



Auburn University

Museum of Natural History



2016 Annual Report

Auburn University Museum of Natural History

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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

Fax:

AUMNH: (334) 844-9234

ALNHP: (334) 844-4462

Websites

Auburn University
Museum of Natural History:
aumnh.org

ALNHP:
www.alnhp.org

Affiliated Websites

NatureServe
www.natureserve.org

From the Director:

It has been two years since we have produced an annual report, and it has been a busy two years. 2016 saw a major transition as our first director, Dr. Jason Bond, took over as chair of the Department of Biological Sciences, and I took over as Director of the museum. The integration of the Alabama Natural Heritage Program into the museum has progressed, and together we have established a series of grants to explore the biodiversity of Redstone Arsenal in Huntsville. This project touches on each of the collections, all of the collection managers and ALNHP staff, and many curators. In addition, the whole team came together along with the School of Forestry and Wildlife to complete a BioBlitz of the Mary Olive Thomas Demonstration Forest on the east side of Auburn. As we have shepherded the various parts of these proposals together and developed BioBlitzes, I was reminded of the strength of the AUMNH/ALNHP team, and the diverse types of rolls that we all play to forward the goals of the museum. I am thankful for a strong, and competent staff that have helped me tremendously as I have taken on the directorship.

On the museum front, we have continued our databasing efforts, and many of the collections are now searchable on aumnh.org as well as international data aggregators such as Vertnet, GBIF, and IDigBio. In addition to serving up collections records, our online system can draw maps of localities and serve images of specimens. With the aid of our outreach coordinator, Kay Stone, we have increased our informal education efforts providing a broad range of outreach activities. In particular, we have offered a course on Museum Education for Education graduate students to produce lesson

plans that will be available for students. We have additionally offered a Museum Practicum course for our summer Graduate Research Assistants so that they can learn various aspects of museum curation during their summer assistantships.

The ALNHP has continued to examine imperiled species distributions throughout the state and beyond. Staff have been actively attacking the backlog of data records and getting them made available through the Biotics data platform. Efforts have also been underway at twenty-first century sampling methods. The ALNHP team, led by Jim Godwin, have been actively sampling using environmental DNA. Organisms continuously slough off cells, and the DNA from these cells can be detected in the environment. Results from one study on Black Warrior Water Dogs and Flattened Musk Turtles was recently published in PLoS One.

Kay Stone has continued her outreach efforts at the Wehle Center. With the merger of ALNHP and AUMNH, Kay has been able to draw on graduate students and collection managers to aid in her programs. She has additionally aided in grant-related outreach efforts for museum curators. The museum has hosted AUExplore, an outreach effort by the College of Science and Mathematics, as well as open houses and demonstration tables at various events throughout the state. Also new to the museum is a Junior Curator Camp. The camp began in 2015 for rising sixth and seventh graders. We give the students the chance to go out in the field and learn about the organisms (both living and fossil) of the region.

2017 is already shaping up to be an active year. With work beginning in earnest

on the Redstone Arsenal Project, museum efforts in support of the Alabama 200th Celebration, developing a display for our dinosaur egg, and hiring of new

staff, the year will be a successful one. With a strong staff in place, I believe we will coast smoothly through our many and diverse activities.

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)
Continued Implementation of the Safe Harbor Plan for the Endangered Red-cockaded Woodpecker in Alabama
Distribution, Abundance, and Health Assessment of the Gopher Tortoise (*Gopherus polyphemus*) in Alabama
Distribution and Habitat Attributes of Southeastern Pocket Gopher (*Geomys pinetus*) in Alabama
Distributional survey of the southern cavefish
Gopher frog survey
Hellbender survey
Historical changes to amphibian and reptile faunas in five key Alabama watersheds
Indigo snake monitoring
Population Structure and Conservation Status of Burrowing Bog Crayfishes
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

Alabama Forest Resources Center

Status Update of *Schwalbea americana*, American Chaffseed, on the Enon Sehoy Plantations, Alabama

COYPU Foundation

Distribution of fishes of the Ireng River

JMR Architecture

Pelham Range Plant Inventory

NatureServe

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

National Science Foundation

All Cypriniformes Species Inventory
Collaborative Research: Urban adaptation and its role in the success of biological invasion in *Anolis* lizards

U.S. Army Garrison - Redstone

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

U.S. Environmental Protection Agency

Ecogeomorphology of the Appalachian Plateau of Alabama and Tennessee

U.S. Fish and Wildlife Service

Black Warrior Waterdog surveys
Hamamelis ovalis Status Survey
Range-wide Status Assessment of *Hexastylis speciosa*, Harper's Ginger



Primary funders (in alphabetical order)

U.S. Fish and Wildlife Service

Recovery of Price's potato-bean (*Apios priceana*) at Sauta Cave National Wildlife Refuge, Alabama

Rhynchospora crinipes Survey

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

U.S. Geological Survey

Behavior and Physiology of Invasive Argentine Tegus in Semi-natural Enclosures in Alabama

Brumation Behavior and Reproductive Success of Argentine Tegus

AUMNH COLLECTIONS

John D. Freeman Herbarium

The Freeman Herbarium (AUA) is the largest herbarium (in total number of specimens) in the state of Alabama and has been designated as the state herbarium. As such, this collection is a critical resource for all areas of botanical and floristic research in Alabama, the southeastern United States and beyond.

The herbarium is an active resource for those studying plant topics such as, anatomy, identification, distribution,

ecology, genetics, phenology, palynology, rarity, nomenclature, conservation, invasive species, herbivory, floristics, historical collections, public awareness and outreach, medicinal & poisonous plants, forensic botany, plant & insect/animal interactions.

Highlighted below are the major activities of the Freeman Herbarium in 2015 and 2016.

Accessions/Acquisitions/Exchanges/Loans

Exchanges have added great diversity to the herbarium and collection growth. The herbarium received over 940 specimens in the past two years from The University of West Alabama, Univ. of Michigan, AL State Lands Div., Botanical Research Institute of Texas, Samford University, Natural History Museum in Vienna,

Univ. of Wyoming and the Australian National Herbarium in Canberra. We sent out 540 specimens as exchange to other institutions. We sent out 6 loans totaling over 3900 specimens (including the large lichen and bryophyte loans for digitization) and we received six incoming loans totaling 348 specimens.

Summary of Exchange and Loan Activity

#Outgoing Loans/ #Specimens	#Incoming Loans/ #Specimens	#Outgoing Exchange/ #Specimens	#Incoming Exchange/ #Specimens
6/3975	6/348	6/540	8/943



Students with The Eufaula Association of Christian Homeschoolers visit AUMNH.



Lichen Program at Wehle, Fall 2015

Digitization/Database Development

Over 2400 specimens were mounted and entered into the Specify database in 2015-2016. Much progress is being made our barcoding effort to add barcode labels to every herbarium sheet for better specimen data tracking. Herbarium specimens are searchable on the Web at the AUMNH website (<http://aumnh.org/research-collections/plants/search-plant-database/>). Our Alabama specimens are searchable on the Alabama Plant Atlas (APA) site (www.floraofalabama.org). The Freeman Herbarium is a founding member and major contributor to the APA. Additionally, information from our five largest plant families is shared and searchable at Morphbank (www.morphbank.net).

The Freeman Herbarium benefited from participation in national efforts to digitize lichens and bryophytes of North America. Our lichen collections (~2000) and bryophyte collections (~1500) were all sent off to University of Wisconsin and Missouri Botanical Gardens respectively, to have specimens barcoded, labeled, photographed and location data entered into a Symbiota portal for access via the Web. These data are now available via Symbiota (www.symbiota.org) but are also being formatted and prepared for addition into the AUMNH Specify database.



Teaching, Students, & Volunteers

Systematic Botany continues to be successfully taught every spring semester with students gaining knowledge and experience identifying plants. The graduate students in the class also prepare plant collections, many of which are accessioned into the herbarium.

Collections cannot run effectively without volunteers and the past two years we have had great help in the herbarium. Returning volunteers Elizabeth Hall and Nick Bugess did great work mounting specimens but they also transitioned into database work. They barcoded and

entered specimens into the database along with Lacy Kamber, another returning volunteer. Lacy and Elizabeth graduated and we wish them well. Brian Swimlear and Alexandra Moore volunteered in 2016 and both did an excellent job mounting plants. Several Honor Biology students also spent volunteer hours helping mount plants, including, Mason Atkins, Maddy Gohlke, Kendall Klumpp, Aric Hall and Jane Chu. We also enjoyed volunteer help from an on-campus club during a museum night activity. Some of these volunteers included, Rebecca Michaels, Kyle Doud, Zane Drummond and Taylor Crumbie.

Research & Collections Related Activities

Marshallia Genomics

The Goertzen lab is focusing on the genomics of the wild sunflower genus *Marshallia* and amassing huge amounts of genomic resources for investigation. Mitochondrial and chloroplast genomes are both being explored and characterized. Work also continues on genomics of several turf grass species in collaboration with Dr. Scott McElroy from Crop, Soil and Environmental Sciences.

Curtis Hansen has continued work on the *Marshallia* genome project and researched and published the type names of Wolfgang Wolf, an early 20th century Alabama botanist. The back log of exchange specimens from Australia and Austria has been completed and work continues to move forward on several hundred specimens from the Rocky Mountain region of the Intermountain West. Additionally, several important collections from Ft. Benning, GA are being prepared for accessioning.



Anthony Melton successfully finished a master's degree with Dr. Goertzen exploring the molecular evolution and functional genomics of *Marshallia* using next generation sequencing. He is now a Ph.D. student working in the Soltis lab at the University of Florida.

Nathan Hall continues to do great work in plant genomics. He has characterized the mitochondrial genome of *Eleusine indica* and has a paper coming out documenting the plastid genome sequence of *E. indica*. He has also successfully published the sequence and characteristics of the Del/Tekay Chromovirus family in *Marshallia obovata* (Asteraceae).

Dr. Roland Dute, Professor (ret.) in the Biological Sciences Department, is finishing work exploring the presence of pit membranes in vascular plant tissue. The herbarium has been critical to his research in facilitating recent loans of *Schisandra* from the Field Museum in Chicago and the Smithsonian Institution, Washington DC.



Eleusine indica. ©2005 Luigi Rignanese

Ichthyology Collection

The Ichthyology Collection has been actively growing, documenting the world's fish biodiversity and making the records available to the public through the museum's web page and data aggregators like Fishnet2, Vertnet, and GBIF. Many papers have been published on the fish collections in the last two years including

descriptions of new species here and abroad. The museum includes a strong teaching component (with 5 students a semester active in fish research) and has been active in outreach with open houses and displays and demonstrations at outreach events.

Accessions/Acquisitions/Exchanges/Loans

The fish collection grew at a steady pace adding 3,869 new lots in 2015 and 2016. New material included specimens from an expedition by Jonathan Armbruster and David Werneke to the upper Ireng River in the highlands of Guyana in January 2016, specimens collected by Brian Helms and David Werneke in the spring and summer of 2015 while working in Bankhead National Forest, and material from Carol Johnston collected across the southeast between 2011 and 2014. The Ireng specimens are especially valuable because, besides from a couple of collections made in the late 1800's, no one has surveyed that remote region of the world. Included within the Ireng collections are several new species and one new genus, which are currently being prepped for formal descriptions. Within the new material

were 940 tissue samples taken for current and future genetics projects. Additionally, researchers deposited two holotypes and 95 paratypes in the fish collection.

In 2015 and 2016, the collection made 33 loans totaling 533 lots to researchers in the United States, Brazil, Canada, Colombia, and France. The fish collection hosted six visiting researchers working on southeastern and South American fishes. Requests for records and loans have continued to increase annually since publishing our database online with the Specify and since we began sharing our data with websites such as GBIF, VertNet, and FishNet2. The Fish Collection had specimens referenced in 38 publications in 2015 and 2016.

Teaching, Students, & Volunteers

The progress we continue to make in the fish collection would not be possible without the help of volunteers. In 2015 and 2016, our volunteers, graduate students, and undergraduate students

worked in a myriad of capacities such as data collection, specimen preparation, outreach, and digital imaging among others. The fish collection also offered tours of the collections to various classes.

Volunteers

Michael Benak
Edward Burress
Ian Coate
Malorie Hayes

MaKalea Kirkland
Aaron Marcinowski
Taylor Mastin
Carla Stout

Milton Tan
Maya Thomas
Dillon Tincher
James West

Brittany Woodruff

Research & Collections Related Activities

All Cypriniformes Species Inventory

A National Science Foundation funded study to examine the diversity of minnows, chubs, carps, suckers, loaches, and their relatives across the globe. AUMNH projects included taxonomy of the African Barbs, phylogenomic analyses across all Cypriniformes and the North American Shiners, and phylogenetic comparative analyses of shape and diet. We have produced some of the most well supported phylogenies for this complex

group, determined that miniaturized cypriniforms have evolved multiple times, determined that eastern North American minnows are smaller as carnivores (in all other fish groups with a pattern, carnivores are larger than herbivores), and have provided information on the timing and pace of morphological and ecological evolution in North American cyprinids.

Distributional Survey of the Southern Cavefish

The Southern Cavefish (*Typhlichthys subterraneus*) occurs in caves throughout Kentucky and Tennessee and the northern parts of Alabama and Georgia, but this likely represents multiple undescribed species. With funding from the Alabama Department of Conservation and Natural Resources, we have run phylogenetic analyses to determine genetic lineages of species and found complex distributional patterns of each lineage. We have examined shape of the fishes, and found that allometry (change in shape with size) is confounding our ability to morphologically identify these lineages, which should hold the rank of species.



Ecogeomorphology of the Appalachian Plateau in Alabama and Tennessee

Three-year project to develop regional curves by collecting ecogeomorphological data from reference streams within the ecoregion. These regional curves will serve as reference points for future stream restoration projects within the Appalachian Plateau of Alabama and Tennessee.

Distribution of Fishes of the Ireng River



Characidium crandellii

We received money from the Coypu Foundation to explore the Ireng River in Guyana for fish, herp, and bird biodiversity with AUMNH covering the fishes. The Ireng River is on the border of Guyana and Brazil, and has been unexplored for biodiversity. We collected first at Orinduik

Falls in a Savannah and then traveled 6 hours by boat upstream to the Patamona Village of Kaibarupai in the rainforest. We collected several new species and a new genus. The new genus was recently submitted as a publication.



ANDU Falls on Sukwabi Creek, Guyana.

Herpetological Collections

The Division of Herpetology continues its efforts to uphold and advance the museum's mission to document, study and educate the public about the biodiversity of Alabama and the world. Division staff, students and associates are continually active in conducting and promoting collection growth and curation, in participating in collections-based research, and in facilitating the dissemination of information through scholarly publication and museum outreach.

Accessions/Acquisitions/Exchanges/Loans

Over the last two years, the herpetological wet collections have experienced incredible growth. Over 1900 amphibian and reptile specimens were added to the alcohol collection during that time representing a collections growth of over 4.6%. The specimens included adults, larvae and eggs. A large number of new specimens arrived as a result of ongoing research associated with the herpetology labs on campus. Melissa Miller's doctoral work on snake parasites with Dr. Craig Guyer has produced several hundred snake specimens. Additionally, other herpetological projects in the labs of Dr. Craig Guyer and Dr. Dan Warner have contributed hundreds of lizard and turtle specimens. Project species include, *Chrysemys picta*, *Trachemys scripta*, *Norops sagrei*, *Ctenonotus cristatellus*, *Agama agama* and *Osteopilus septentrionalis*.

The other herpetological collections also increased in number and scope with close to 50 skeletal specimens, primarily turtles, being added to the osteological collection and 483 digital vouchers added to our photo/audio/video voucher collection. Associated with these new specimens, were over 900 new tissues samples added to the herpetological tissue collection. Combined, these new herpetological specimens produced over a hundred county records (the first documented individual of a species in a given county) and three state records.

The herpetology collections were also well utilized by researchers over the two year period. During this time, a total of 19 loans were sent out and no less than 38 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 and Herpetology. During 2015-2016 over 120 students utilized the herpetological teaching collections. Of those, more than 80 enrolled in Vertebrate Biodiversity, over 40 in Herpetology. Additionally, 12 student class projects were based out of the herpetological collections

and 2 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 tireless work of over 35 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

A. Joseph Jenkins	Gabrielle Dunham	Madeline Schuster	Samantha Wood
Ashley Nielsen	Jordan Broadhead	Marcia Thomas	Stephanie Barton
Aundrea Westfall	Jordan Traff	Marisa Pierluisi	Stephen Mirkin
Chad Wallwork	Kaelyn Dobson	Marisa Pierluisi	Travena Hawkins
Christina Holbrook	Katie Kreider	Marissa Donovan	Vanessa Nickerson
Christopher Buff	Kayla Wilson	Mary Pruitt	Victoria Self
Dani Douglas	Kaytlan Casares	Maude Dinan	Winona Daniels
Donald Ward	Laryssa Ferrara	Morgan Lyons	
Faith Lyles	Lesley Turner	Rachel Hodge	

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 seen above, close to 500 vouchers were sent in over the last two years and many of these represented county records. We hope to soon develop educational components to each of these programs.

Research & Collections Related Activities

Scientists took advantage of our new space in the BLC to conduct collections-based research at the museum on 3 different occasions. Use of the herpetology collections by visiting scientists focused on turtles, lizards and snakes.

Herpetology personnel were also diligent in producing original collections-based or collections-related research. In 201-2016, no less than 34 papers and notes related to the herpetological collections were published. 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, the last two years saw 18 oral presentations and 8 poster presentations. All major groups of Alabama amphibians and reptiles were represented in the above publications and presentations. Furthermore, no less than 6 papers utilizing AUMNH herpetological specimens have been published over this same time period by authors not associated with the museum, as have dozens of amphibian and reptile county records, documenting the first occurrence of a species in a county.



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 60 events in 2015-2016 and were seen by over 3,785 people.



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. Over the last two years, 73 new

skins were added to the ornithological collection and 40,000 photographic images were archived.

There were four ornithological loan requests and two data requests. One of the loan requests was for material from the ornithology collection, namely several of our owls, to be used by the Jule Collins Smith Museum of Fine Arts for their "Call and Response" exhibition. A second loan consisted of birds that were utilized as 'models' for an art course.

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.

Volunteers

Curt Burney
Jared Fuqua
David Quinn
Hunter Walters

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 the foot of each specimen. Museum volunteer, David Quinn, has begun the process of digitizing all remaining data located on the specimen tags.

Research & Collections Related Activities

The ornithology collection saw two visiting researchers. One of these is Enna Rhodes, an undergraduate at the University of South Alabama. Her research is focused on window strikes and bird mortality. She utilized the ornithology collection to collect data on the birds' age and the time of year when they struck the window.

Mammal Collection

Accessions/Acquisitions/Exchanges/Loans

The AUMNH mammal collection is comprised of just under 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 few years, over 1000 skins have been added to the collection and a Mammalogy tissue collection has been started. One mammal data request was received in during this time.

Teaching, Students, & Volunteers

During 2015-2016, the collection benefited from a group of seven highly motivated volunteers. Their efforts helped maintain and organize the collection.

Curatorial Assistants

Jordan Traff
Liz Erwin

Kayleigh Hudson
Audrey Henson

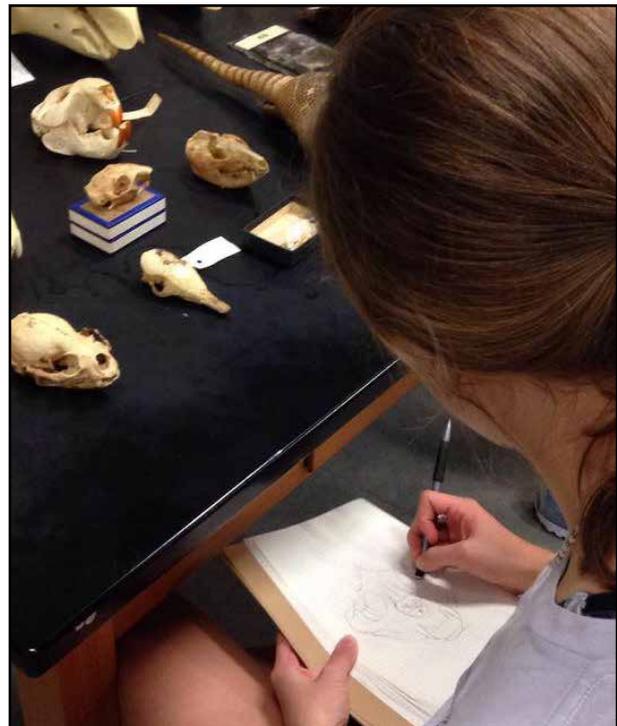
Rhegan Shields
Brittany Woodruff

Jennifer Weber



Digitization/Database Development

As with all of the museum collections, the mammal database is in the process of moving over to the Specify platform. Much progress was made over the two year period due to Jordan Taff's work at cleaning up and preparing the mammal database for its transition to the Specify platform.



Vertebrate Paleontology Collection

Accessions/Acquisitions/Exchanges/Loans

The vertebrate paleontology collections at Auburn University 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. The Vertebrate Paleontology Collection contains Mesozoic material, both terrestrial and marine, primarily from the Cretaceous period. This includes terrestrial dinosaurs as well as marine groups such as Plesiosaurs and Mososaurs. It also contains important collections of terrestrial mammals from the Cenozoic Era.

This past year saw the return to Auburn of our dinosaur egg! After a long journey around the world, the egg has made its way back to the museum. 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.

Teaching, Students, & Volunteers

Another great development in the vertebrate paleontology collection was the great volunteer help provided by Claire Wilson and Dr. Bill Deutsch. Through their efforts, the collection is being organized and the fossils' housing is being improved.



Dinosaur egg.

Invertebrate Paleontology Collection

Accessions/Acquisitions/Exchanges/Loans

Last year saw the inception of the museum's invertebrate paleontological collections. Thanks to the work of museum volunteer, Chris Parsons, the museum is home to a small collection of over 120 invertebrate fossils. Chris identified, accessioned and cataloged the material over his summer vacation.

Digitization/Database Development

The invertebrate paleontology database is digitized and awaits preparation and transfer to the Specify platform.

Volunteers

Chris Parsons

Invertebrate Collection

There was considerable activity in the Invertebrate Collection during 2015-2016. Multiple research projects were active and significant specimen acquisition/accession occurred, most with considerable student involvement. There was also significant Invertebrate Collection representation in University teaching, outreach, and international scientific meetings. Below, these activities are outlined.

Accessions/Acquisitions/Exchanges/Loans

Additions were made to the AUMNH-IC through significant student, volunteer, and personal efforts. Over 13000 lots were added to the invertebrate collection during 2015-2016. These included accessioning recent significant mollusk acquisitions including the Renate Wittig marine collection from East Carolina University and Antarctic collections made by Ken Halanych. Other acquisitions included benthic aquatic macroinvertebrates from, crayfish, branchiobdellidans, snails, and freshwater inverts from Alabama, Florida, and Georgia, and significant acquisitions of leaf-litter invertebrates from Costa Rica. Finally, work is continuing on accessioning the AL caddisfly acquisition from late

2012. Additionally, approximately 2000 specimens were accessioned into the arachnid and myriapod collection. Considerable progress was made on digitizing the State Entomology Collection, housed in the Invertebrate Collection. Of the estimated 500,000+ specimens, approximately 85,000 were digitized during 2015-2016 with work continuing.

A total of 8 loans were processed this year. Loans were requested from Jacksonville State University, Appalachian State University, Martin Methodist College, and Auburn University.



Teaching, Students, & Volunteers

Specimens in AUMNH Invertebrate Collection served as an educational resource for several classes, including Invertebrate Zoology, Organismal Biology, Conservation of Freshwater Invertebrates, and Summer Curator Camp. Progress in the collections would not be possible without the help of volunteers, undergraduates, graduate students, and post-docs that assist in data collection, specimen preparation, digitizing, and general curation duties. Notable volunteer contributions include the multiple Museum Night gatherings of the undergraduate service group Nerd Fighters (dutifully organized by Brittany Woodruff), individual undergraduates, and the student worker army involved with the insect digitization effort, including:

Volunteers/student researchers

Kelly Herman (Undergraduate, DBS)
Sam Jeffers (Undergraduate, DBS)
Kate Hatfield (Undergraduate, DBS)
Richard West (Undergraduate, DBS)
Ross Diggs (Undergraduate, DBS)
Brody Betz (Undergraduate, DBS)
Sean Kelly (Undergraduate, DBS)
Isabel Wagoner (Senior, Auburn High School)

Insect digitization

Jennifer Weber (Masters Student, DBS)
Rebecca Godwin (PhD Student, DBS)
Kelley Bourguignon (Masters Student, DBS)
Hugh Godwin (Undergraduate, DBS)
Alan Jeon (Undergraduate, Entomology)
Jordan Traff (Undergraduate, DBS)

Their efforts and contributions are invaluable.



Research & Collections Related Activities

Active Research Projects

There are several active research projects associated with the Invertebrate Collection. Below are those that were active

during 2015-2016, with a listing of their associated students and a brief project overview.

Dynamics of crayfish inquiline communities.

Student: Andrew Collins, Martin Wan (DBS undergraduate)

Describing invertebrate communities associated with the burrows of *Cambarus harti* (Piedmont Blue Burrower), a state endangered crayfish in west Georgia.



Cambarus harti

Morphological variation in introduced crayfish populations

Student: Jennifer Weber (DBS MS student)

Quantifying shape in different populations of *Orconectes virilis*, an introduced crayfish species in North America, to determine the role of morphological variation in invasion success.



Orconectes virilis, photo by D. Gordon E. Robertson, [CC BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/)

Eco-Morphological Mitigation Design and Assessment Tools for the Alabama and Tennessee Appalachian Plateau

Student: Eric Bauer (DBS PhD student); Richard West (DBS undergraduate)

Developing reference stream hydraulic geometry relationships (i.e. regional curves) and ecological endpoints (fish, crayfish, and insect assemblages) for evaluating restoration potential and success in Bankhead National Forest.

Population structure and conservation status of burrowing bog crayfishes (*Fallicambarus* spp.).

Student: Mallery Clay (DBS MS student)

Identified population structure and developed eDNA techniques for 3 closely-related species of burrowing crayfishes (*Fallicambarus* spp.) found associated with pitcher plant bogs of south Alabama to provide short-term management recommendations.



Fallicambarus burrisi

Species delimitation in a group of trapdoor spiders from the California Floristic Province.

Student: Nicole Garrison (DBS PhD Student)

Utilizing specimens in the AUMNH cryogenic collection to conduct molecular studies in order to delimit species of trapdoor spiders collected from central and southern California.

Species delimitation in a group of trapdoor spiders in North America.

Student: Rebecca Godwin (DBS PhD Student)

Utilizing specimens from both the morphological and cryogenic collections to delimit species of trapdoor spiders from multiple groups collected from across North America using morphological and molecular techniques.

Species delimitation in a group of trapdoor spiders from the Southeastern United States.

Student: Kelley Bourguignon (DBS Masters Student)

Utilizing specimens from both the morphological and cryogenic collections to delimit species of trapdoor spiders collected from the Eastern United States using morphological and molecular techniques.

Species delimitation in a group of troglobitic pseudoscorpions in the eastern United States

Student: Charles Stephen (DBS PhD Student)

Using specimens both from the arachnid morphological collection and the cryogenic collection to discover and demilit unknown diversity among pseudoscorpions using both morphological and molecular techniques.

Population Regulation of Neotropical Vertebrates: Testing the Guyer Hypothesis

Student: Brian Folt (DBS PhD student) and Sean Kelly (DBS undergraduate)

Evaluated invertebrate communities associated with litterfall under 2 tree species with different phenologies in Costa Rican rainforests.

Testing the monophyly of a family of trapdoor spiders.

Student: Rebecca Godwin (DBS PhD Student) and Vera Opatova (Post Doc, DBS)

Using specimens from the morphological and cryogenic collections to test the monophyly of a world-wide distributed family of trapdoor spiders

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. A 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. 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 that also entailed establishing permanent monitoring plots to further assess the long-term effects of natural and human-derived disturbances.

Through this project, all occurrences of



Photo by W. Testo

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. Plants at six sites could not be relocated as part of this project from 2013-2016. 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. However, given ongoing surveys in 2017, these boundaries are subject to change.

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.

As part of this project, incidental observations of the Kral's water-plantain (*Sagittaria secundifolia*), a federally listed species, were also made from eight locations in the Sipsey Fork and Brushy Creek. Information reflecting the biology, colony dimensions, and locations will be updated in ALNHP's Biotics database. Additional colonies are expected to be found.

American Chaffseed Assessment at the Enon and Sehoj Plantations

ALNHP was commissioned by the Alabama Forest Resources Center and the U.S. Fish and Wildlife Service to undertake a two-year study beginning in May 2015 to furnish census updates, citing apparent disturbances, and identifying potential threats of existing populations, in addition to conducting surveys for new colonies of American chaffseed on the Enon-Sehoj Plantation complex in Bullock and Macon Counties. American chaffseed (*Schwalbea americana*) is considered globally imperiled with various aspects of its ecology having garnered heightened attention during the past 20 years in an effort to promote conservation efforts, specifically in relation to receiving federal protection as an endangered species on September 29, 1992, under the Endangered Species Act. Historically, American chaffseed extended from New York and Massachusetts southward, primarily along the Atlantic Coast to central Florida and westward to southeast Texas, with interior populations known from the Cumberland Mountains of Kentucky and Tennessee. Once widely distributed in 15 eastern states, the taxon has drastically declined throughout its range to less than 25 distinct occurrences in seven states as of this report. Although additional populations have been found since the time of Federal listing, the species still remains under significant threat primarily associated with residential development and fire exclusion within its fire-maintained habitat.

Results of census data gathered during the two-year study tallied a total of 134 plants, with 62 individuals having been tabulated among six colonies in 2015 and 120 individuals among five colonies in 2016. These data show a marked decrease in the number of plants from when the species was first documented at the site in 2008. One new occurrence was discovered as part of the study.



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 temporally 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 will conclude this year. Data from Sipsey Fork, Brushy Creek, and tributaries of these streams has been collected on the occurrence of the Black Warrior waterdog and flattened musk along with habitat features. Sampling for flattened musk turtles has been through visual surveys, trapping, and water sample collection for eDNA. Similar data on the Black Warrior waterdog has been collected with the use of baited minnow traps and water sample collection for eDNA. Management recommendations will be 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 influence 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 and our eDNA results were 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>).

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.

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

Behavior and Physiology of Invasive Argentine Tegus in Semi-natural Enclosures

In 2014, in collaboration with the United States Geological Survey, the Auburn University Department of Biological Sciences, and the Auburn University Veterinary School, we initiated a study to determine whether Argentine Tegus (*Tupinambus merianae*), currently invasive in South Florida, could survive and reproduce in Alabama.

In spring of 2014 we renovated a number of outdoor mesocosms (3 m wide fiberglass tubs) and outfitted them with camera traps, ibutton temperature

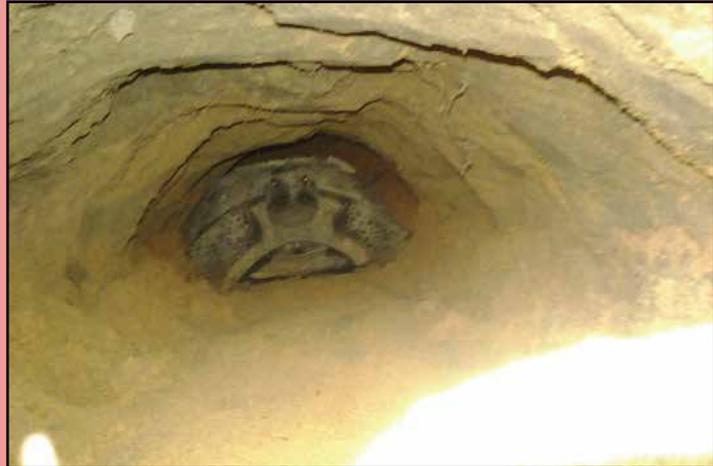
recorders and artificial burrows. In summer of 2014 we obtained 19 adult tegus and surgically implanted them with radio-transmitters (in case of escape) and ibutton temperature recorders. Tegus were released into individual tubs following surgeries. In 2016 we worked towards initiating a second phase of this project and began constructing additional outdoor enclosures to house tegus in 2017.

Funding for this project has been through the United States Geological Survey.



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

As the keystone species of the Southeast US coastal plain, the Gopher Tortoise has experienced population declines across its range. Currently, populations of the Gopher Tortoise, range-wide, are being studied with the goal of providing information to the US Fish and Wildlife Service regarding a final decision on federal listing. Due to a lack of basic information on the status of the Gopher Tortoise in Alabama, on public and private lands, this effort will be to conduct an in-depth study on the distribution, abundance, movement patterns, and health of Gopher Tortoises in Alabama. Additionally, because a potentially life-threatening emerging infectious disease, upper respiratory



tract disease (URTD), has been observed in tortoises across North America, an additional study was done to further understand the mechanism that may be causing gopher tortoise mortality in Alabama, and how land management might help conserve this species. Basic data related to the current distribution and abundance of Gopher Tortoises in the state has been acquired to determine their status on public and private property.

URTD assessment work was expanded to total seven populations of Gopher Tortoises in Alabama. The populations include the largest populations of Gopher Tortoises on public property in Alabama, and are thus important populations for long-term management and conservation efforts. Every site had animals present that were at least suspect for exposure to *Mycoplasma agassizii*, the bacterial agent responsible for URTD.

In 2016, worked continued on analysis of disease data. Jeff Goessling completed his PhD dissertation and results of a portion of that work appear in the scientific journal titled



"Seasonal Acclimation of Constitutive Immunity in Gopher Tortoises *Gopher Polyphemus*" (Goessling et al. 2016a). This paper documents a seasonal pattern of immunity. The research also suggests that changes in corticosterone (CORT) are independent of this seasonal pattern and that seasonal pattern of immunity is not mediated by CORT secretion.

Line Transect Distance Sampling (LTDS) survey work occurred on six sites in 2015 and 2016. Surveys were completed at seven sites: Perdido Wildlife Management Area, one large block on Conecuh National Forest, Solon Dixon Forestry Education Center, Barbour Wildlife Management

Area, Upper State Game Sanctuary, Saloom Properties LLC, and Wehle Nature Center. Surveys are ongoing at two sites: Geneva Wildlife Management Area Addition and Fred T. Stimpson Community Hunting Area. Results on the completed sites include total transect length surveyed, total estimated area surveyed, number of burrows scoped, number of occupied burrows, burrow occupancy rate, estimated tortoise density, estimated tortoise population, and the dates in which the LTDS was performed. Total transect lengths to complete LTDS at sites have ranged from 45.97

to 100.3 kilometers. Estimated tortoise densities from the sites completed range from 0.132 to 0.421 tortoises/ha, with estimated average population sizes ranging from 163 to 589 tortoises/ha.

This study is being funded by a State Wildlife Grant and is 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.

Distribution and Habitat Attributes of the Southeastern Pocket Gopher in Alabama

Southeastern Pocket Gophers (*Geomys pinetis*) are of increasing conservation concern because of an apparent rangewide distributional decline. Recent surveys have failed to detect populations in many previously occupied areas, particularly in central Georgia, west central Alabama, and south central Florida. Pocket Gopher surveys were conducted to identify the current distribution of the species in Alabama. Historic Southeastern Pocket Gopher locations were compiled from museum specimens, published records, and biodiversity databases. Mammalogists and other biologists also were contacted to request information on locations at which they had observed Pocket Gophers or Pocket Gopher mounds in the past. Additional areas of potential occupancy were identified by examining aerial photos for the presence of pocket gopher mounds. All sites at which pocket gophers had been observed in the past and potentially occupied areas identified from aerial photos were searched for the presence of pocket gopher mounds.

Southeastern Pocket Gophers are patchily distributed in Alabama but can



Photo by John Trent.

be locally common. Pocket Gophers were detected at 18 of the 89 total historic sites (20.2%) compiled from previous records and 69 new sites, for a total of 87 occupied sites. They were confirmed to be present at sites in Barbour, Bullock, Coffee, Crenshaw, Escambia, Henry, Houston, Macon, Montgomery, Pike, and Russell counties.

The range of Southeastern Pocket Gophers has continued the decline reported by Skelly et al. (2001), with a continued contraction to the southeast on the periphery of the range. The populations in Autauga and Baldwin county appear to have been extirpated, and all extant populations are well to the south and east of the Alabama River. The range of the Southeastern Pocket Gopher now appears to be almost restricted to Choctawhatchee and Apalachicola basins. One cluster in Macon County extends into the Coosa-Tallapoosa Basin and one cluster was found in the Coosa-Tallapoosa Basin in Montgomery County. All other occupied sites were found within the Choctawhatchee or Apalachicola basins.

Eastern Hellbender (*Cryptobranchus alleganiensis*)

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 five streams and one single point stream site suggesting that the Eastern Hellbender is present in more streams in Alabama than indicated through conventional sampling.

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

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.

In 2015 four ponds in Mobile County were examined and deemed unsuitable

for Mississippi Gopher Frog. Ponds in Conecuh National Forest (CNF) fluctuated dramatically and experienced drying and filling cycles due to low rainfall during the winter and spring. Carolina Gopher Frog egg masses were observed in four of 11 ponds surveyed in CNF. Two ponds, both with egg mass observations, were positive for eDNA.

A torrential rain event occurred in December 2015 filling ponds in CNF to capacity. Egg mass surveys were difficult to perform due to extremely high water levels and egg mass was observed in only one pond in the spring of 2016. No male gopher frogs were heard during frog call surveys. Although visual surveys had low gopher frog egg mass detections, eDNA positive detections were high. Positive eDNA detections were returned for eight of 10 ponds on CNF and one pond on Geneva Wildlife Management Area and Carolina Gopher Frog tadpoles were also identified from four of the 10 ponds on CNF.

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



Photo by Kevin Enge.

Jean Lafitte National Historic Park Vegetation Classification and Mapping, Louisiana

ALNHP 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 is 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



many geospatial and vegetation data products. An in-depth project report discussing methods and results will be completed in 2017, and will include 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 will also include 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.

Natchez Trace Parkway Vegetation Classification and Mapping

ALNHP teamed up with NatureServe and the National Park Service to assist with a vegetation classification and mapping effort of the Natchez Trace Parkway a 444-mile scenic byway extending from Nashville, Tennessee to Natchez, Mississippi. The project was designed to gather baseline data on ecological associations as a means to assess habitat integrity in an effort to guide proper management protocols. The project entailed a large vegetation mapping component designed to deliver many geospatial and vegetation data

products. An in-depth project report discussing methods and results was completed in 2016, 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.

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 the high level of canopy closure in the location where *A. priceana* has disappeared on SCNWR is the cause and has also contributed to decreased reproduction. The amount of canopy closure in the area of plant disappearance has been observed numerous times during the course of several years by USFWS staff and 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 needed 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. No discernable reduction in the overstory and subsequently, no effects in relation to increased vigor and reproduction were detected at the end of the second year of the study in 2016. It is conjectured that lack of canopy change is likely attributable to the need for a longer period of time for the chemicals to take effect. The project is proposed to continue for an additional three years.



Inventory, Classification, and Assessment of Alabama's Geographically Isolated Wetlands

In October 2011, ALNHP, AU Department of Geology and Geography, and the AU Water Resources Center initiated an EPA-funded wetland mapping project to identify, classify, and assess geographically isolated wetlands in Alabama. We constructed GIS models of wetlands in Alabama using National Wetlands Inventory (NWI) data, Soil Survey Geographic (SSURGO) data, and geographic object based image analysis (GeOBIA) of 2011 National Imagery Program (NAIP). Expanding the methodology introduced by Tiner (2003),

we created a GIS model that identifies geographically isolated wetlands from each of the wetland models based on the USGS National Hydrography Dataset (NHD) and Federal Emergency Management Agency (FEMA) National Flood Hazard Layer (NFHL) database. A subset of the wetlands identified as geographically isolated in the total combined model were selected for field visits to verify the classification and to conduct an ecological classification and assessment.



Isolated wetlands in all models tended to be small, with a mean size generally <1 ha. The NWI model contained a higher number and acreage of wetlands than the other two individual models with the soils model containing the fewest. The number of geographically isolated wetlands uniquely identified in each model followed the same pattern. The total combined model identified 92,160 individual geographically isolated wetlands covering 70,664 ha.

Thirteen high quality ecological community types were identified from wetlands visited, with Pond Cypress (*Taxodium ascendens*), Swamp Black

Gum (*Nyssa biflora*), and Myrtle-leaved Holly (*Ilex myrtifolia*)-dominated associations appearing most numerous in the southern part of the state, whereas examples dominated by a combination of Sweetgum (*Liquidambar styraciflua*), Red Maple (*Acer rubrum*), and Swamp Black Gum were most prevalent of those wetlands documented in north Alabama. A host of rare plants monitored by ALNHP were also recorded, including some of the state's rarest species such as Epiphytic Sedge (*Carex decomposita*), Springs Clearweed (*Pilea fontana*), Chapman's Butterwort (*Pinguicula planifolia*), and Dwarf Burhead (*Echinodorus tenellus*).

Red-cockaded Woodpecker Safe Harbor Agreement

ALNHP has worked with ADCNR and USFWS to encourage forest landowners to enroll property in the Red-Cockaded Woodpecker Safe Harbor program. Under a Safe Harbor Agreement, the landowner agrees to carry out activities expected to benefit red-cockaded woodpeckers, but no added federal restrictions will be imposed should the numbers (or occurrences) of the species expand beyond a "baseline" level when the agreement is entered into. Copies of the brochure describing the Safe Harbor Program have continued to be distributed to interested individuals.



The Enon-Sehoy Plantation agreement has continued to be amended to reflect changes in land ownership at this location. Three of five new owners signed agreements in 2016 keeping the property enrolled in Safe Harbor. As of 2015, there were 32 active clusters with 135 cavity trees on the two enrolled properties with Red-cockaded Woodpecker present. The populations on these two properties consisted of 32 potential breeding groups and one solitary bird. ALNHP's involvement with Safe Harbor ended in September 2016 when ADCNR made the decision to keep this project within the Division of Wildlife.

Reintroduction of the Eastern Indigo Snake onto Apalachicola Bluffs and Ravines Preserve

In 2016 we continued to work towards an Indigo Snake reintroduction onto Apalachicola Bluffs and Ravines Preserve in the Florida panhandle. A graduate student was recruited to monitor these animals, which are scheduled to be released in summer of 2017.

Funding for this project has been provided by the Florida Fish and Wildlife Conservation Commission and the Joseph W. Jones Ecological Research Center and is being conducted in partnership with a variety of state and federal agencies as well as non-governmental conservation organizations, notably the Orianne Center for Indigo Conservation.



Reintroduction of the Eastern Indigo Snake onto Conecuh National Forest

We continue our Indigo Snake reintroduction program in Conecuh National Forest. We are currently attempting to monitor the animals we have already released while determining how the reintroduction of the Indigo Snake has affected wildlife assemblages.

Since 2014 we have A) used 18 drift-fence arrays to capture amphibians and reptiles both in the release site (six arrays) and in areas where there are no Indigo Snakes (12 sites), and B) trapped small mammals in these areas. In 2015 we began to conduct point counts to assess the composition of bird assemblages and now do so on a yearly basis. In 2016 we installed approximately 150 bluebird nest boxes in Conecuh National Forest to monitor nest survival and predation rates as well as to determine if the reintroduction of the Indigo Snake influences these parameters.



Collaboration continues to be the key to this endeavor involving Auburn University, Alabama Department of Conservation and Natural Resources (ADCNR), The Orianne Society, U.S. Forest Service, U.S. Fish and Wildlife Service, Georgia Department of Natural Resources, Zoo Atlanta, and Ft. Stewart (US Army).



Funding for this project has been provided by the State Wildlife Grants administered through the Alabama Department of Conservation and Natural Resources.

The Army Corps of Engineers provided funds to initiate components of our study related to bird nests.

Teaching, Students, & Volunteers

Hellbender studies in 2015-2016 had 34 volunteers participate in field surveys.

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 has been funded during 2015-2016 as field technician on the Bankhead National Forest Flattened Musk Turtle And Black Warrior Waterdog study. Data collected during the summer months on the flattened musk turtle will be used by Joe for his thesis.

Nicole Garrison, in the Bond Lab, has been supported on ADCNR grants to process eDNA samples.

Mary Bennett, a grad student in the Gitzen Lab (School of Forestry and Wildlife Sciences), received funding to collect habitat data on the Pocket Gopher study. Data collected during this study will be used for her thesis.

Jeff Goessling (in the Mendonca lab) and Helen Tripp (MS student in the Gitzen lab, School of Forestry and Wildlife Sciences) received support for their research projects on the Gopher Tortoise grant.

The Argentine Tegu project provided undergraduate research opportunities for two students (Joni Wilison and Charlotte Musser) in 2015.

Arthur Jenkins conducted an undergraduate research project on the spatial ecology of Flattened Musk Turtles in 2015.

ALNHP has provided loans of GPS units and other equipment to three graduate students for use on their research project for a total of 18 months of use.

Hannah Gerke, an Undergraduate Research Scholars Thesis Student from Texas A&M University conducted research on the Indigo Snake project.



Trail walk at the Wehle Tract.

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 1,487 rare plant and animal taxon (Fig. 1) plus 93 natural communities. There are 7,608 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 two year's efforts focused on redigitizing data imported from BCD to improve the spatial representation, last observation date, and updating federal status data to include species which have been petitioned for listing. We also concentrated on creating shapes for Managed Area records so that the mapped component for the area was included in the database. Another focal area for database improvement was addressing the data backlog. This effort has led to the creation of 409 new records and updating an additional 744 records over the past two years. 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 redigitizing data imported from BCD to improve the spatial representation and reducing the data backlog. We will also begin a concerted effort to begin addressing the backlog of data entry.

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 October 2016, with the list distributed to cooperators and other interested parties and posted to the ALNHP website.

Data Requests

Over the past two years, ALNHP has responded to 130 requests for data or information. This included 28 paid data requests and 102 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.

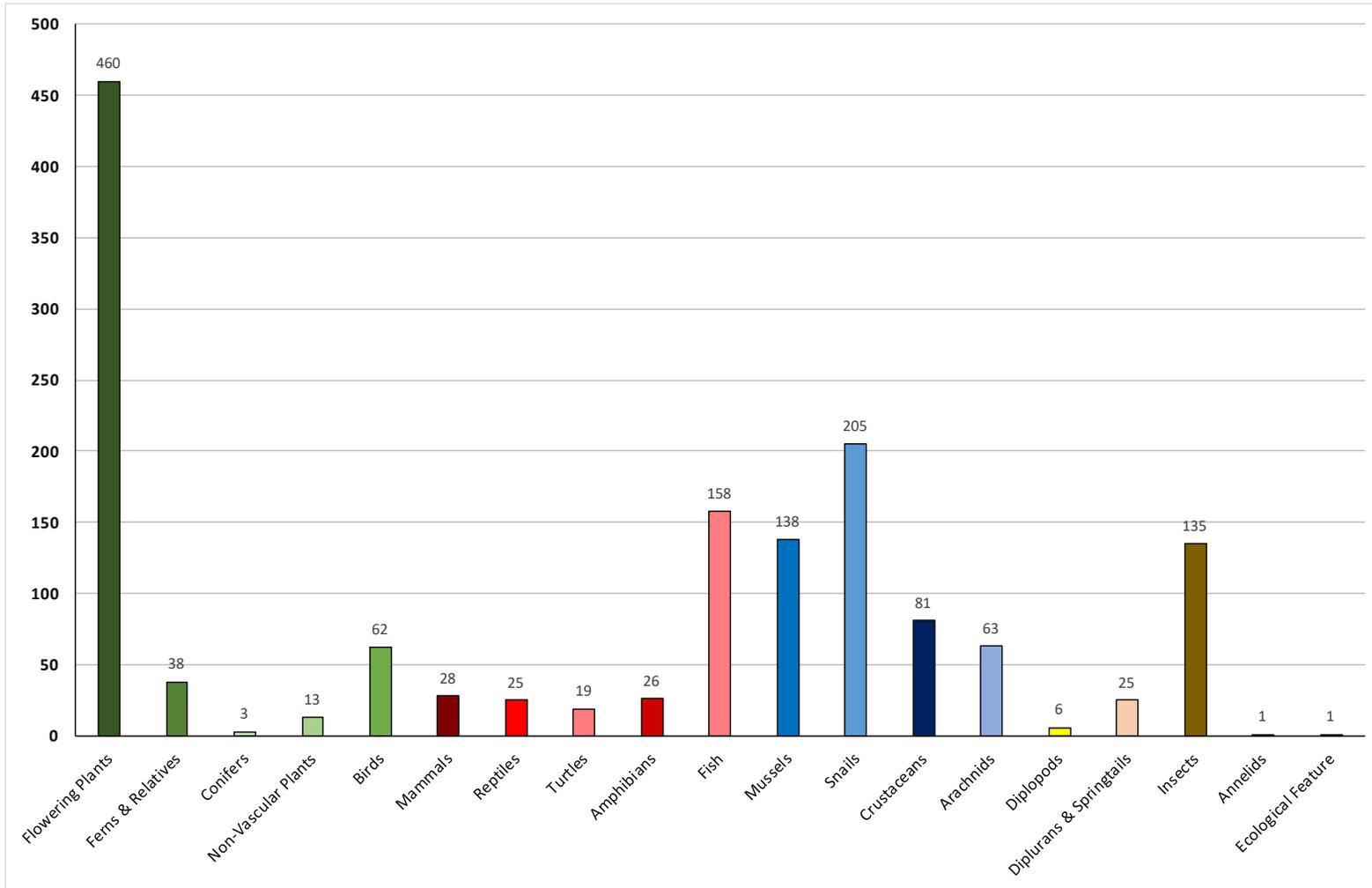


Figure 1. Number of rare plant and animal species track by ALNHP (total 1,487).

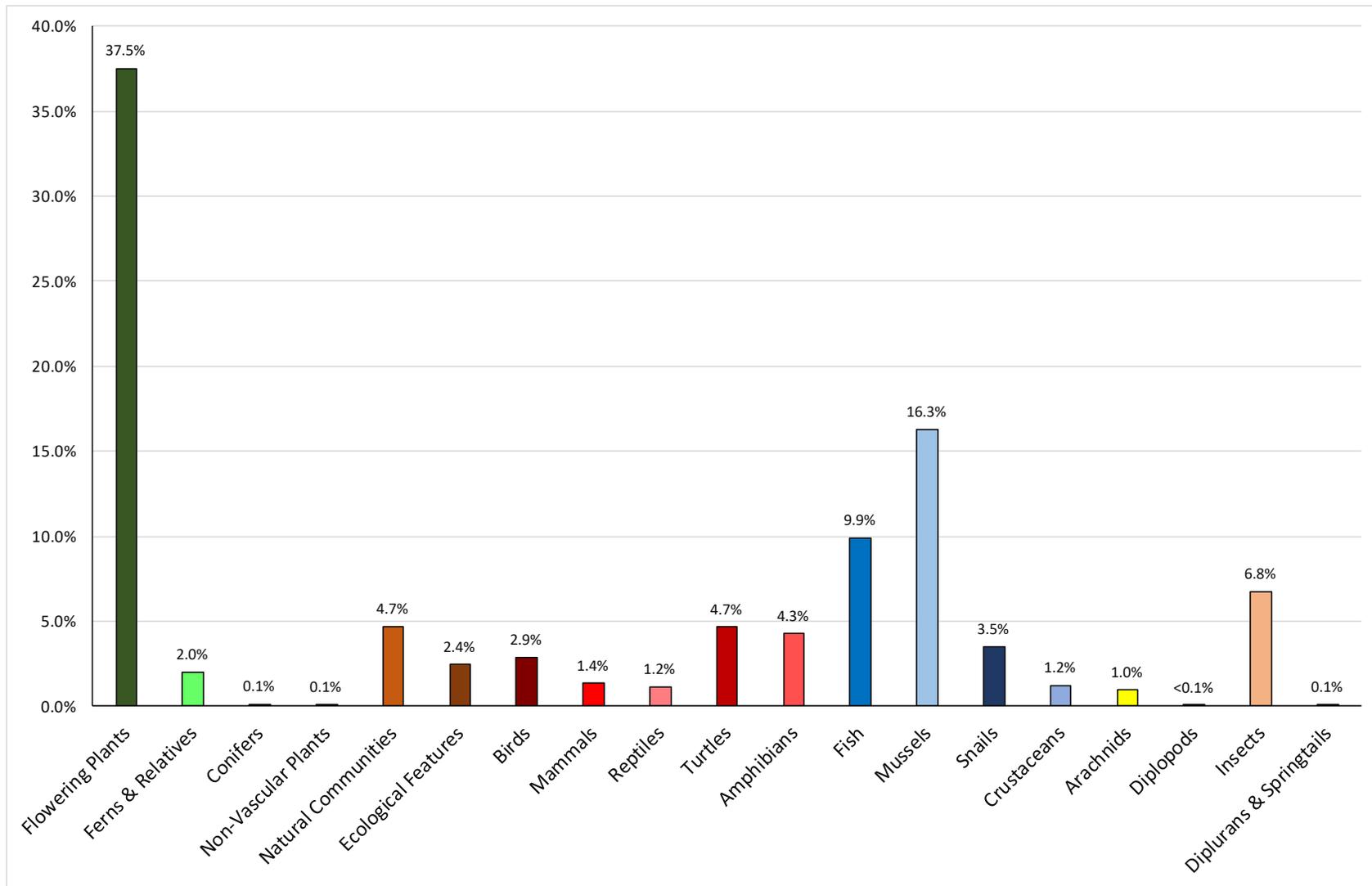


Figure 2. Percentage of 7,608 Element Occurrences in Biotics by major taxonomic group.

OUTREACH

The Auburn University Museum of Natural History continued to develop outreach programs and raise public awareness of the Museum's research and conservation efforts during 2015 and 2016. Approximately, 118 outreach

programs and 55 tours were conducted during that period. Museum staff and associates reached over 7,360 individuals through tours and outreach events away from the Museum.

"Nightmare on Mell Street" Fall 2015 Open House



The summer of 2015 brought a new venture to the Museum with the creation of two one-week Junior Curator Camps. Students in the seventh and eighth grades attended the day camps. Each camper learned how scientists conduct field work, identify specimens and curate those specimens into the Museum's collections. The camps were so successful they were offered again during the summer of 2016.



Alumni Tailgate Event, Fall 2015



Arachnid hunting on the Wehle Tract

Museum staff also hosted a variety of on campus groups for tours as well as specific course requirements. For the first time, the College of Liberal Arts requested classes from their Art Department tour and use Museum specimens as inspiration for a collaborative class project.

Junior Curator Camp 2016



The partnership between the Museum and the Alabama Department of Conservation and Natural Resources, State Lands Division to conduct environmental science and art outreach at the Wehle Nature Center continued as 55 events were conducted during the two year period. Students from public schools in the surrounding counties attend events that focus on Alabama's Natural History as a way to motivate classroom participation and promote student retention.

Museum staff partnered with the Alabama Cooperative Extension to host a Bioblitz

at Auburn University's Mary Olive Thomas Demonstration Forest on 23 April 2016. AUMNH staff and many AU graduate students led groups to document the flora and fauna at the demonstration forest. The Bioblitz was very successful with over 200 members of the general public attending and participating, and documentation of 348 taxon in the forest. The taxa documented were 14 amphibians, 7 reptiles, 40 birds, 15 mammals, 10 fish, 135 insects, 8 butterflies, 26 spiders, 3 hexapods, 1 scorpion, 2 opiliones, 12 aquatic invertebrates, 2 crayfish, 10 fungi, 39 plants, and 24 trees.



SIGNIFICANT DISCOVERIES

Significant Botanical Discoveries

Carex decomposita (cypress-knee sedge): Redstone Arsenal, Madison County; discovery in 2016 represents fifth occurrence documented in Alabama. Former candidate for federal listing.



Schwalbea americana (American chaffseed): New occurrence documented from Bullock County in 2016 representing the second extant site in Alabama. Species is currently listed as federally threatened.



Significant Zoological Discoveries

Crawfish Frog (*Lithobates areolatus*): Discovered in Sumter County on 22 February 2016. This discovery was the first reported occurrence for the species in Alabama.



Eastern Hellbender (*Cryptobranchus alleganiensis*): Captured in Madison County, Flint River, 18 September 2015 and Lauderdale County, Butler Creek, 22 August 2016. Last reported live Eastern Hellbender reported in Alabama was in 2014 in Cypress Creek. These reports confirm the presence of the Eastern Hellbender in additional streams.



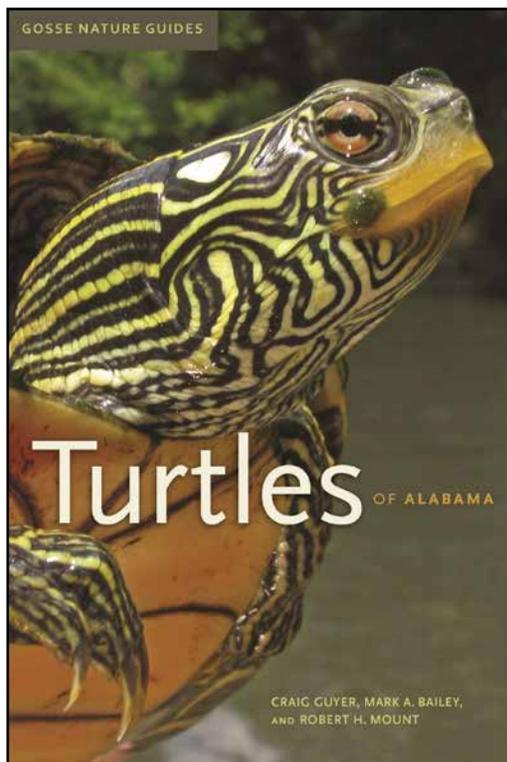
Jim Godwin with Hellbender discovered in Flint Creek in 2015.

David Laurencio, the herpetology collections manager, found and was part of the team that described the first known female of the lizard, *Norops fungosus* in Panama. Interestingly, it is one of the species of anole where the females possess a colorful dewlap, a character usually restricted to the males of the group.

Museum staff, working with the McConell, family which found the frogs in Mobile County, published a note documenting the state record for *Eleutherodactylus cystignathoides*, the Rio-Grand Chirping Frog. This note serves as the first published occurrence of this species for the state and it extends the range of the species several hundred miles to the east.

AUMNH Herpetology Curators Emeritus Dr. Craig Guyer and Dr. Robert Mount, along with their co-author Mark Bailey, published the Turtles of Alabama. This book represents the first book of four that will update Dr. Mount's seminal work "The Reptiles and Amphibians of Alabama".

Dr. Geoff Hill, Curator of Birds, published a new species concept and explained why DNA barcodes are so effective in his paper: "Mitonuclear coevolution as the genesis of speciation and the mitochondrial DNA barcode gap."



PUBLICATIONS & PRESENTATIONS

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Davenport, L. J. 2015. From Cro-Magnon to Kral: A history of botany in Alabama. *Journal of the Botanical Research Institute of Texas* 9:397-431.

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Project Reports

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Barbour, Michael, Alfred Schotz, Tyler Jones, Luke Marzen, Samriddhi Shakya, and Samuel Fowler. 2015. Inventory, classification, and assessment of Alabama's geographically isolated wetlands. Report submitted to U.S. Environmental Protection Agency, Atlanta, Georgia. Alabama Natural Heritage ProgramSM, Auburn University Department of Geology and Geography, and Auburn University Water Resources Center; Auburn University, Alabama. 53 pages.

Barbour, Michael, Robert Gitzen, and Mary Bennett. 2015. Distribution and habitat attributes of the southeastern pocket gopher in Alabama. Report submitted to the Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, Montgomery, Alabama. Alabama Natural Heritage ProgramSM and School of Forestry and Wildlife Sciences, Auburn University, Alabama. 41 pages.

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- Godwin, James and Al Schotz. 2016. 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 ProgramSM, Auburn University, Alabama. 17 pages.
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- Godwin, James, Jimmy Stiles, Sierra Stiles, Mike Wines, and David Steen. 2015. Reintroduction of the Eastern Indigo Snake onto Conecuh National Forest: Optimizing husbandry protocols for raising of head-started snakes and movements, habitat and survival of released animals. Report submitted to the Alabama Department of Conservation and Natural Resources, State Wildlife Grants Program, Montgomery, Alabama. Alabama Natural Heritage ProgramSM, Auburn University, Alabama. 99 pages.
- Helms, Brian, Mallery Clay, Scott Santos, Michael Barbour, and Jason Bond. 2016. Population structure and conservation status of burrowing bog crayfishes (*Fallicambarus* spp.) in south Alabama. Report submitted to the Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, Montgomery, Alabama. Auburn University, Auburn, Alabama. 45 pages.
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Popular Press Articles

Steen, D. A. 2016. What really happened to turtle soup? Slate Magazine.

Theses

AUMNH Collections

Mammals

Hirt, S. J. 2015. Sexual dimorphism, The big-mother hypothesis, and analyses of hormones, minerals, and stable isotopes to determine reproductive events in bowhead whales (*Balaena mysticetus*). Ph.D. dissertation, Auburn University, Alabama, 104 pages.

Moore, L. H. 2015. Activity of bats (Mammalia: Chiroptera) in coastal South Carolina: an acoustic study. M.S. thesis, Auburn University, Alabama, 198 pages.

Moss, J. L. 2015. Ecological distribution of shrews in the Cumberland Plateau of Alabama. M.S. thesis, Auburn University, Alabama, 54 pages.

Presentations

ALNHP

Barbour, Michael. 2015. "Mobile data collection." Seminar presentation, Auburn University Department of Biological Sciences, Auburn, AL; 30 September.

Barbour, Michael. 2016. "Distribution of the southeastern pocket gopher in Alabama." 21st Annual Meeting of the Southeastern Bat Diversity Network and 26th Annual Colloquium on the Conservation of Mammals in the Southeastern U.S., Lake Guntersville State Park, Guntersville, Alabama; 19 February.

Barbour, Michael. 2016. "OpenRefine – a tool for cleaning data." Biodiversity Without Boundaries 2016, San Juan, Puerto Rico; 22 April.

Barbour, Michael. 2016. "Care and feeding of the data monster." Seminar presentation, Auburn University Department of Biological Sciences, Auburn, AL; 7 September.

Bennett*, M. E., R. A. Gitzen, M. Barbour, and H. Tripp*. 2016. "Habitat Analysis of the Southeastern Pocket Gopher (*Geomys pinetis*) in Southeast Alabama." 21st Annual Meeting of the Southeastern Bat Diversity Network and 26th Annual Colloquium on the Conservation of Mammals in the Southeastern U.S., Guntersville State Park, Guntersville, Alabama; 19 February.

Bennett*, M. E., R. A. Gitzen, M. Barbour, and H. Tripp*. "Above the Tunnels: Habitat Use of the Southeastern Pocket Gopher." This Is Research Symposium, Auburn, AL; 13 April.

Bennett*, M. E., R. A. Gitzen, and M. Barbour. 2016. "Resource Selection of the Southeastern Pocket Gopher." Alabama Department of Conservation and Natural Resource Meeting, Auburn, AL; 26 April.

de Souza, Lesley, James Godwin, and Eric R. Larson. 2016. "Applying occupancy models and detection probability to environmental DNA (eDNA) survey data for the Flattened Musk Turtle (*Sternotherus depressus*) and Black Warrior Waterdog (*Necturus alabamensis*)." Southeastern Partners in Amphibian and Reptile Conservation, Annual meeting, Nauvoo, AL; 19 February.

Godwin, James C. 2015. "Reintroduction of the Eastern Indigo Snake in Conecuh National Forest." Eastern Indigo Snake Partners and Collaborators Meeting, Solon Dixon Forestry Center, AL; 25 February.

Godwin, James C. and Lesley de Souza. 2015. "Black Warrior Waterdog (*Necturus alabamensis*) and Flattened Musk Turtle (*Sternotherus depressus*) Survey Using Environmental DNA (eDNA)." Southeastern Partners in Amphibian and Reptile Conservation (SEPARC), Covington, LA; 20 February.

Godwin, James C. and Lesley de Souza. 2015. "Black Warrior Waterdog and Flattened Musk Turtle Survey Using Environmental DNA." Alabama Chapter of the Wildlife Society (ACTWS), Guntersville State Park, AL; 27 March.

Godwin, James C. and Lesley de Souza. 2015. "Flattened Musk Turtle (*Sternotherus depressus*) Survey Using Environmental DNA (eDNA)." Turtle Survival Alliance, 13th Annual Symposium, Tucson, AZ; 8 August.

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Godwin, James C. 2016. "The Alabama Red-bellied Turtle (*Pseudemys alabamensis*): A Component Of The Turtle Fauna of Mobile Bay." Southeastern Partners in Amphibian and Reptile Conservation, Annual meeting, Nauvoo, AL; 19 February.

Godwin, James C. 2016. "Alabama Department of Conservation and Natural Resources Project Updates: Environmental DNA (eDNA) in the Detection and Monitoring of Aquatic Species; Black Warrior Waterdog (*Necturus alabamensis*) and Flattened Musk Turtle (*Sternotherus depressus*) Survey using Environmental DNA (eDNA); Gopher Frog; Eastern Hellbender; Reintroduction of the Eastern Indigo Snake in Conecuh National Forest." School of Forestry and Wildlife Sciences, Auburn University, AL; 26 April.

Godwin, James C. 2016. "Review of the Status of the Alabama Red-bellied Turtle (*Pseudemys alabamensis*)." Turtle Survival Alliance, 14th Annual Symposium, New Orleans, LA; 3 August.

- Godwin, James C. 2016. "Search for the Eastern Hellbender in Alabama." Birmingham Audubon Society, Birmingham, AL; 17 November.
- Godwin, James C. and Scott M. Goetz. 2016. "Venomous Snakes of Equatorial Africa." National Guard, Ft. McClellan, Anniston, AL; 18 May.
- Schotz, A. 2016. Botanical Treasures of Alabama. Guest Lecturer for Les Goertzen's Plant Systematics Class. Department of Biological Sciences, Auburn University; April 1.
- Schotz, A. 2016. Overview of the Alabama Plant Conservation Alliance and Plant Conservation in Alabama. Biodiversity without Boundaries 2016, San Juan, Puerto Rico; 23 April.
- Schotz, A. 2016. Summary of 2009 Black Belt Prairie Assessment Report. Meeting of the Black Belt Prairie Restoration Initiative; May 9.
- Schotz, A. 2016. Alabama's Remarkable Biodiversity. Buffalo Museum of Science, Buffalo, New York; May 23.
- Schotz, A. 2016. Overview of Natural Community Assessment of Natchez Trace Parkway. National Park Service; September 15.
- Schotz, A. 2016. Moderator for two sessions: Conference for Southeastern Partners in Plant Conservation; Atlanta, GA; Nov. 2-3.
- Steen, D. A. 2015. "Ecological Effects of Indigo Snake Reintroductions and Future Directions." Alabama Indigo Snake Reintroduction Stakeholder's Meeting, Andalusia, AL. February 2015
- Steen, D. A. 2015. "Wildlife Ecology and Conservation in Changing Landscapes". Auburn University-Department of Biological Sciences, Auburn, AL February 2015 (invited)
- Steen, D. A. 2015. "Road Mortality and Freshwater Turtle Conservation in North America." Auburn University Society for Conservation Biology Chapter, Auburn, AL; March 2015 (invited)
- Steen, D. A. 2015. "Integrating Reptile Health into Applied and Ecological Studies." University of Tennessee-Knoxville Wildlife Disease Association Chapter Meeting, Knoxville, TN; April 2015 (invited)
- Steen, D. A. 2015. "Leveraging Social Media for Online Outreach: My Greatest Hits." Society for the Study of Amphibians and Reptiles and Partners in Amphibian and Reptile Conservation Annual Conference, Lawrence, KS; August 2015 (invited)
- Steen, D. A. 2015. "Reintroducing the Indigo Snake to Alabama." Clemson University Natural Resources Seminar Series, Clemson, SC; September 2015 (Graduate Student Association invitation)
- Steen, D. A. 2015. "Reintroducing the Indigo Snake to Alabama." Kennesaw State University Ecology, Evolution, Behavior & Organismal Biology Seminar Series, Kennesaw, GA; October 2015 (invited)
- Steen, D. A. 2015. "Reintroducing the Indigo Snake to Alabama." Tennessee State University Seminar Series, Nashville, TN; October 2015 (invited)
- Steen, D. A. 2016. "Bringing back big blue: reintroducing the Indigo Snake to Alabama and Florida." Discover Auburn Lecture Series, Auburn, AL; March 2016 (invited)
- Steen, D. A. 2016. "Large reptile research at Auburn University: the big, the bad, and the beautiful." Auburn University College of Science and Mathematics Leadership Council, Auburn, AL; April 2016 (invited)

Steen, D. A. 2016. "Large reptile research at Auburn University: the big, the bad, and the beautiful." Auburn University Physics Department Awards Banquet Auburn, AL; April 2016 (invited)

Steen, D. A. 2016. "Wildlife restoration in fire-suppressed longleaf pine sandhills." Alabama Chapter of The Wildlife Society Annual Meeting, Andalusia, AL; April 2016 (invited)

Steen, D. A. 2016. "Bringing back big blue: reintroducing the Indigo Snake to Alabama and Florida." Minnesota Herpetological Society Monthly Meeting, St. Paul, MN; June 2016 (invited)

Steen, D. A. 2016. "Reintroductions and eradications: conservation biology of large reptiles in the southeastern United States." University of Southern Mississippi Department of Biological Sciences Research Seminar, Hattiesburg, MS; September 2016 (invited)

Steen, D. A. 2016. "Intra and interspecific interactions may influence reintroduction success." Enhancing Wildlife Reintroduction Success symposium at annual The Wildlife Society Conference Raleigh, NC; October 2016 (invited)

Steen, D. A. 2016. "Reintroductions and eradications: large reptile research at Auburn University." Midwest Herpetological Symposium Invited Speaker, Lisle, IL; October 2016 (invited)

Steen, D. A. 2016. "Leveraging Social Media for Online Outreach: My Greatest Hits." American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America Annual Conference, Phoenix, AZ; November 2016 (invited).

Steen, D. A. 2016. "Reintroductions and eradications: conservation biology of large reptiles in the southeastern United States." Arizona State University Polytechnic Campus, Mesa, AZ; November 2016 (invited)

Poster Presentations

ALNHP

Bennet*, Mary, Robert A. Gitzen, and Michael Barbour. 2015. "Where the other gophers go! Habitat analysis of the southeastern pocket gopher (*Geomys pinetis*) in Southeast Alabama." 37th Annual Gopher Tortoise Council Meeting, Covington, Louisiana; 16-18 October.

Bennett*, M. E., R. A. Gitzen, and M. Barbour. 2016. "What's Above When Living Below? A Look at Habitat Use of the Southeastern Pocket Gopher. Poster" Annual Meeting of the Alabama Chapter of the Wildlife Society, Solon Dixon Forestry Center; 14-15 April.

Bennett*, M. E., R. Gitzen, and M. Barbour. 2016. "Resource Selection of the Southeastern Pocket Gopher (*Geomys pinetis*) in Southeast Alabama." The 23rd Annual Conference of the Wildlife Society, Raleigh, NC; 15-19 October.

Gitzen, R. A., Mary E. Bennett*, Patricia J. Hartman, Elizabeth Parsons, and Michael Barbour. 2016. "Dig Me Out, Dig Me In: Ecology and Conservation of a Southeast Ecosystem Engineer." This Is Research Faculty Symposium, Auburn University Hotel and Dixon Conference Center, Auburn, AL; 16 September.

Goetz, Scott M., James C. Godwin, Fred Antonio and David A. Steen. 2016. "Eastern Indigo Snakes Discriminate Among Prey Odors And Prefer Copperheads." Southeastern Partners in Amphibian and Reptile Conservation, Annual meeting, Nauvoo, AL; 19 February.

Goetz, Scott M., James C. Godwin, Fred Antonio and David A. Steen. 2016. "Eastern Indigo Snakes Discriminate Among Prey Odors And Prefer Copperheads." Alabama Chapter of the Wildlife Society, Annual meeting, Solon Dixon Forestry Center; 14-15 April.

Hartman, Patricia, Robert A. Gitzen, David C. Carter, John S. Kush, Midge Coates, and Michael Barbour. 2016. "Using historical citizen science to understand wildlife in the longleaf pine ecosystem." 11th Biennial Longleaf Conference, Savannah, GA; 1-4 November.

Hartman, Patricia J., Robert A. Gitzen, Midge Coates, John S. Kush, Michael S. Barbour, and David C. Carter. 2016. "A Cultural History of Alabama Wildlife." Alabama Chapter of the Wildlife Society, Annual meeting, Solon Dixon Forestry Center; 14-15 April.

Tripp*, Helen, Sharon Hermann, Michael Barbour, and Jim Godwin. 2015. "Mapping the distribution of soils to predict potential for gopher tortoise population viability on Alabama public lands." Alabama Chapter of the Wildlife Society, Annual meeting, Solon Dixon Forestry Center; 14-15 April.

Hellbender Publicity

COSAM webpage:

<http://www.auburn.edu/cosam/news/articles/2016/12/the-long,-hard-road-for-hellbenders.htm>

Outdoor Alabama:

<http://www.outdooralabama.com/no-lure-hellbender-found-north-alabama>

AL.com:

http://www.al.com/news/index.ssf/2016/05/hellbenders_of_alabama_search.html

http://www.al.com/news/montgomery/index.ssf/2016/12/hellbender_salamander_once_tho.html

http://www.al.com/opinion/index.ssf/2017/01/giant_salamander.html

Newsweek:

<http://www.newsweek.com/hellbender-salamander-rediscovered-alabama-532089>

The Wildlife Society:

<http://wildlife.org/hot-on-the-alabama-trail-of-the-elusive-hellbender/>

Vimeo:

<https://vimeo.com/149180433>

Funded Projects

Funding Source	Project	Responsible Party	Amount	Status
ADCNR	Black Warrior Waterdog and Flattened Musk Turtle Status Survey Using Environmental DNA (eDNA)	Godwin	\$31,700	Completed
ADCNR	Continued Implementation of the Safe Harbor Plan for the Endangered Red-cockaded Woodpecker in Alabama (2015)	Barbour	\$13,334	Completed
ADCNR	Continued Implementation of the Safe Harbor Plan for the Endangered Red-cockaded Woodpecker in Alabama (2016)	Barbour	\$13,334	Completed
ADCNR	Distribution and Habitat Attributes of the Southeastern Pocket Gopher in Alabama	Barbour and Gitzen	\$26,667	Completed
ADCNR	Distribution, Abundance, and Health Assessment of the Gopher Tortoise (<i>Gopherus polyphemus</i>) in Alabama	Hermann	\$467,572	Ongoing
ADCNR	Distributional survey of the southern cavefish	Armbruster	\$14,800	Completed
ADCNR	Distributional survey of the southern cavefish	Armbruster	\$11,091	Completed
ADCNR	Gopher Frog Survey (2015)	Godwin and Bond	\$20,000	Completed
ADCNR	Gopher Frog Survey (2016)	Godwin and Bond	\$20,000	Completed
ADCNR	Gopher Frog Survey	Godwin and Bond	\$20,000	Ongoing
ADCNR	Hellbender Multi-state	Godwin and Bond	\$80,183	Ongoing
ADCNR	Hellbender Survey (2015)	Godwin and Bond	\$35,500	Completed
ADCNR	Hellbender Survey (2016)	Godwin and Bond	\$35,042	Completed
ADCNR	Hellbender Survey (2017)	Godwin and Bond	\$30,000	Ongoing
ADCNR	Historical Changes to Amphibian and Reptile Faunas in Five Key Alabama Watersheds	Godwin		Completed
ADCNR	Indigo Snake Monitoring	Steen and Godwin	\$150,058	Ongoing
ADCNR	Population structure and conservation status of burrowing bog crayfishes (<i>Fallicambarus</i> spp.)	Helms, Santos, and Bond	\$23,430	Completed

Funding Source	Project	Responsible Party	Amount	Status
ADCNR	Reintroduction of the Eastern Indigo Snake onto Conecuh National Forest	Godwin and Guyer	\$121,353	Completed
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	\$150,058	Ongoing
ADCNR - State Lands	Environmental Science and Art - AUMNH Outreach at Wehle 2015	Stone and Bond	\$21,000	Completed
ADCNR - State Lands	Environmental Science and Art - AUMNH Outreach at Wehle 2016	Stone and Bond	\$21,000	Completed
AL Forest Resource Center	Status Update of <i>Schwalbea americana</i> , American Chaffseed, on the Enon Sehoy Plantations, Alabama	Schotz	\$10,000	Completed
Big Cedar Education Foundations	Environmental Science and Art - AUMNH Outreach at Wehle 2015	Stone and Bond	\$2,500	Completed
Big Cedar Education Foundations	Environmental Science and Art - AUMNH Outreach at Wehle 2016	Stone and Bond	\$2,500	Completed
Coypu Foundation	Distribution of fishes of the Ireng River	Armbruster	\$49,983	
JMR Architecture	Pelham Range Plant Inventory	Schotz	\$129,000	Completed
NatureServe	Natchez Trace Parkway Vegetation Mapping Project	Schotz	\$66,167	Completed
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

Funding Source	Project	Responsible Party	Amount	Status
Project Learning Tree	Longleaf Pine Outreach 2015	Stone and Bond	\$550	Completed
Scott's Miracle Gro	Evaluation of Snake Response to Potential Repellents	Steen	\$17,907	Ongoing
Turtle Conservation Fund	Population demographics of <i>Rhinoclemmys funerea</i> and <i>Kinosternon leucostomum</i> at La Selva Biological Station, Costa Rica, and a comprehensive survey for <i>Kinosternon angustipons</i>	Folt	\$2,000	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 EPA	Eco-Morphological Mitigation Design and Assessment Tools for the Alabama and Tennessee Appalachian Plateau	Brantley (PI), Helms, and Werneke	\$400,228	Completed
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	Ongoing
USFS	Monitoring of Alabama Streak-sorus Fern on Bankhead National Forest	Schotz	\$40,000	Ongoing
USFWS	Black Warrior Waterdog	Godwin and Bond	\$37,542	Completed
USFWS	<i>Hamamelis ovalis</i> Status Survey	Schotz	\$8,000	Completed
USFWS	Range-wide Status Assessment of <i>Hexastylis speciosa</i> , Harper's Ginger	Schotz	\$30,000	Ongoing

Funding Source	Project	Responsible Party	Amount	Status
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	Schotz	\$15,554	Completed
USFWS	<i>Rhynchospora crinipes</i> Survey	Schotz	\$9,000	Completed
USFWS	Turkey Creek Musk Turtle	Godwin and Armbruster	\$5,000	Ongoing
USGS	Behavior and Physiology of Invasive Argentine Tegus in Semi-natural Enclosures in Alabama	Steen	\$35,000	Completed
USGS	Brumation Behavior and Reproductive Success of Argentine Tegus	Steen	\$41,135	Ongoing
Wiregrass RC&D	Environmental Science and Art - AUMNH Outreach at Wehle 2015	Stone and Bond	\$1,833	Completed