the Auburn Fisheries Lab.

Digitization/Database Development

Over 1,939 specimens were glued and added to the Specify database in 2017. Progress continues on barcoding every herbarium sheet. Herbarium specimens, including vascular plants, lichens, bryophytes and fungi, are searchable on the Web at the AUMNH website (aumn.org/research-collections/plants/search-plant-database/). Our Alabama vascular plants are searchable on the Alabama Plant

Atlas website (www.floraofalabama.org) and Morphbank (www.morphbank.net) and many of our lichens and bryophytes may be found on the Symbiota web portals, <http://lichenportal.org/portal/> and <http://bryophyteportal.org/portal/>, respectively. Approximately 1,500 specimens from Ft. Benning were added to the database, finally completing this multi-year project.



GUTS program



Teaching, Students, & Volunteers

Volunteers are critical to successful collections management and this past year we have had great support. Returning volunteers Alexandra Moore and David Hall continued to glue plants while Nick Bugess furthered work on barcoding and database entry. This year several new volunteers did excellent work including

Isabella Lopez, Gerilyn Kim and Trey Kidd. Several honors biology students spent volunteer hours helping to glue plants. Systematic Botany continues to be successfully taught every spring semester with students gaining knowledge and experience in plant identification.

Research & Collections Related Activities

Graduate student Nathan Hall published a paper documenting the complete plastid genome sequence of *Eleusine indica*. He is finishing up his dissertation which also includes *Marshallia* phylogenetics using the mitochondrial and plastid genomes.

Dr. Roland Dute, Professor (ret.) in the Biological Sciences Department, completed work exploring the presence of pit membranes in vascular plant tissue of the genus *Schisandra*. The herbarium facilitated several loans for this research.

Curtis Hansen published an article typifying the scientific names authored by Wolfgang Wolf, an early 20th century Alabama botanist. The Freeman Herbarium houses Wolf's collections from the St. Bernard Herbarium formerly located in Cullman Co., AL. Hansen was also active on the Redstone Arsenal collecting lichens from the base the ongoing biological surveys contracted to AUMNH.



Plant collection during Junior Curator Camp 2017.

Ichthyology Collection

In 2017, the AUMNH Fish Collection added 1,170 lots containing 11,491 specimens. Most of the new material came from ongoing AUMNH fish surveys in Alabama and surveys made by Carol Johnston's lab (School of Fisheries, Aquaculture and Aquatic Sciences) in previous years. Also included in this year's accessioning were ten paratype specimens of recently described or soon to be described species from Brazil, Colombia, Peru, and Venezuela. This past year the Fish Collection sent out 23 loans that included 562 vouchers and tissues. Eight of the loans were to researchers at international institutions in Europe and South America with the remainder made to institutions in the United States. Requests for loans came from faculty, graduate students, post-doctoral researchers, museum curators, and government researchers. Thirty peer reviewed publications cited AUMNH Fish Collection specimens in 2017. The research topics citing Fish Collection specimens included taxonomy and systematics, ecology, functional morphology, and biogeography.

In addition to material collected by Auburn University researchers, the museum received over 700 collections from the Florida Fish and Wildlife Conservation Commission and 20 collections made by the USDA Forest Service in Bankhead National Forest. The Florida collections are of particular importance because they represent 10 years of surveys from streams across the panhandle of Florida

made between 2006 and 2015. These collections complement our existing holdings from the Alabama side of the drainages in which these belong. Additionally, the Florida panhandle is an area typically underrepresented in museum collections so the addition of these specimens will greatly increase our knowledge of fish distributions. Included in this material are species rare in Alabama and Florida such as the Ironcolor Shiner (*Notropis chalybaeus*) and the Bluenose Shiner (*Pteronotropis welaka*). Processing of the Florida and Bankhead collections will continue in 2018 and 2019, and it is estimated to add another 2000-3000 lots to the collection when completed.

New collections made by AUMNH personnel in 2017 include samples made as part of the NSF funded RAPID grant. This grant was to study the effects of the 2016 drought on the aquatic fauna of Alabama. Between June and August of 2017, we sampled 16 sites in Bankhead National Forest and 18 sites in the piedmont of Alabama. The fish collected during the summer were sorted and identified by AUMNH staff in the late summer and early fall. Four undergraduate students volunteered on the project by taking length and weight measurements during the 2017 fall semester on the fish collected in Bankhead National Forest. The remaining fish from the piedmont samples will be measured during the spring semester of 2018.

Herpetological Collections

Accessions/Acquisitions/Exchanges/Loans

Twenty seventeen saw continued growth in the herpetological collections. Over 500 amphibian and reptile specimens were added to the alcohol collection representing a collections growth of over 1.2%. The specimens included adults, larvae, eggs, and cleared and stained specimens. Many of the new specimens arrived as a result of ongoing research associated with the herpetology labs on campus. As was the case over the last two years, Melissa Miller's doctoral work on snake parasites with Dr. Craig Guyer continues to produce snake specimens from the southeastern United States. Additionally, other herpetological projects in the labs of Dr. Craig Guyer and Dr. Dan Warner have contributed lizard and turtle specimens. Project species included many exotic and invasive species including *Agama picticauda*, *Anolis cristatellus*, *Anolis distichus*, *Anolis equestris*, *Ctenosaura similis*, *Gecko gecko*, and *Basiliscus vittatus*.

There was great growth in the other herpetological collections with close to 90 skeletal specimens, primarily turtles, being added to the osteological collection and 1200 digital vouchers added to our photo/audio/video voucher collection. Associated with these new specimens, were 800 new tissues samples added to the herpetological tissue collection. Of special concern this year, was the accessioning of more than 360 cleared and stained

amphibians, primarily Plethodontid salamanders. This collection has been in the museum for years, but now through the dedication and hard work of the herpetology volunteers, these specimens are now cataloged, numbered, properly jarred and labeled, and available for study.

The herpetology collections were also well utilized by researchers in 2017. During this time, a total of 7 loans were sent out and more than 30 data and tissue requests were processed.



Digitization/Database Development

The work of digitizing and serving the herpetological databases online continues. The majority of the wet collections are available online through the museum's website. The remaining specimens should be added shortly. The frozen tissue collection has been organized and is now digitized. It now awaits being inputted in to Specify. Additionally, we continue also to add to and maintain a

series of ecological databases that are available online through our website. Last year also saw the beginnings of efforts to photograph the museums specimens. These photographs will be added to our Specify database and be made available online, allowing researchers and the public to see each individual specimen as they search the database.

Teaching, Students, & Volunteers

The Museum's herpetological scientific and teaching collections were also extensively utilized by undergraduate and graduate courses for class use, class projects and individual research. The availability of room 251 as a lab instructional area has allowed several courses to teach their labs within the museum. These include Vertebrate Biodiversity, Herpetology. Not only did students utilized the herpetological teaching collections for lab, several student class projects were based out of the herpetological collections as well and several undergraduate research projects were conducted in the herpetological collections.

A crucial component of our museum family is the group of dedicated and talented volunteers that work with us at the museum. The herpetology collections benefited from the hundreds of hours of tireless work of over 12 volunteers (see list) who worked in just about every corner of the collections including: the wet collections, the skeletal collection, the beetle colony, the frozen tissue collection and in the collections databases. Their work is invaluable to the mission of the museum.

Volunteers

Christina Holbrook
Vahab Rajaei
Katie Kreider
Kody Lewis
Lesley Turner
Caroline Nelson
Zachary Singh
Nicole Gassman
Sarah Bailey
Miles Horne
Shannon Muratta
Cindy Scruggs



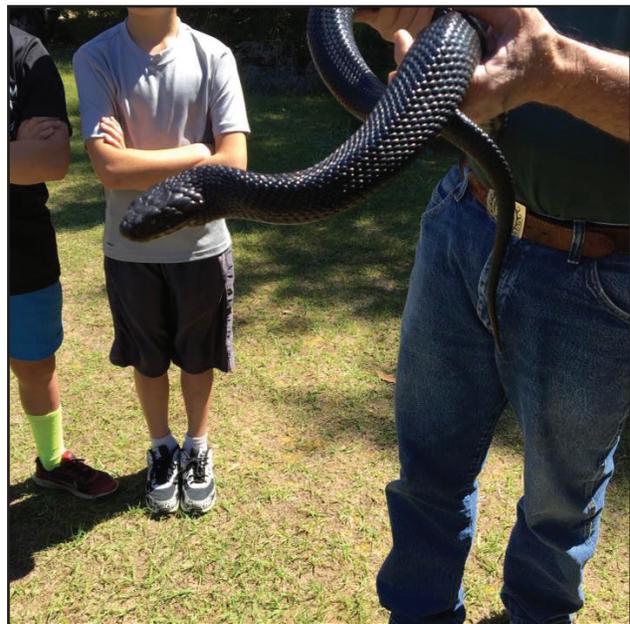
Citizen Science

The museum continues to participate in citizen science programs that allow Alabamians to participate in the collection of real scientific data and add to our knowledge base on the calling phenology of our state's frog species as well as the geographic distribution of our herpetofaunal diversity. The AUMNH is home to a chapter of FrogWatch USA, a nation-wide citizen science program where volunteers monitor frog call activity to help conserve amphibians and wetlands. Over the last two years, several volunteer workshops have been

held throughout the state. The museum is also home to the Alabama Herp Atlas Project (AHAP), a citizen science program where citizens can send in photo, audio or video documentation of any amphibian or reptile species. These records are curated and added to both our photo voucher catalog our geographic distribution maps for those species. As describe above, close to 1,200 vouchers were accessioned in 2017, several of which represented county records. We hope to soon develop educational components to each of these programs.

Live Animal Collection

Continuing our long tradition, the live animal room, now located in nearby Funchess Hall, has been an indispensable resource, which we utilized during both tours and outreach programs. Moreover, our live animals are utilized by other campus programs and departments, further increasing both the impact of the museum collections and the visibility of the museum. In all, live animals were utilized in over 17 events in 2017 and were seen by over 1,500 people.



Research & Collections Related Activities

Herpetology personnel continued producing original collections-based and collections-related research. In 2017, no less than 6 papers and notes related to the herpetological collections were published, with another half dozen in press and in review at the end of the year. These papers showcase the breadth of research being conducted at the AUMNH and cover among other topics: basic ecology and

natural history, herpetofaunal diversity and geographic distributions, taxonomy, behavior, invasive species, as well as the conservation of threatened and endangered species. Additionally, 2017 saw 6 oral presentations and 5 poster presentations. All major groups of Alabama amphibians and reptiles were represented in the above publications and presentations.

Ornithological Collections

Accessions/Acquisitions/Exchanges/Loans

The ornithological research collection consists of about 2500 bird skins, 50 bird nests with eggs, and 50 empty bird nests. A great majority of the material originates in Alabama. Of the remaining material, the skins are primarily from elsewhere in the Southeast, although a few specimens collected in Central America and Europe are represented. Many of the skins represent the first documentation of that

species in the state, and a few remain the only documentation of the species for the state.

There were one ornithological loan requests and two data requests. The loan requests was for material from the ornithology collection to be utilized as 'models' by several art and design courses on campus.



Digitization/Database Development

The ornithological collections are housed in Specify and are available online. There is more data available for each bird however. These data are located on the hand written specimen tags which are affixed to the foot of each specimen. Museum volunteer, Abigail Shashikanth has taken over for David Quinn, and continues to digitize all remaining data located on the specimen tags.

Teaching, Students, & Volunteers

In addition to the research collection, the AUMNH houses a large teaching collection consisting of about 100 bird skins, bird nests, and taxidermy mounts of birds. Most of the skins in the teaching collection were prepared from salvaged carcasses by students taking Ornithology. The teaching collection is used by several classes in the Department of Biological Sciences to teach bird identification and avian anatomy. The two spring semesters saw 83 students enrolled in Ornithology, and the Vertebrate Biodiversity courses had over 80 enrollees. Two student projects originated in the ornithology collection.



Junior Curator Camp 2017

Mammal Collection

Accessions/Acquisitions/Exchanges/Loans

The AUMNH mammal collection is comprised of just over 5000 specimens, primarily from east-central Alabama. The collection has a focus on insectivores, bats, rodents and carnivores and consists of traditional skin and skull preparations with numerous taxidermy mounts, completed skeletons, fluid-preserved specimens and frozen tissues. Museum specimens are accompanied by standard measurements, such as tail length, mass, and total length, along with information

about the collection site and date. To complement its research collections, the museum houses a separate teaching collection used in courses such as Mammalogy and Natural History of the Vertebrates. Over the last year, two mammal data requests were received and one scientist visited the mammal collection. Additionally, one tissue loan was taken in 2017.

Teaching, Students, & Volunteers

During 2017, the collection benefited greatly from three dedicated and highly motivated volunteers: Jackson Moss, Alswell Aryee, and Chara Wood. Their efforts helped maintain and organize the collection. Of note was the preparation of dozens of skins and hundreds of skulls and skeletons that were prepared during the year. These specimens are now properly prepared and ready to be accessioned into the collection.

Digitization/Database Development

As with all of the museum collections, the mammal database is in the process of moving over to the Specify platform. During 2017, this effort continued and the location of each specimen was updated with its current drawer and cabinet.



Vertebrate Paleontology Collection

Accessions/Acquisitions/Exchanges/Loans

The vertebrate paleontology collections include close to 2,500 specimens. The collection focuses on the state of Alabama, but also includes significant material from other portions of the southeastern United States. This past year saw the start of preparations for the museum's first public display. The first display will be of our dinosaur egg! Originally discovered by Prescott Atkinson, the egg represents

the only dinosaur egg known from east of the Mississippi River and the only egg in the world found in marine sediment. The museum is now working on developing a public display for the egg on the campus of Auburn University.

The collection grew by one specimen in 2017.

Teaching, Students, & Volunteers

Another great development in the vertebrate paleontology collection was the great volunteer help provided by Claire Wilson and Dr. Bill Deutsch and

Skye Walker. Through their efforts, the collection is being organized and the fossils' housing is being improved.

Invertebrate Paleontology Collection

Accessions/Acquisitions/Exchanges/Loans

The museum's invertebrate paleontological collections were first curated in 2016. Thanks to the work of museum volunteer, Chris Parsons, the museum is now home to

a small collection of over 120 invertebrate fossils. Chris identified, accessioned and cataloged the material over his summer vacation.



Junior Curator Camp 2017

Invertebrate Collection

Accessions/Acquisitions/Exchanges/Loans

We had a total of six outgoing loans this year totaling 135 specimens, and one incoming loan. We loaned cave-adapted snails to researchers at the University of Tennessee Knoxville, cave beetles to a researcher at the Illinois Natural History Survey, mussels to Auburn

University Montgomery for use at the Environmental Education Association of Alabama conference, and marine invertebrates to researchers at Martin Methodist College and Auburn University. We received pseudoscorpions on loan from the University of Alaska.

Digitization/Database Development

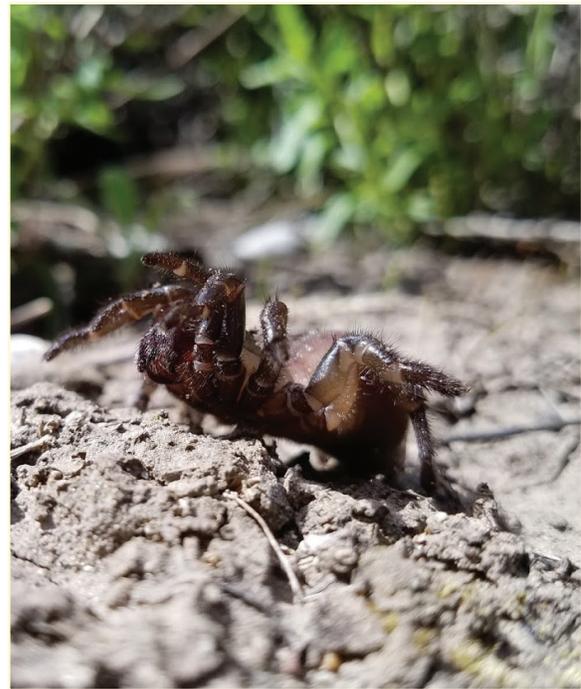
Considerable progress has been made on digitizing the Alabama State Entomology collection. With the hard work of many students and volunteers, we have digitized nearly 200,000 specimens over the past four years. Additionally, 2,000 aquatic insects were accessioned into the collection this year, with work continuing. Approximately 8,500 arachnids and myriapods have been digitized, and thousands more from a California USGS

survey are actively being identified and accessioned. The marine and aquatic invertebrate collection is steadily growing, with 2,500 lots accessioned last year.

All of the information is being added to our Specify database, and each specimen receives a barcode for more efficient tracking. The data will soon be available online at the AUMNH website, as well as through GBIF, SCAN, and InvertEBase.

Research & Collections Related Activities

There have been many collecting expeditions by personnel in the Invertebrate collections. Charles Stephen, a PhD student, collected Pseudoscorpiones and other cave invertebrates from caves throughout the United States. Dr. James Starrett, a post-doc, along with collaborators from the U. of Nebraska, collected wolf spiders from the United States, and received specimens from Canada, South Africa, Uruguay, and Costa Rica. Rebecca Godwin and Nicole Garrison, PhD students, collected trapdoor spiders throughout California. Dr. Vera Opatova collected spiders in South Africa, and along with Charles Stephen and Dr. Jesse Grismer, also collected spiders in Morocco. This collection-based research resulted in a plethora of publications and presentations at conferences.



California trapdoor spider collecting trip
Rebecca Godwin and Nicole Garrison

Teaching, Students, & Volunteers

The Invertebrate collections have benefited greatly from the amazing group of students and volunteers who have worked diligently on specimen preparation, accessioning, digitizing, and outreach. We are so grateful for all of their contributions.

Sarah Asher (Undergraduate, DBS)

Mary Bolton (Senior, Auburn High School)

Kellie Bourguignon (Masters student, DBS)

Nicole Garrison (PhD student, DBS)

Rebecca Godwin (PhD student, DBS)

Amelia Grider (Undergraduate, DBS)

Sarah Harbison (Undergraduate, DBS)

Alan Jeon (Undergraduate, Entomology)

Nicholas Lockert (Undergraduate, DBS)

Kristin Mays (Undergraduate, DBS)

Callie Newton (Volunteer)

Lacie Newton (PhD student, DBS)

Sarah Odom (Undergraduate, DBS)

Vahab Rajaei (Undergraduate, DBS)

Charles Stephen (PhD student, DBS)

Yuexun Tian (Undergraduate, Entomology)

Cory Unruh (Volunteer)

Jen Weber (Masters student, DBS)

Brittany Woodruff (Undergraduate, DBS)

Xavier Zahnle (PhD student, DBS)

AUMNH Open House 2017



Monthly museum tour



AUMNH Research Projects

Redstone Arsenal Planning Level Surveys

Redstone Arsenal contracted with ALNHP and AUMNH to conduct planning level surveys to document the precise of species of conservation concern on the installation. Surveys focused on areas designated as Ecologically Sensitive Areas but also included other areas of suitable habitat for rare species. Surveys in 2017 focused on plants, lichens, birds, mammals, and cave fauna.

Over 466 lichens were collected from the Redstone Arsenal, virtually all county records. Of those collections, over 147 species were identified from 60 genera, including 12 new state records and 2 new species to science currently being described. In addition to the rare plant surveys, classification of significant natural communities is underway, where examples are identified and cross-walked with the National Vegetation Classification ecological system framework.

The following sensitive species have been documented from the base.

- Allegheny woodrat (*Neotoma magister*)
- American Black Duck (*Anas rubripes*)
- Wood Stork (*Mycteria americana*)
- Black-Crowned Night Heron (*Nycticorax nycticorax*)
- Northern Harrier (*Circus cyaneus*)
- Price's potato-bean (*Apios priceana*)
- Cypress-knee Sedge (*Carex decomposita*)
- American Smoketree (*Cotinus obovatus*)
- Cream-flower Tick-trefoil (*Desmodium ochroleucum*)
- Harper's Umbrella-plant (*Eriogonum longifolium* var. *harperi*)
- Pale Avens (*Geum virginianum*)
- Michaux's Leavenworthia (*Leavenworthia uniflora*)
- Cumberland Rosinweed (*Silphium brachiatum*)
- Least Trillium (*Trillium pusillum*)
- Southern Cavefish (*Typhlichthys subteranneus*)
- Alabama Cave Shrimp (*Palaemonias alabamiae*)
- Green Salamander (*Aneides aeneus*)



Southern Cavefish (*Typhlichthys subteranneus*)



Allegheny Woodrat (*Neotoma magister*)

ALABAMA NATURAL HERITAGE PROGRAMSM

The mission of the Alabama Natural Heritage ProgramSM (ALNHP) is to provide the best available scientific information on the biological diversity of Alabama to guide conservation action and promote sound stewardship practices. ALNHP is administered by the Auburn University Museum of Natural History, Department of Biological Science. Established by The Nature Conservancy in 1989, it is one of a network of such programs across the United States, Canada, and Latin America, collectively known as the Natural Heritage Network (NHN). As a member of the NHN, ALNHP is represented by its membership organization NatureServe. NatureServe works to aggregate data from individual Network Programs and is dedicated to the furtherance of the Network and the application of Heritage data to biodiversity conservation.

Natural Heritage Programs have three broad functions:

- to collect information on the status and distribution of species and natural communities,
- to manage this information in a standardized way, and
- to disseminate this information to a wide array of users.

Natural Heritage Programs use a standardized information management system to track biodiversity data including taxonomy, distribution, population trends, condition, and viability. ALNHP provides the following services: biodiversity data management, inventory, biological monitoring, conservation planning, Geographic Information System services, and land management expertise.



NatureServe is a non-profit conservation organization that provides the scientific information and tools needed to help guide effective conservation action.

NatureServe represents an international network of biological inventories - known as natural heritage programs or conservation data centers - operating in all 50 U.S. states, Canada, Latin America and the Caribbean. NatureServe and its network of natural heritage programs are the leading source for information about rare and endangered species and threatened ecosystems. Together we not only collect and manage detailed local information on plants, animals, and ecosystems, but develop information products, data management tools, and conservation services to help meet local, national, and global conservation needs. The objective scientific information about species and ecosystems developed by NatureServe is used by all sectors of society - conservation groups, government agencies, corporations, academia, and the public - to make informed decisions about managing our natural resources.

Project Summaries

Alabama Streak-sorus Fern Monitoring

The Alabama streak-sorus fern (*Thelypteris burksiorum*) is a federally listed species endemic to the Sipsey Fork of the Black Warrior River in Bankhead National Forest. The low number of individuals combined with an extremely limited distribution prompted the U.S. Fish and Wildlife Service to list the species as threatened under the Endangered Species Act on July 8, 1992. It was during this time that a comprehensive status assessment was prepared to obtain census data, to qualify habitat preferences, and to identify apparent disturbances and potential long-term threats to the species. Since the initial assessment of the species in the early 1990s, comprehensive surveys have not been implemented to determine population viability, evaluate population trends and to identify disturbances and potential threats. To update information on existing occurrences and to search new sites, ALNHP partnered with the U.S. Forest Service and Alabama Power in 2013 to embark on a five-year project, which was finalized in 2017. The project also entailed establishing permanent



monitoring plots to further assess the long-term effects of natural and human-derived disturbances.

Now finalized, all occurrences of Alabama streak-sorus fern documented in the data system at ALNHP have been surveyed. Previously, 19 sites were identified as containing the species, primarily based on surveys conducted in 1992. Six of those populations could not be relocated during this project. As an effort to place a greater emphasis in following NatureServe guidelines defining an element occurrence and the distances that separate them, boundaries of existing occurrences have been redefined. Occurrences documented previously in ALNHP's data system have now been combined and delineated to represent two occurrences.

Four permanent plots have been established at two colonies as an effort to monitor population dynamics. Site selection was based on ease of accessibility, as colonies in each occurrence generally require an extension ladder to access the plants for census work. Each plot was delimited by inserting nails affixed with numbered metal tags in rock crevices. It is anticipated that long-term monitoring will serve as a platform to evaluate the impacts of climate change.

This project also included updating existing records and documenting new occurrences of Kral's water-plantain (*Sagittaria secundifolia*), a federally listed species. Eight sites containing the species were recorded in various drainage courses throughout the National Forest, where information reflecting the biology, colony dimensions, and locations were entered into data system of ALNHP.

Black Warrior Waterdog (*Necturus alabamensis*) and Flattened Musk Turtle (*Sternotherus depressus*)

The Black Warrior waterdog (*Necturus alabamensis*) and flattened musk turtle (*Sternotherus depressus*) are aquatic endemics of the upper Black Warrior River watershed in NW Alabama.

These species are connected by distribution and habitat as their ranges and known habitat preferences are essentially identical. Characteristics of preferred habitat for both species consists of clean, clear, rocky permanent streams with substrate of underwater rocks, crevices, and ledges. The species are seasonally disconnected with the Black Warrior waterdog being a cool season-active species, late-October to early-April, while the flattened musk turtle is active during the warm season from early-April to October.

Best remaining habitat and populations of the Black Warrior waterdog and flattened musk turtle remain in Bankhead National Forest. A five-year study on distribution of the Black Warrior waterdog and

movements and habitat needs of the flattened musk concluded in 2017. Data from Sipsey Fork, Brushy Creek, and tributaries of these streams was collected on the occurrence of the Black Warrior waterdog and flattened musk along with habitat features. Sampling for flattened musk turtles was through visual surveys, trapping, and water sample collection for eDNA. Similar data on the Black Warrior waterdog were collected with the use of baited minnow traps and water sample collection for eDNA. Management recommendations were prepared for the Bankhead National Forest to ensure the long-term survival of these species within the forest.

Data from distributional studies on the Black Warrior waterdog and flattened musk turtle using eDNA were analyzed in a seasonal and occupancy modeling framework and published in PLoSOne (de Souza, L.S., J.C. Godwin, M.A. Renshaw, and E. Larson. 2016. Environmental DNA (eDNA) detection probability is



influenced by seasonal activity of organisms. PLoS ONE 11(10):e0165273. doi:10.1371/journal.pone.0165273). The USFWS funded a study on the status of the Black Warrior waterdog outside of Bankhead National Forest in which conventional sampling and eDNA was used. Low detections of the Black Warrior waterdog in the Upper Black Warrior River basin outside of Bankhead National Forest highlight the importance of this public landholding to the survival of the Black Warrior waterdog. The Black Warrior waterdog was proposed for listing as endangered by the USFWS in October 2016 with our eDNA results used as supportive information for the proposed listing of the species and designation of critical habitat (<https://www.federalregister.gov/documents/2016/10/06/2016-24119/endangered-and-threatened-wildlife-and-plants-endangered-species-status-for-black-warrior-waterdog>; <https://www.federalregister.gov/documents/2016/10/06/2016-24118/endangered-and-threatened-wildlife-and-plants-designation-of-critical-habitat-for-the-black-warrior>). In January 2018, the U.S. Fish and Wildlife Service published the decision to list the Black Warrior waterdog as endangered.



Turkey Creek near Pinson, AL is a stream of interest by the USFWS for the presence of the federally threatened flattened musk turtle. Area of focus is in the vicinity of Turkey Creek Nature Preserve. A hatchling flattened musk turtle was observed and photographed in the summer of 2014 and the objective of the upcoming study is to confirm the presence of the flattened musk turtle in Turkey Creek through conventional sampling, the collection of individuals with the gathering of morphometric, tissue, and photographic data, and eDNA analysis of water samples. One sampling survey to collect water samples for the eDNA study was made in June 2017.

These projects have been funded by the U.S. Forest Service, Bankhead National Forest and U.S. Fish and Wildlife Service.

Preliminary Status Assessments

Three preliminary status assessments for the U.S. Fish and Wildlife Service were finalized in 2017. Reports summarizing the range-wide statuses of the west Florida cowlily (*Nuphar ulvacea*), hairy-peduncled beakrush (*Rhynchospora*

crinipes), and Mississippi witch-hazel (*Hamamelis ovalis*) will be used by the Fish and Wildlife Service to assist with future protection efforts.

Distribution, Abundance, and Health Assessment of the Gopher Tortoise (*Gopherus polyphemus*) in Alabama

Due to a lack of basic information on the status of the Gopher Tortoise in Alabama, on public and private lands, this effort was initiated to conduct an in-depth study on the distribution, abundance, and health of Gopher Tortoises in Alabama.

We evaluated 22 sites to determine if they had sufficient area of suitable soils for gopher tortoises. Line Transect Distance Sampling (LTDS) survey work occurred on six sites in 2015 and 2016. Full surveys were completed at nine sites, pilot surveys did not yield enough tortoise detections to justify a full survey on six sites, and seven sites were deemed inappropriate for surveys based on remote sensing data or initial site visits. Many large sites in Alabama continue to maintain Gopher Tortoises and many are close to or are supporting enough individuals to meet minimum



viable population standards.

An additional study was done to determine the status of upper respiratory tract disease (URTD), and how land management might help conserve this species. Jeff Goessling completed his PhD dissertation conducting the URTD assessment work. Every site had animals present that were at least suspect for exposure to *Mycoplasma agassizii*, the bacterial agent responsible for URTD. Resulting from this set of physiological investigations, we can conclude that URTD is present across Alabama Gopher Tortoise populations, and that environmental change likely has a direct effect on natural patterns of disease. As a result, future management targeting Gopher Tortoises in Alabama should consider the effects of incipient disease in these sites.

This study was funded by a State Wildlife Grant and was in collaboration with Dr. Sharon Hermann (PI), Dr. Mary Mendonca, Jeff Goessling (PhD student) (Department of Biology, Auburn University), and Dr. Robert Gitzen and Helen Tripp (MS student) Department of Forestry and Wildlife.



Eastern Hellbender

The Eastern Hellbender (*Cryptobranchus alleganiensis*) is one of the largest salamanders of North America and population declines and extirpations have been reported throughout its range. The U.S. Fish and Wildlife Service is reviewing the status of the species in consideration of proposing for federal listing. Most states within the range of the Eastern Hellbender have had research underway to determine status of the salamander. Ideal habitat for this fully-aquatic salamander is clear flowing streams with riffles, runs, and pools plus an abundance of slab rock and boulders over a substrate of clean gravel. Stream channelization, impounding, and alteration of riparian habitats have degraded aquatic habitats resulting in increased water temperatures, sedimentation, and siltation, consequently impacting hellbender populations leading to suspected declines. In Alabama the Eastern Hellbender occurs only in the Tennessee River system and has been documented from 11 historical localities in Franklin, Colbert, Lauderdale, Limestone, Madison, and Morgan counties. Earliest Alabama record is from the 1920s with records peaking in the 1960s and 1970s. The decline of records through the 1980s to the present indicate the need for renewed survey effort particularly in light of a recent capture of an individual in 2014 in Cypress Creek.

Standard sampling techniques for the Eastern Hellbender include trapping, snorkeling, and visual searches. These methods can be effective in the capture of hellbenders but may be affected by limited accessibility to sites, efficacy due to water level and clarity, and trap security. The novel survey technique commonly known as environmental DNA (eDNA) has become more widely used for aquatic species yet yields only presence data. Success with this technique for



the hellbender has been demonstrated in Missouri, Indiana, Kentucky, and North Carolina. In our Alabama surveys we are using both standard sampling methods and eDNA.

Streams of historic hellbender occurrence and streams that have not been surveyed are included in the survey effort to collect information on the current status of the Eastern Hellbender. Ten stream sections from 5 to 18 kilometers in length and seven single point stream sites have been sampled. Two Eastern Hellbenders through standard sampling have been documented, one in Flint River in 2015, second in Butler Creek in 2016. Positive eDNA detections have come from six streams and one single point stream site suggesting that the Eastern Hellbender is present in more streams in Alabama than indicated through conventional sampling.

Presently the Mudpuppy, *Necturus maculosus*, is ranked P3 in the 2015 SWAP but data on records from Alabama does not support this rank, instead a rank of P1 is recommended. The Eastern Hellbender is ranked P1 and the U.S. Fish and Wildlife Service is evaluating the status of the species regarding potential proposal to

list. Seventy-four records exist for the Eastern Hellbender in Alabama. The Black Warrior Waterdog, *Necturus alabamensis*, a relative of the Mudpuppy, is ranked P1 and has been listed as Endangered by the U.S. Fish and Wildlife Service. This salamander is known from 62 records. Mudpuppy records in Alabama total 53 and when compared to the other species the SWAP rank of P3 is unsupported.

Watershed conservation and restoration for the improvement of water quality is critical to the survival of the Eastern Hellbender. The Tennessee River

basin supports 115 aquatic Species of Greatest Conservation Need (SGCN), or approximately 1/3 of the total of SGCN in Alabama. Land use actions to promote improved water quality for the Eastern Hellbender would confer benefits to other aquatic species, thus the Eastern Hellbender could serve as an umbrella species for Tennessee River basin watershed conservation and restoration.

This project has been funded by the Alabama Department of Conservation and Natural Resources.

Eastern Indigo Snake

The last snake release in Conecuh National Forest was in 2015 with the release of nine Indigo Snakes; six were captive bred and head-started at the Orianna Center for Indigo Conservation (OCIC), while the remaining three were progeny of wild-captured Georgia females. In 2014 and 2015, the OCIC captive bred snakes using founder stock supplied by Auburn University. Thirty captive bred snakes, 15 each from the 2014 and 2015 clutches, were sent to Zoo Atlanta (ZA) for head-starting with the OCIC retaining the remainder of the captive bred cohorts. The 2016 snake release was postponed due to the discovery at the OCIC of a Louisiana Pine Snake (*Pituophis ruthveni*) infected with *Cryptosporidium serpentis*. *C. serpentis* is a coccidian protozoan parasite and infected snakes often die. Discovery of *C. serpentis* at OCIC raised concerns pertaining to the spread of this infection to the Eastern indigo collection at both OCIC and ZA. At the time of discovery a polymerase-chain reaction (PCR) test was the diagnostic tool to identify the causative agent. Research veterinarians at the University of Florida College of Veterinary Medicine's Zoological Medicine and



Wildlife Disease Laboratory (UF ZMWDL) were developing a more sensitive qPCR assay for *Cryptosporidium*. The 2016 Conecuh National Forest snake release was postponed until UF veterinarians using the new qPCR procedure could test snakes held at OCIC. Because snakes at ZA were initially housed at OCIC the ZA snakes were also tested for *C. serpentis* with the new qPCR technique.

Zoo Atlanta screened 29 snakes for *C. serpentis* on 21 and 28 June 2017 using the newer qPCR technique. Test results on all snakes from the 21 June screening were negative but multiple screenings for *C. serpentis* are recommended to rule out infection by *C. serpentis*. In subsequent

testing three individuals were withheld for the 14 July release due to either a positive *C. serpentis* test result (1 snake) or unclear results (2 snakes).

The 2017 snake release was scheduled for 14 July at a site a few kilometers north of the original release area. This site was selected as having a dense gopher tortoise colony and proximity to a wetland. One week prior to the indigo snake release approximately 35 gopher tortoise burrows, to serve as release points for snakes, were located, marked with flagging, and geo-referenced. Thirty snakes were selected for release with ZA providing 26 *C. serpentis* negative snakes and OCIC providing four. Twenty-six indigo snakes were released with four being held back due to unforeseen issues.

One snake in earlier disease testing that had *C. serpentis* results return as "negative/insufficient" and one as "pending" were retested on 28 July and cleared to be released. Release of these snakes was scheduled for 24 August. One was picked up from ZA on 23 August and released at the new site on 24 August bringing the total number of snake released in 2017 to 27. The second was withheld from release because the snake had developed an issue resulting in regurgitation; this snake was later transported from ZA to OCIC to be held

over the winter and released in 2018.

Data was collected to study the possible impact of eastern indigo snakes upon the native wildlife assemblages. This study incorporates three different treatment types:

1) 2009-2016 Release Site (Original Release): represented by a 2km circular buffer encompassing 95% of all Indigo Snake locations that were recorded as a component of our 40 month radio-telemetry study (2010-2013).

2) 2017-2023 Future Release Site: Represented by a 2km circular buffer and adjacent to the 2009-2016 site and in an area of comparable soils and Tortoise density. This buffer will overlap with a buffer representing 100% of snake location points but not overlapping with the 95% buffer. Snakes will be released within the center of this circular buffer.

3) Control: Represented by a 2km circular buffer and adjacent to the 2009-2016 site and in an area of comparable soils and Tortoise density. This buffer will overlap with a buffer representing 100% of snake location points but not overlapping with the 95% buffer. No Indigo Snakes will be released within this buffer and data collected within it will serve as a control group.





We currently have 24 amphibian and reptile sampling points across the landscape that comprises the study site. At each sampling point we have constructed a drift fence and box trap array. Box trap arrays sample amphibians, reptiles and small mammals and were operational between April – July 2017. Between May 2014 and July 2017 we have recorded 2084 captures of 21 species of amphibians and 1061 captures of 32 species of reptiles, including turtles in our 24 drift fence/box trap arrays, including 19 different species of snakes.

We conducted eight minute point counts for breeding birds at ten points within each treatment area between May and June 2017. Point counts occurred between sunrise and 0930. Shrub layer or ground nesting species are potential prey for Eastern Indigo Snakes and other species such as Gray Rat Snakes (*Pantherophis*

spiloides) and Corn Snakes (*Pantherophis guttatus*). The shrub and ground nesting bird species are potential prey items of the Rat and Corn Snakes, and the aforementioned birds and snakes are potential prey of the Indigo Snake.

In an attempt to monitor bird nest and fledgling survival rates in relation to Indigo Snake reintroductions, we constructed and installed approximately 259 bluebird nest boxes in grids in each of the control (85), original release (88) and future release (86) treatment areas in December 2015-March 2016. In early 2017, we inspected and repaired all nest boxes and installed new boxes as necessary. Nest boxes were checked every four days to determine if they were colonized. Motion-triggered camera traps were installed on all active nests and we determined the number of eggs and chicks. Nests were monitored until chicks fledged or the nest was completely depredated. Nests were monitored in 2017.

Data collected on amphibians, reptiles, and small mammals with drift fences includes species identification, sex, mass and length. In addition, we are individually marking all snakes captured in the drift fences. Data collected on small mammals from live traps include species identification, sex, mass and length. Data collected from point counts include numbers of each species documented per point count. At the conclusion of the study, we will compare assemblages among treatments to examine the possible influence the Eastern Indigo Snake may exert upon potential prey.

Gopher Frog

Carolina (*Lithobates capito*) and Mississippi Gopher Frogs (*Lithobates sevosus*) are inhabitants of longleaf pine sandhills ecosystem, often associated with the presence of the Gopher Tortoise, and breed in isolated, ephemeral, fishless ponds. Carolina Gopher Frog populations ranged across south Alabama but now the best remaining habitat and pond complexes occur in Conecuh National Forest. A sister species, the Mississippi Gopher Frog, historically likely ranged into Mobile and Washington counties, AL yet is now only known from nearby Mississippi. Both species have state protection while the Mississippi Gopher Frog is also federally endangered. Status surveys have been underway to collect information on the presence of the gopher frogs at selected historic and potential ponds with visitation during the breeding and larval development period. Survey techniques used were auditory surveys for calling males, visual surveys for adult frogs and egg masses, collection of water samples for environmental DNA (eDNA), and collection of tadpoles.

Sixteen ponds were sampled from January to May 2017 for gopher frog presence, either aurally for calling males, visually for adult frogs, egg masses, or tadpoles, and with eDNA. Thirteen ponds were in Covington County on Conecuh National Forest, one pond in Covington County on Geneva Wildlife Management Area, and the remaining four on Geneva State Forest in Geneva County.

Egg masses were observed in only two ponds on Conecuh National Forest in January. No male gopher frogs were heard calling or adults observed during the survey periods. Water samples for eDNA analysis were collected in late March from all ponds. A second water sample collection was scheduled for late April to allow for DNA concentrations to

presumably increase as tadpole biomass in ponds increased. Water could only be collected from seven ponds in Conecuh National Forest and one on Geneva State Forest; three ponds on Conecuh National Forest, the one pond on Geneva Wildlife Management Area, and three ponds on Geneva State Forest had dried.

Gopher frog usage was documented at three ponds on Conecuh National Forest, and none on Geneva Wildlife Management Area or Geneva State Forest. In ponds holding water in early May, tadpoles were collected but no gopher frog tadpoles were identified in the samples.

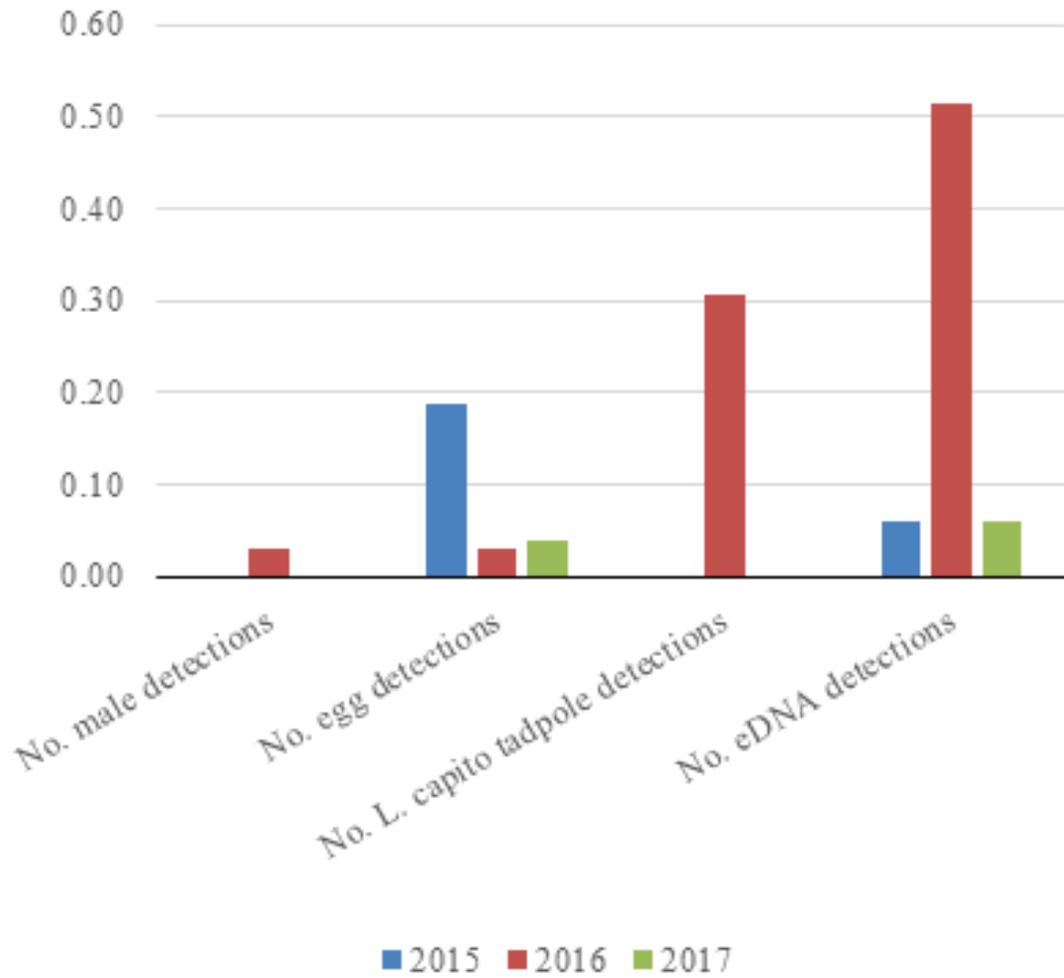
Five metamorph gopher frogs were captured at drift fence arrays on Conecuh National Forest, from late May to early July. Based on proximity of nearest known pond to capture, four of the small frogs are thought to have come from Nellie and Salt ponds, with the remaining individual from an undocumented breeding pond. In mid-October four adults gopher frogs were observed at gopher tortoise burrows.

Detection of gopher frogs at breeding ponds is best done utilizing aural, visual, and eDNA techniques

This project has been funded by the Alabama Department of Conservation and Natural Resources.



Photo by Kevin Enge.



Comparison of relative frequency of detection of sampling methods for the presence of Gopher Frog (*Lithobates capito*) in ponds of Conecuh National Forest. Relative frequency = number of positive observations or detections/number of sampling events.

Jean Lafitte National Historic Park Vegetation Classification and Mapping, Louisiana

The Auburn University Museum of Natural History and the Alabama Natural Heritage Program partnered with the National Park Service and NatureServe to assist with a vegetation classification and mapping effort of the Barataria Preserve, a 20,000-acre unit of the Jean Lafitte National Historic Park in Louisiana. The purpose of this project was to establish long-term reference points to provide the National Park Service with scientifically credible information on the type, quality, and distribution of ecological communities throughout the preserve to evaluate temporal change and guide proper management protocols.



The project also entailed a large vegetation mapping component designed to deliver geospatial and vegetation data products. An in-depth project report discussing methods and results was completed in 2017, and included a field key to vegetation associations, map classification and map-class descriptions, and a contingency table detailing the kind and number of plots associated with vegetation types. The suite of products also included a database of vegetation plots, verification sites, digital pictures of field sites, field data sheets, digital aerial imagery and index, and a geodatabase of vegetation and land cover.



Status Assessment for Harper's Heartleaf

Harper's heartleaf (*Hexastylis shuttleworthii* var. *harperi*) is a narrowly restricted species endemic to a three-county region in central Alabama. The plant is a low-growing perennial herb that was first brought to the attention of the scientific community by Roland Harper in 1924, from specimens collected in Autauga County. Because of a low number of occurrences (less than 10) and an unknown status, the U.S. Fish and Wildlife Service has contracted with the AUMNH/ALNHP to gather data related to the biology of the species and to assess conservation needs.



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Monitoring of Price's Potato-bean at Sauta Cave National Wildlife Refuge

Beginning in 2015 AUMNH/ALNHP entered into an agreement with the U.S. Fish and Wildlife Service to assist with recovery efforts of the Price's potato-bean (*Apios priceana*) at Sauta Cave National Wildlife Refuge (SCNWR) in north Alabama. The species was listed as federally threatened by the U.S. Fish and Wildlife Service (USFWS) in 1989, and is currently ranked as G3 by NatureServe suggesting it to be globally vulnerable. At the time of listing, the species had been collected from 21 sites in Alabama, Mississippi, Kentucky, Tennessee, and Illinois, with only 10 extant occurrences having been known and with 60% of those threatened by destruction. Since the discovery of the species on the refuge in August 2002, USFWS staff and Al Schotz had detected a marked decrease in reproduction and an overall decline in the vigor and number of plants. It was hypothesized that a high level of canopy closure was correlated to attrition of the species throughout the refuge because the amount of canopy closure in the area of plant disappearance has shown a marked increase to nearly 100% coverage. Occurrences having the greatest vigor appear to be often associated with clearings in forests and along rights-of way, including roadsides and power lines. As of this study, it is unknown how much canopy opening is



desirable to promote optimal growth and reproduction of Price's potato-bean.

This study was designed to span a five-year period in an effort to determine the ideal canopy cover necessary to promote and maintain optimal growth and reproduction of Price's potato-bean at SCNWR. It is anticipated the results of the project will have broader applications, serving as a resource guide as it relates to management across the range of the species. To evaluate the influence canopy cover has on the reproductive capacity of the species, efforts were made to reduce overstory coverage through herbicide application of two plots to 25-50% in 2015. A reduction (11%) in the overstory was recorded at the end of the third year of the study in 2017. An increase of vegetative and reproductive plants were also observed during the third year, a stimulatory effect possibly correlated to increased light, precipitation (rainfall was more pronounced in 2017 than previous two years of study), or a combination of both. No discernable canopy reduction was apparent during the first two years of the study, with no significant change in population dynamics. The project is proposed to continue for an additional two years.



Teaching, Students, & Volunteers

The Hellbender field survey in 2017 had participation of 9 volunteers.

ALNHP held an Environmental DNA training workshop for staff of Alabama Power for use of this technique to sample for the Black Warrior waterdog in upper reaches of Lewis Smith Reservoir. January 2017.

Joe Jenkins was funded on a GRA summer 2017 for work on the Bankhead National Forest flattened

musk turtle and Black Warrior waterdog study. Data collected during the summer months on the flattened musk turtle have been used by Joe for his thesis and for completion of the report for the U.S. Forest Service

Viktoria Bogates, in the Halanych Lab, was supported on an ADCNR grant to process eDNA samples.

The Redstone Arsenal project provided GRA funding for four students.



Database Development

Biotics Biodiversity Database

ALNHP maintains a comprehensive database on the location and conservation status of species and ecological communities in Alabama. Biotics 5 is an integrated, web-enabled platform for tabular and spatial data management that centralizes the data and software hosting in a shared "cloud" environment maintained by NatureServe using a software-as-a-service delivery model. Biotics 5 provides a common data management platform for members of the NatureServe network to achieve and maintain a unified taxonomy and consistent application of our shared data standards and methodology. Biotics 5 provides the framework for managing taxonomic and biological data on elements of biodiversity and mapping known locations for elements of concern.

The Biotics database is supported by funding through our inventory and conservation planning projects. Although building and improving the database has always been a primary goal of the program, securing funding to support this important program area remains a challenge. ALNHP is currently tracking 1,499 rare plant and animal taxon (Fig. 1) plus 93 natural communities. There are 7,657 individual occurrences of these species and natural communities documented in Biotics, with the majority of the Element Occurrences (EO) being for vascular plants or aquatic species (Fig. 2).

Since March 2008, we have been working on improving our database compliance with the Benchmark Data Content Standards (BDCS) for natural heritage data. This past year's efforts focused on Updating the State Wildlife Action Plan status to match the latest SGCN list revisions and last observation date. Another focal area for database improvement was addressing the data backlog. This effort has led to the addition of 14 new Elements (species) to the database with an additional 496 Element records updated and the creation of 35 new occurrence records with an additional 537 occurrence records updated. We will continue working to improve the database with the goal of meeting all BDCS goals and reducing the backlog. The focus in the coming year will be reducing the data backlog, continued review of Benchmark Data Content Standards, and QC of EO Rank, EO Rank Date, and Survey Date.

One of the important tasks each heritage program performs is the regular compilation of a Rare Species Inventory List for the state that ranks each element tracked by the program based on the number and quality of occurrences. Our latest revised Alabama Inventory List was published August 2017, with the list distributed to cooperators and other interested parties and posted to the ALNHP website.

Data Requests

Over the past year, ALNHP has responded to 69 requests for data or information. This included 16 paid data requests and 53 requests from academia, conservation non-profits, government agencies, NatureServe, other Heritage Network members, or cooperating partners. The number of requests was similar to past years.

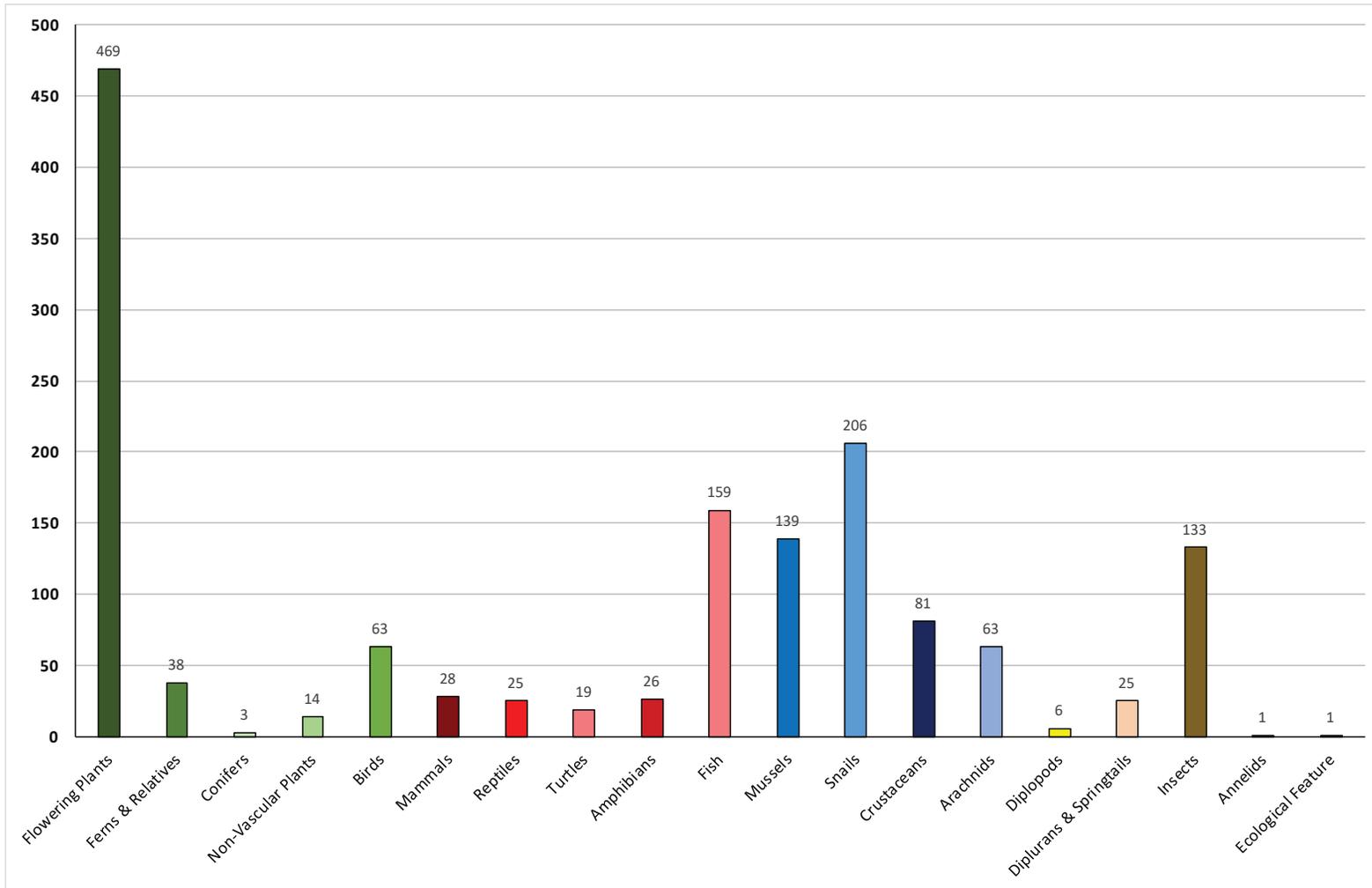


Figure 1. Number of rare plant and animal species track by ALNHP (total 1,499).

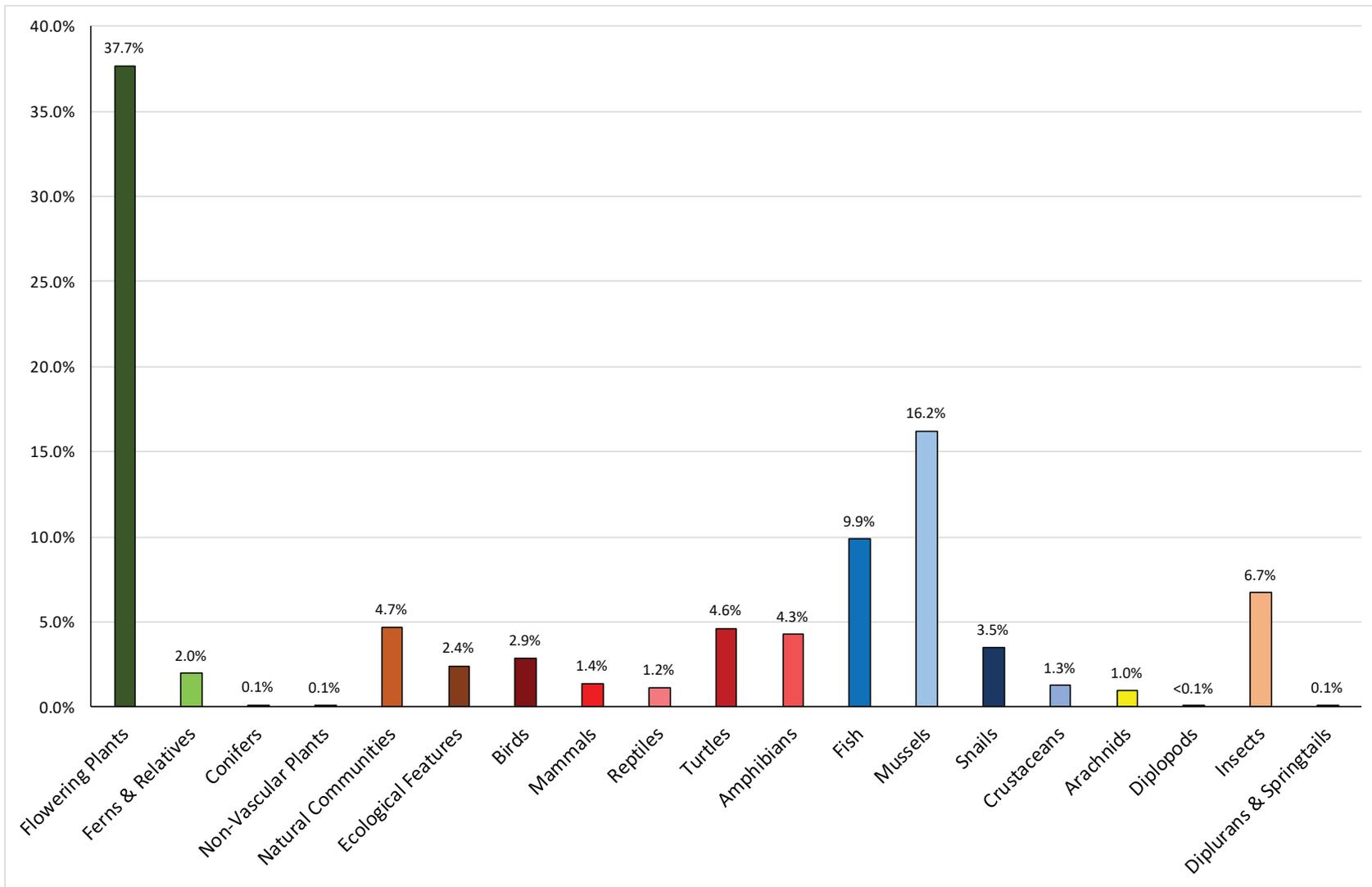


Figure 2. Percentage of 7,657 Element Occurrences in Biotics by major taxonomic group.

OUTREACH

The Auburn University Museum of Natural History (AUMNH) is committed to serving Auburn, the state of Alabama and the southeast region by conducting a variety of Outreach Programs. These programs range from monthly public tours to

presentations at Alabama State Parks. Highlighting the research and education aspects of the Museum's work, outreach promotes conservation, awareness and enthusiasm for the natural world around us.



AUMNH served over 4,000 citizens in 2017 aging in range from pre-schoolers to members of senior organizations. The seventy plus events included the Museum's annual open house, two weeks of Junior Curator Camps in the summer and school programs for K-12 students in four east-central Alabama Counties.

AUMNH staff shares educational fun with parents and children at the COSAM GUTS program.

Collaborations with on-campus entities and outside organizations continues to



2017 BioBlitz at the Forest Ecology Preserve

produce greater impacts in education and public awareness of the Museum's research and conservation efforts. Auburn University students attending Professor Rose McLarney's creative writing course visited the Museum to use a wide variety of specimens as inspiration for a class project. Dr. Zanzot's Honors Principals



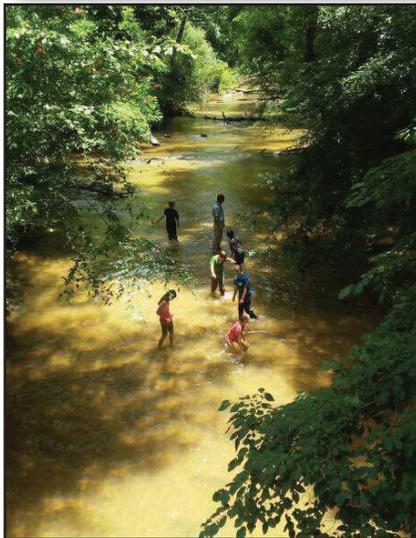
Graduate student, Jennifer Weber, assisting with avian and mammal specimens for a 4-H Leadership Tour

of Biology students were assigned a group project involving interviewing Museum Curators and Staff to develop presentations on curating specimens and research approaches used in curation. Museum faculty and staff also participated in COSAM outreach events such as Destination STEM, GUTS, COSAM Freshman Open House, Science Matters Camps, Early Learning Center and TALONS Days.

Beyond the AU Campus, the Museum engaged with the Alabama Department of Conservation and Natural Resources, State Lands Division to conduct 27 educational programs at the Wehle Nature

Center for underserved schools in Macon, Bullock and Barbour Counties. Museum staff also collaborated with Alabama State Parks with programs and exhibits at Wind Creek, DeSoto and Lakepoint State Parks. Museum staff also presented for the Lee County Youth Development Center this year which is a residential program for challenged youth.

Museum tours served a variety of groups from seniors living at Azalea Place Assisted Living to Honor Fraternities on campus. Staff and curators insure opportunities for group tours with minimal disruption to ongoing research, AU classes and curation.



Exploration and learning the skills of curation at the 2017 Junior Curators Camp.

SIGNIFICANT DISCOVERIES

Significant Botanical Discoveries

Over 466 lichens were collected from the Redstone Arsenal in Madison County, AL, virtually all county records. Of those collections, over 147 species were identified from 60 genera, including 12 new state records and 2 new species to science currently being described.



Gyalolechia flavovirescens at Redstone Arsenal.

Desmodium ochroluecum (Cream-Flower Tick-Trefoil): Redstone Arsenal, Madison County; discovery represents a county record of this globally rare species. Species of special concern by the U.S. Fish and Wildlife Service.

Lathyrus palustris (Marsh Pea): State record represented by two collections, one from Cherokee County in 2004 and another made in Shelby County in 2006. Globally common taxon reaching its southern distribution limits in Alabama.

Significant Zoological Discoveries

Significant discoveries by Charles Stephen included:

- rediscovered a presumed extinct species of *Kleptochthonius* in a Tennessee cave
- first known record of *Apocheiridium* (Cheiridiidae) from Alabama, is likely a new species
- first known record of *Acuminochernes crassopalpus* (Pseudoscorpiones: Chernetidae) in Alabama collected from Highland Lake, Blount County
- first known record of *Levichelifer* (Cheliferidae) from Tennessee, is likely a new species
- first known record of a pseudoscorpion from Rhode Island, is family Cheliferidae, but likely a new species
- first known record of *Paroliochthonius* (Chthoniidae) from Alabama
- potential first known record of *Kleptochthonius griseomanus* (Chthoniidae) from Illinois
- potential first known record of *Garyops depressus* (Garypidae) from Florida
- 45 new records of *Hesperochernes* spp. (Chernetidae) from Appalachians caves in Alabama, Georgia, Tennessee, Virginia, and from Ozarks caves in Missouri and Oklahoma, some may be undescribed species, many of these will be new county records
- 2 new records of *Chitrella* (Syariniidae) from Tennessee caves

Dr. Charles Ray and collaborator, Scott Clem, discovered 44 new Alabama county records of Reduviidae (assassin bugs).

Dr. James Starrett collected *Schizocosa salsa* in Beaufort, North Carolina (Carteret County), which has not been reported for decades.

A population of western blacknose dace (*Rhinichthys obtusus*) was discovered in the Brushy Creek system of the Black Warrior River Drainage, the first report of this species from the Brushy Creek system.



Acuminochernes crassopalpus



A cave-adapted pseudoscorpion that is very likely to be an undescribed species.

PUBLICATIONS & PRESENTATIONS

Asterisks (*) denote Auburn University student authors or presenters.

Peer-Reviewed and Published Articles

AUMNH Collections

Herbarium

Hansen, C. J. 2017. A brief biography of Wolfgang Wolf and typification of the plant names he published. *Journal of the Botanical Research Institute of Texas* 11:103-116.

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- Roberts, J. R., K. M. Halanych, C. R. Arias, B. Folt, J. M. Goessling, and S. A. Bullard. 2017. Emendation and new species of *Hapalorhynchus* Stunkard, 1922 (Digenea: Schistosomatoidea) from musk turtles (Kinosternidae: *Sternotherus*) in Alabama and Florida rivers. *Parasitology International* 66:748-760.
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Publications Acknowledging AUMNH Specimens and/or Staff

Herbarium

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Fish

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Birchfield, C. 2017. The long, hard road for hellbenders. Auburn Research, Auburn University. Spring 2017:12-15.

Project Reports

ALNHP

Godwin, J. 2017. Gopher Frog status survey. Report submitted to the Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, Montgomery, Alabama. Alabama Natural Heritage Program®, Auburn University, Alabama. 23 pages.

Godwin, J. 2017. Hellbender status survey in Alabama using standard methods and environmental DNA (eDNA). Report

submitted to the Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, Montgomery, Alabama. Alabama Natural Heritage Program®, Auburn University, Alabama. 14 pages.

Godwin, J. and A. Schotz. 2017. Black Warrior Waterdog, Flattened Musk Turtle, Streak Sorus Fern, and Kral's Water Plantain studies in the Bankhead National Forest, Alabama. Report submitted to the U.S. Forest Service, Bankhead National Forest, Double Springs, Alabama. Alabama Natural Heritage Program®, Auburn University, Alabama. 79 pages.

Godwin, J. and D. Steen. 2017. Eastern Indigo Snake reintroduction in Conecuh National Forest: future release site selection and impact on prey species. Report submitted to the Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, Montgomery, Alabama. Alabama Natural Heritage Program®, Auburn University, Alabama. 29 pages.

Hermann, S. M., M. Barbour, and J. Godwin. 2017. The status of Gopher Tortoise populations in Alabama. Final report submitted to the Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, Montgomery, Alabama. Auburn University, Alabama. 48 pages + appendices.

Schotz, A. 2017. Preliminary Status Assessment of *Hamamelis ovalis* S.W. Leonard (Hamamelidaceae), the Big-Leaf Witch Hazel. Alabama Natural Heritage Program, Auburn University, Alabama. Report for the U. S. Fish and Wildlife Service. 13 pages + Appendix.

Schotz, A. 2017. Preliminary Status assessment of *Nuphar ulvacea* (G.S. Miller & Standley) Standley (Nymphaeaceae), West Florida Cowlily. Alabama Natural Heritage Program, Auburn University, Alabama. Report for the United States Fish and Wildlife Service, Jackson, Mississippi. 12 pages.

Schotz, A. 2017. Preliminary status assessment update of *Rhynchospora crinipes* Gale (Cyperaceae), Hairy-Peduncled Beakrush. Alabama Natural Heritage Program, Auburn University, Alabama. Report for the United States Fish and Wildlife Service, Jackson, Mississippi. 13 pages.

Schotz, A. 2017. Recovery of the Price's potato-bean (*Apios priceana*) at Sauta Cave National Wildlife Refuge, Alabama – Year 3. Report submitted to Wheeler National Wildlife Refuge, U.S. Fish and Wildlife Service, Decatur, Alabama. Alabama Natural Heritage Program, Auburn University, Alabama. 16 pages.

Popular Press Articles

Godwin, J. 2017. The Hellbender in Alabama. Alabama Wildlife Federation magazine. 81(2):17-19.

Schotz, A. 2017. A spring spectacular: Wildflower viewing in north Alabama, Part 1 of 3. Alabama Living Magazine (March 2017).

Schotz, A. 2017. A spring spectacular: Wildflower viewing in south Alabama, Part 2 of 3. Alabama Living Magazine (April 2017).

Schotz, A. 2017. A spring spectacular: Wildflower viewing in central Alabama, Part 3 of 3. Alabama Living Magazine (May 2017).

Funded Projects

| Funding Source | Project | Responsible Party | Amount | Status |
|---------------------------------|---|-----------------------|-----------|-----------|
| ADCNR | Alligator Snapping Turtle | Godwin | \$25,000 | Ongoing |
| ADCNR | Distribution, Abundance, and Health Assessment of the Gopher Tortoise (<i>Gopherus polyphemus</i>) in Alabama | Hermann and Godwin | \$467,572 | Completed |
| ADCNR | Gopher Frog Survey | Godwin and Bond | \$20,000 | Completed |
| ADCNR | Gopher Frog Survey | Godwin and Bond | \$20,000 | Ongoing |
| ADCNR | Hellbender Survey | Godwin and Bond | \$35,042 | Completed |
| ADCNR | Hellbender Survey (2017) | Godwin and Bond | \$30,000 | Ongoing |
| ADCNR | Hellbender Survey | Godwin and Armbruster | \$31,505 | Ongoing |
| ADCNR | Hellbender Multi-state | Godwin and Bond | \$80,183 | Ongoing |
| ADCNR | Indigo Snake Monitoring | Steen and Godwin | \$150,058 | Ongoing |
| ADCNR | Map Turtles | Godwin and Armbruster | \$25,000 | Ongoing |
| ADCNR | Reintroduction of the Eastern Indigo Snake onto Conecuh National Forest | Godwin and Guyer | \$217,445 | Ongoing |
| ADCNR | Reintroduction of Eastern Indigo Snake in Conecuh National Forest | Steen and Godwin | \$150,058 | Ongoing |
| ADCNR - State Lands | Environmental Science and Art - AUMNH Outreach at Wehle 2017 | Stone and Armbruster | \$21,000 | Completed |
| Big Cedar Education Foundations | Environmental Science and Art - AUMNH Outreach at Wehle 2017 | Stone and Bond | \$2,500 | Completed |
| Cave Conservancy Foundation | Distribution and conservation of subterranean biodiversity of Alabama | Stephen | \$15,750 | On-going |

| Funding Source | Project | Responsible Party | Amount | Status |
|-----------------------------|--|--|---------------|---------------|
| Cave Conservancy Foundation | A revision of two problematic pseudoscorpion clades and an exploratory transcriptomic approach to examining troglomorphic evolution in pseudoscorpions | Stephen | \$15,000 | On-going |
| Coypu Foundation | Distribution of fishes of the Ireng River | Armbruster | \$49,983 | |
| NatureServe/NPS | Jean Lafitte National Historic Park Vegetation Reference point Establishment and Mapping Project | Schotz | \$35,000 | Completed |
| NSF | All Cypriniformes Species Inventory | Armbruster | \$785,682 | |
| NSF | Collaborative Research: Urban adaptation and its role in the success of biological invasion in <i>Anolis</i> lizards | Warner | \$262,426 | Ongoing |
| Scott's Miracle Gro | Evaluation of Snake Response to Potential Repellents | Steen | \$17,907 | Completed |
| US Army Garrison - Redstone | Planning Level Survey of Redstone Arsenal for At-risk Species and Ecologically Significant Communities | Armbruster, Barbour, Godwin, Schotz, and Steen | \$170,000 | Ongoing |
| US Army Garrison - Redstone | Planning Level Survey of Redstone Arsenal for At-risk Species and Ecologically Significant Communities - Herpetofauna Addition | Armbruster, Barbour, Godwin, Schotz, and Steen | \$29,000 | Ongoing |
| US Army Garrison - Redstone | Planning Level Survey of Redstone Arsenal for At-risk Species and Ecologically Significant Communities - Year 2 | Armbruster, Barbour, Godwin, and Schotz | \$150,000 | Ongoing |
| US EPA | Establishment of Reference Wetland Sites in Alabama | Armbruster, Barbour, Helms, and Schotz | \$305,935 | Ongoing |
| US EPA | Establishment of Reference Wetland Sites in Alabama | Armbruster, Barbour, Helms, and Schotz | \$305,935 | Ongoing |

| Funding Source | Project | Responsible Party | Amount | Status |
|-----------------------|---|--------------------------|---------------|---------------|
| USFS | Black Warrior Waterdog, Flattened Musk Turtle, Streak Sorus Fern & Kral's Water Plantain Studies | Godwin and Feminella | \$112,000 | Ongoing |
| USFS | Inventory <i>Hamamelis ovalis</i> , <i>Nuphar ulvacea</i> , and <i>Rhynchospora crinipes</i> on Conecuh and Tuskegee National Forests | Schotz | \$10,000 | Completed |
| USFS | Monitoring of Alabama Streak-sorus Fern on Bankhead National Forest | Schotz | \$40,000 | Completed |
| USFWS | Preliminary Status Assessment of <i>Hamamelis ovalis</i> , Mississippi Witch-Hazel | Schotz | \$9,000 | Completed |
| USFWS | Preliminary Status Assessment of <i>Nuphar ulvacea</i> , West Florida Cowlily | Schotz | \$6,000 | Completed |
| USFWS | Preliminary Status Assessment of <i>Rhynchospora crinipes</i> , Hairy-Peduncled Beakrush | Schotz | \$7,000 | Completed |
| USFWS | Range-wide Status Assessment of <i>Hexastylis speciosa</i> , Harper's Heartleaf | Schotz | \$30,000 | Ongoing |
| USFWS | Range-wide Status Assessment of <i>Lindera subcoriacea</i> , Bog Spicebush | Schotz | \$25,000 | Ongoing |
| USFWS | Recovery of Price's potato-bean (<i>Apios priceana</i>) at Sauta Cave National Wildlife Refuge, Alabama - Year 3 | Schotz | \$10,000 | Completed |
| USFWS | Status Assessment of <i>Spigelia gentianoides</i> , Gentian Pinkroot, in Alabama | Schotz | \$16,000 | Completed |
| USFWS | Turkey Creek Musk Turtle | Godwin and Armbruster | \$5,000 | Ongoing |
| USGS | Brumation Behavior and Reproductive Success of Argentine Tegus | Steen | \$41,135 | Ongoing |