

Part I: Applicant Information

1. Date: August 1, 2019 to July 31, 2020

2. Project title: Biodiversity of Pollinators and Predators: Surveying and Increasing Appreciation of the Bees, Ants and Wasps of Georgia Southern University

3. Amount requested: \$40,869.42

4. Proposal authors: Joshua D. Gibson, Bonnie A. Cobb, Kevin J. Loope

5. Contact information

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6. Academic department: Biology

7. Qualifications & Experience

This proposal is authored by one faculty member, Joshua D. Gibson, and one Research Faculty member, Kevin J. Loope, as co-PIs, and one graduate student, Bonnie A. Cobb:

Joshua D. Gibson: I am an Assistant Professor in the Department of Biology at the Statesboro campus of Georgia Southern University. I currently teach Bioinformatics and Biotechnology (BIOL 5500/G), which integrates computational analysis with biological data, but I also have experience teaching General Entomology labs that were designed around collecting and identifying insects. Teaching these labs involved verifying the identification of ~4000 specimens each semester. I primarily study Hymenopteran insects (bees, ants, and wasps) and have authored 16 peer-reviewed papers, 14 of which are focused on these insects. I was also involved in a statewide National Science Foundation funded citizen science project as a Postdoctoral Scholar at the University of California, Berkeley. <http://www.backyardbiodiversity.org/>

Bonnie A. Cobb: I am currently a M.S. student at GSU studying the incompatibilities between nuclear and mitochondrial genomes in jewel wasp hybrids. I received my B.S. in Biology at the University of Saint Mary in Leavenworth, KS. I have worked as an avian technician for the Audubon Society in Alton, MO doing avian census work and contributing to a greater biodiversity survey for the Army Corp. of Engineering. Here at GSU, teaching students about anthropogenic effects on biodiversity, ecosystem dynamics, and their own environmental responsibilities has been an important part of my career. I took an active interest in educating students beyond the classroom when teaching Environmental Biology Lab. I'm currently working as a Graduate Assistant for the Center for Sustainability where I coordinate outreach events and educate students on how to increase sustainable behaviors in the community.

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Kevin J. Loope: I am currently a part-time Research Assistant Professor at Georgia Southern's Statesboro campus, where I study animal behavior, evolution and ecology. My research focuses on

the evolution of behavior in social insects, including both bees and wasps, and on the ecology of invasive wasps. I have authored 15 peer-reviewed papers on a variety of wasps and bees, and I have participated in a variety of pollinator-centered outreach events as a graduate student and postdoctoral scholar. I generally love the Hymenoptera, social and otherwise.

Roles of students

Graduate students will be involved in all aspects of the proposed project: designing and implementing the biodiversity survey, preparing and identifying specimens, coordinating education, outreach, and citizen science data collection, and maintaining the website with updated identification data. Three undergraduate students will be hired to assist in specific areas of the project. The hiring focus will be on individual students with a conservation/entomology interest to assist with field sampling and identification for the biodiversity survey and students with an analytical/bioinformatic (computational biology) interest to assist in data analysis and website integration. Thus, participation in this project will provide training in a variety of relevant skills for these students. In order to maximize participation in the citizen science project by both GSU students and the greater Statesboro community we will publicize this project through the Biological Organization of Graduate Students (BOGS), the TriBeta Biology Honors Society, the Natural History Collections Club, in relevant courses, through social media, and at outreach and education events. Students will have opportunities to engage with and learn from the project through workshops, using the iNaturalist platform (smartphone and web based) for citizen science, and through Service Learning projects.

Part II: Purpose and Description

8. Sustainability theme

Using biodiversity surveys, web-based data collection and dissemination, and educational outreach the proposed project will address the sustainability themes of Biodiversity, Citizen Science, Native Species Education & Appreciation, and Promotion of Sustainable Practices.

9. Project Summary

This project aims to expand previous diversity assessments to include a wide range of Hymenoptera pollinators (bees and some wasps) as well as focusing on the predatory Hymenoptera (ants, and some wasps) that do not pollinate. Pollinators are responsible for the production of nearly 1/3 of all human food, while the ants and wasps have major impacts on biological communities through predation and other interactions. The educational and sustainability focus of this project is on teaching students and the public about these less understood insects that play tremendous roles, both positive and negative, in biodiversity and pollination. We will interact with students and the public through outreach events and workshops, as well as through a citizen science project using the “iNaturalist” platform to engage and educate them in their local biodiversity and the process of science.

10. Project description

There are three components of the proposed project.

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Biodiversity assessment of pollinators and Hymenoptera

The first main goal is to survey the Hymenopteran pollinators (mostly bees and wasps) and other Hymenopteran insect diversity on the Georgia Southern Statesboro campus. A previous

Sustainability Fee funded project, entitled “Assessing Insect Biodiversity and Promoting Sustainable Practices Toward Pollinators on Campus” (2018), focused on two charismatic insect orders, the Lepidoptera (butterflies and moths) and the Odonata (dragonflies and damselflies). However, this survey didn’t include the largest group of pollinators (Hymenoptera) nor did it focus on insect and data collection techniques specifically designed to assess pollinator diversity. Hymenoptera (bees, wasps, and ants) are one of the most diverse groups of insects, with over 150,000 described species and bees specifically are the most important pollinators of native plants and food crops alike. In the last decade, the decline of bees has been heralded as a conservation crisis. There has been a major focus on a single species, the non-native Western Honey Bee (*Apis mellifera*), but there are ~200 species of native bees in Georgia alone, many of which are highly efficient pollinators and many of which may be in decline. Moreover, ants and wasps have their own unique impacts, both positive and negative, on the campus biological community. In addition to being important pollinators for some plants, wasps are important predators of detrimental insects like aphids and caterpillars that harm plants, as well as flies and other nuisance insects. Ants, as the dominant group of insects on campus, can greatly alter the community through predatory, foraging, and territorial interactions. In particular, our campus has at least four invasive species of ants that dominate the insect community in the areas where they are found. Due to these positive and negative impacts of these insects, pollinating and non-pollinating Hymenoptera should be included in the long-term assessment of biodiversity on campus in order to inform decisions on sustainability practices.

This portion of the project will utilize multiple techniques to collect and identify the focal insects. Insect identification is complex and involves investigating subtle anatomical differences, therefore it often requires that specimens be collected for investigation in the lab. Fortunately, insect populations are very large and multiple studies have shown that biodiversity surveys do not negatively impact their populations. All efforts will be made to identify insects through live capture techniques and to identify them from photographs when possible. The techniques will focus on collecting insects at flowering plants to identify those that are actively pollinating and to utilize traps and colony identification for assessing ants and non-pollinating wasps. When designing collecting surveys, we will use the data generated by the Georgia Southern Walking Tour of Trees (Sustainability Fee Project 2018) to identify and focus a portion of survey effort on the primary blooming trees and shrubs on campus during different collection periods. This will allow us to build a pollination network linking insects to flowers and to determine what plant species foster the greatest pollinator diversity. These data could inform decisions on sustainable planting on campus to promote biodiversity in the future, and will be used in outreach to promote pollinator-friendly plants for home gardens and yards. Most of the identification of insects will be to the level of family or genus, as species level identification typically requires expertise in each genus. Undergraduate students that are involved in this identification will be exposed to a wide variety of insect groups and will gain valuable skills to further their careers.

Citizen Science

Our second goal is to expand the use of citizen science at GSU by creating our own Hymenopteran pollinators identification and information website, offering workshops on how to use iNaturalist, and participating in the Georgia Southern Biological Survey (participation approved by

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Dr. Lance McBrayer). We will create an information card to hand out at outreach events (described below) that will include a general program description, our social media and website information, and a QR code linking to our website. Participants can visit the website from their computers or scan the QR code on their phones to take them straight to the website where we will provide a link to the iNaturalist website and a simple guide for uploading their observations. This will simplify the

identification process for first time users who are hesitant to download the iNaturalist application on their smartphone. To identify the pollinators, citizen scientists will provide geographic location (general location, no identifying information), insect size, insect behavior, photographs of the insect, and what plant (if applicable) it was found on. They can also include a tentative identification if they know the insect. Examples of previously identified Hymenopteran pollinators will also be provided for reference. While the project is actively funded, we will also include a section for citizens to send their pollinator information directly to our student workers, who can upload the information to iNaturalist for them. Once this information is included in the iNaturalist project, student researchers employed on this project will identify species and update this information in iNaturalist. An important aspect of iNaturalist is that it allows crowdsourced identification of species, which will enhance the data in our project and will also serve to help student workers improve their identification skills. Information on pollinator species and plant pairings will be further studied to compile recommendations of plants to grow that most benefit local pollinator species.

To increase student participation, we will implement a Service Learning component that will introduce students to biodiversity surveys as well as educate them on sustainable practices to promote pollinator populations. The three hours will be divided between using iNaturalist to survey and identify pollinators and preparing materials for mason/leafcutter bee houses for outreach events. Students will learn how to begin to identify local pollinators and receive instruction on the importance of promoting native species and to build habitats for them using sustainable materials. Students participating in Service Learning will check in with one of the GAs and will be trained on using iNaturalist (or they will attend a training workshop). GAs will organize a workshop for students to learn about native bees where the students will help prep materials for outreach events. This Service Learning component can continue after project funding ends by focusing on the iNaturalist survey, thereby also providing additional data in future semesters

Education, outreach, and sustainability

Our third project goal is to develop and use outreach tools based on our biodiversity survey. We will create a representative collection of local Hymenopteran species to highlight local native bee populations, identify native and invasive ant species on campus, and acknowledge ecologically important predatory wasp species. In addition to preserved/museum specimens, we propose to keep live displays of invasive ants to use in outreach events as an education tool for informing the public of the magnitude of impact invasives have on native diversity. Finally, the website will provide a powerful portal to reach the community and to educate them on sustainable practices regarding these insects. We will focus this portion of the project on the main groups in the Hymenoptera (Bees, Ants, and Wasps).

Bees: With ~200 native bee species documented in GA and very few documented on the Statesboro campus, a collection of native bees would greatly benefit local biodiversity surveys. We will be creating a display specifically for comparing local pollinating bees and wasps to the Western Honey Bee and educating the community on the vast number of bee species found in Georgia. We will

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promote sustainability by educating the community on flora that can be planted to best help these native pollinators.

Ants: Native ant population typically curb aphid populations through predation, which has a positive impact on local flora by decreasing the populations of these plant-feeding insects. However, invasive ants drive out native ant populations and many actually “farm” plant-feeding insects and protect them from other predators. These interactions have a negative impact by

damaging the plants themselves, but they also directly impact pollinators by excluding them from flowers. Through outreach activities and the website, we will educate the community on the differences between native and invasive ant species, as well as providing sustainable practices for dealing with ants in their homes.

Wasps: Although paper wasps and yellowjackets may be seen as pests due to their seemingly threatening presence, they are great pollinators and important predators of true pests like harmful caterpillars and hornworms that destroy gardens. For example, a single yellowjacket colony can consume several pounds of caterpillars, flies and other insects in a single season, yet these colonies are often killed by people when found. We therefore seek to improve the public's perception of beneficial insect species and educate them on the vital roles they play in pollinating gardens and the natural biological control of pests they provide.

As part of our outreach efforts, we will participate in Greenfest 2019 where we will have a display local Hymenopteran pollinator exhibit to increase awareness of pollinator diversity as well as our live invasive ant colony to increase awareness of damaging invasive species. We will also distribute a take-home guide as well as hold a workshop on constructing mason/leafcutter bee homes from reclaimed and recyclable materials. We also propose to have our pollinator display up during the No Impact Week Farmer's Market to hand out informational cards on how to support local pollinator populations and teach students how to distinguish honey bees from bumblebees and other common native bees. Our website QR code will be featured on the back of our handout.

An additional component to our website will be information pages to educate the community about ants, wasps, native bees, and pollinators in general. We will begin with information about physical descriptions, ecological importance, and general distribution of the various species in the area. As we compile data, we will expand upon the general pages to include more information on species found to be prevalent in the greater Statesboro area. In analyzing the data we collect, we seek to find biodiversity hotspots on the Statesboro campus for students to seek out and observe pollinator and plant interactions themselves. Plant interaction data of pollinators can also provide valuable information on what plant species are most widely utilized by local pollinators. We will make this information available on our website so that community members have access to what native plants could be added to their gardens to attract native pollinators. To encourage community participation, graduate students employed on the project will offer iNaturalist workshops twice a semester to Statesboro campus students and the local community to instruct individuals on how best to document observations, look for beneficial insect species, and become an active member of the citizen science community.

Measurement of results:

Results will be measured based on the completion of: the pollinator exhibit and live ant display, the year-long biodiversity survey, outreach and education events, and implementation of the iNaturalist project and website. The number of individuals for outreach and education events

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will be tracked, as will the number of observations in iNaturalist and number of visitors to the website. The biodiversity survey itself will provide quantitative measures of the diversity of pollinators and Hymenopteran insects, and will also provide a measure of seasonal variation in these species. All specimens that are collected and not used for the pollinator display will be submitted to the Georgia Southern University Entomology Collection. Graduate students will gain valuable experience in mentoring and will be trained in assessing undergraduate students' research development. This will be measured via assessment of poster presentations (using standardized rubrics) that they will prepare and present at either the Georgia Southern Research Symposium or

the Department of Biology's Undergraduate Research Symposium. These experiences are invaluable for both the graduate and undergraduate students as they prepare for careers in science. Results of the survey and citizen science project will be prepared by the students for peer-review and publication in a relevant scientific journal.

III: Project Timeline

11. Implementation plan

The pollinator and Hymenoptera biodiversity survey will take place throughout the 2019-2020 academic year, starting in August 2019 when students can be hired and ending in August 2020. We will sample insects throughout the year, but will focus sampling during the Fall, Spring, and Summer when insects are most active and will particularly focus on times when large numbers of flowers are blooming to best assess pollinators on campus. During winter, we will focus on identifying species and on data analysis of citizen scientist observations. We will utilize several methods to collect data for the campus survey to ensure that we specifically sample pollinators and to ensure adequate sampling of other Hymenopteran species. All methods that will be utilized can collect insects without killing them so that many insects can be photographed, identified, and released without harming them. These methods include:

Nets: One of the main methods for collecting pollinators will be the use of insect nets to capture insects flying near and landing on flowers. We will use heavy duty nets that will allow us to collect directly from vegetation without damaging the nets while also allowing us to collect flying insects. By specifically collecting from a variety of flowering plants throughout the year we will be able to survey the full breadth of pollinating insects on campus, and determine which common flowering plants are visited by the most diverse pollinators.

Bait traps: There are two forms of this trap. One is used for collecting flying insects. Using the correct baits (fruit vs protein baits) will allow us to specifically collect wasp species that are not found visiting flowers. These can be left out continuously and insects can be collected by students on a weekly basis. The other version consists of small plastic tubes that have a bait put in them (tuna or sugar water) and they are dropped every 10 meters along a transect and left to sit for ~1 hour. They tubes are then picked up and capped and insects that have come to the bait will be trapped inside to await identification. This trap is primarily for collecting ants.

Pitfall traps: These are small plastic cups that are set into the ground and are used to collect ground-dwelling insects, particularly ants. They can be used with a non-toxic preservative (dish soap) or empty to be able to release the insects. These can be left out continuously and insects can be collected by students on a weekly basis.

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Aspirators: Aspirators are small handheld collecting devices for small insects such as small ants and some small wasps. They use mouth suction to pull insects through a tube and into a small collecting chamber. These can be used in conjunction with nets, or on their own to collect insects on flowers. Inline filters are used to protect the student collector.

Vacuum aspirator: This is a larger, more powerful battery powered form of the mouth aspirators. It has a separate battery powered vacuum and interchangeable collecting tubes so that collected insects can be separated by location (e.g. one tube used in one flower type). This device allows collecting many larger insects at once before they can fly away, and is also important when collecting ants as the amount of dust brought in tends to clog the filter

on mouth aspirators before collection is completed.

Collection methods: Pollinators (Bees & Wasps): We will use nets to collect insects flying near flowers as well as aspirators to collect directly from flowers. Photography of larger insects will also be used for identification. All bees, wasps and ants have completely separate life stages, including an egg, larval, pupal, and adult stage. Adult stages are the ones involved in pollination in all of these groups, so we will focus on identifying them. There are currently ~200 described species of native bees in Georgia, so we expect to find a wide range of species. Surveys will be designed such that the common flowering plants during each collection period are identified and surveyed systematically, allowing us to compare the pollinators that visit different plants on campus.

Collection methods: Non-pollinators (Ants & Wasps): Wasps will be collected using bait traps and insect nets. Ants will be collected using pitfall traps, aspirators, the vacuum aspirator, and using bait traps. Wasps and ants also have four life stages (egg, larval, pupal, and adult) but only the adults can be readily identified so we will again focus on those individuals.

Citizen science initiative: The citizen scientist portion of this project aims to have students and other community members take photographs of insects pollinating their flowers, add information about the types of plants, give generalized location information, and then upload this information through the iNaturalist platform. iNaturalist is a free app designed specifically for this kind of citizen science project, and is well-suited to this kind of data collection, as pollinators and plants can often be identified from photographs. Students involved in the project will identify the insects from submitted records, aided by the broader iNaturalist community, and this information will be used to provide key information for an outreach website. The website will include: lists of pollinator species with associated photos to help others identify pollinators on their own, lists of plants that were associated with specific pollinators to act as a local planting guide for a pollinator friendly garden, and informational pages about various pollinators as well as the different Hymenopteran groups studied by this project. The data from iNaturalist will ultimately be added to the Georgia Southern Biological Survey project that was started as part of a Sustainability Fee grant in 2016. See attachment from Dr. Lance McBrayer for permission to add our data to that survey database.

Pollinator exhibit: We will hold events to display a pollinator exhibit that includes a range of species collected on campus as well as information about the role that these species play in our lives as well as in the broader biological community. We will also have live colony displays of invasive ants that serve as key points to start conversations about these insects in general, as well as the impact of invasive species. These ants are widespread on campus, so there is no risk of moving invasive species. These events will be advertised via fliers, at events, and through course announcements.

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Timeline: The pollinator and hymenopteran survey will continue throughout the year, focusing on times of highest insect abundance and when flowers are blooming, from roughly August to December, and February to May. One graduate student will focus primarily on the insect collection and identification while the other will focus primarily on managing the iNaturalist program and the website. Undergraduates will work under these graduate students. While we have split these responsibilities broadly, our goal is that all students will be involved in the outreach and education and will be exposed to every aspect of the project to ensure the broadest possible experience.

Date Task Personnel

August 2019 Design sampling timeline based on specific flowers on campus Set up

iNaturalist program
Set up website

Begin sampling of sites	GA2	
Identification of species	GAs & USs	GAs & USs
GA1		
GA2		
September	Continue pollinator, wasp, and	Building
December 2019	ant collecting until too cold	GA2
Roll out Citizen Science	Continue identification of	GA1 & US GA1 & US GAs &
program	species	USs
	Exhibit in Biology-Science	
October 5, 2019	Participate in Greenfest	Everyone
January May 2020	continues	Continue pollinator, science data
Identification of species	wasp, and ant collecting	GA1 & USs GA2 & USs GA1
	Continue collecting citizen	
April 2020	Participate in No-Impact Week	Present poster at Georgia Entomological
Activities		Society annual meeting
Exhibit in Rotunda		Everyone Everyone GAs & USs
May-August 2020		publication Preparation of
	Part IV: Budget 12. Budget:	manuscript
	Analysis of data for	Everyone

Personnel: \$37,680
Equipment and Supplies: \$3,189.42
Total Requested: \$40,869.42

Personnel

		<u>Per semester/per student</u>	<u>Total cost</u>
<u>2 Graduate students, stipend, Fall '19/Spring '20</u>	<u>\$5,250</u>	<u>\$21,000</u>	<u>2 Graduate students, summer '19</u>
	<u>\$4,500</u>		<u>\$9,000</u>
<u>3 Undergraduate students, field assistants, Fall '19/Spring '20</u>	<u>\$8/hr X10 hrs/wk X 16 wks</u>	<u>X 27,680</u>	
	<u>semesters = \$1,280</u>		

Total Personnel \$37,680

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Equipment and Supplies

Item	Supplier	Quantity	Part number	Unit price	Cost	Permanent display boxes Bioquip 12
		1006	\$61.41	\$736.92		Exhibit display boxes Bioquip 12 1042J \$27.07 \$324.84

Insect pins, various sizes

100/pack Bioquip 10 1203S \$6.84 \$68.40

Conical Centrifuge Tubes

(500/case) 50ml Fisher Sci. 1 05 539 7 \$264.00 \$264 Insect Collection Jar Bioquip 10 1120B \$5.79 \$57.90 Ethyl acetate, 4L Fisher Sci. 1 E195-4 \$193.00 \$193.00 Ethanol, 95%, 4L Fisher Sci. 1 AC61509004 \$298.99 \$298.88 Insect nets Bioquip 4 7312C \$36.49 \$145.96 Bait traps Bioquip 6 1420C \$11.85 \$71.10 Aspirators Bioquip 6 1135A \$8.99 \$53.94 HEPA filter for aspirator Bioquip 6 1135Y \$20.40 \$122.40 Vacuum aspirator, cordless Bioquip 1 2820GA \$250.82 \$250.82

Nozzle Extension for

vacuum Bioquip 1 2820X \$29.16 \$29.16 Vacuum collecting chamber Bioquip 12 2820D \$7.99 \$95.88 Flexible, retractable posters Vistaprint 2 \$131.24 \$262.48 Information cards (100/pk) Eagle

Printing 5 \$5.90 \$29.50

8x12 fliers (100/pk) Eagle

Printing 3 \$32.00 \$96.00

2"x8"x8' yellow pine, cut Lowes 5 \$12.57 \$62.85 wood screws 1" (40/pk) Lowes 5 \$1.00 \$5.00 Construction paper (50/pk) Staples 10 826292 \$2.39 \$20.39

Total equipment &

supplies \$3,189.42

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13. Budget Justification

Insect identification is a very time consuming and laborious process and will require significant time. In particular, attempting to identify as many species as possible while alive requires extended time in the field. In addition, implementing the broader citizen science aspect of the project with associated iNaturalist project and website will require extensive time doing outreach activities and continually supporting and updating the website. Due to the time involved, the majority of our budget is focused on personnel. This proposal requests funds to hire two graduate students as Graduate Assistants to coordinate these aspects of the project and to provide ample person-power to collect data, train undergraduates, interact with the local and university community, and compile information for dissemination. We also seek to hire three highly motivated undergraduate students to assist in these varied aspects of the project while gaining valuable skills and expertise for their careers. The supplies requested are for collecting and identifying insects, exhibiting them for outreach activities, and for curating our findings in the Georgia Southern University Entomology Collection for future generations. We are also requesting supplies for advertising our project and for the mason/leafcutter bee home workshop. Non-expendable collecting items will be available for future insect/arthropod collection efforts, including for courses focused on these organisms such as Entomology (BIOL 5442) and Invertebrate Zoology (BIOL 4541).

Part V: Measurements

14. Project value

The Sustainability Fee fund is intended to support proposals to improve environmental sustainability across the Statesboro campus. This project follows the mission of the Center for Sustainability in addressing biodiversity, food sustainability through pollinators, and community involvement in sustainable practices relating to pollinators. It achieves this in several ways.

First, this project further expands previous efforts to assess the biodiversity of the Statesboro campus by focusing on functional pollinators and other Hymenopteran insects that greatly impact the rest of the biological community. Students funded by this project will be involved in the collection and curation of biodiversity data, while also gaining valuable skills in insect science and data management. The iNaturalist platform will allow any interested students on campus to contribute as well. Moreover, this platform can be easily used for Service Learning projects for professors who are interested in including them in their Environmental Science courses. The crowd sourcing nature of iNaturalist for identification of specimens included in the Georgia Southern Biological Survey will allow this component of our project to continue unhindered for years to come. This data can be easily retrieved and used to update the website, either by Dr. Gibson and Dr. Loope or through a separate Service Learning project by a motivated student. The exhibit display and specimens submitted to the Georgia Southern University Entomology Collection will also serve the research community at Georgia Southern and across the Coastal Plain for decades. These will also directly impact students who will use these collections in their invertebrate courses within biology by providing material for them to study in classes such as Entomology (BIOL 5442) and Invertebrate Zoology (BIOL 4541).

Second, these insects provide important functions within the biological community, including directly impacting humans economically. Pollination services provided by insects are estimated to offset hundreds of billions of dollars globally each year, and tens of billions of dollars in the US alone. Nearly 20 billion dollars of this estimate is by honey bees alone (one of the few

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cultivated pollinators), yet their populations face severe impacts from diseases and insecticides. Native pollinators, numbering in the hundreds in Georgia alone, can supplement these services of honey bees, but first we need to educate individuals on the importance of these other pollinators. Similarly, wasps are often viewed as a scourge, yet they are highly beneficial insects that help reduce pest populations. By engaging with students at Georgia Southern, and the wider community, we can help to change attitudes toward these insects, which will lead to more sustainable actions when dealing with insects. Educating the community about the importance of these species will help to reduce pesticide use and increase the use of pollinator-friendly plants, which will help the overall health of our environment.

Finally, we are proposing a broad citizen science component to this project to engage the Georgia Southern community, as well as the public community beyond our campus. The iNaturalist platform will allow the community to engage in the process of science while also providing them with the opportunity to observe and learn about nature in their own backyard. The proposed website will serve as a hub for combining this data and sharing it with the community. There will be pages providing information about locally important pollinators and other Hymenopteran insects. The site and our analysis will also combine species interactions between pollinators and various plants that are grown readily in gardens in the Coastal Plain. This will provide clear evidence of which plants the public can plant if they want to attract and help pollinators. This engagement with the broader community will continue to bolster the recognition of Georgia Southern as a leader in Sustainability

and will help to further integrate the University with the local community, ultimately leading to greater opportunities for Georgia Southern students.

15. Outreach plan

This project will be advertised to the community of the GSU Statesboro campus and greater Statesboro area through various forms of media. fliers posted on campus and throughout the community, information cards, department video monitors, social media posts, student organization promotion (TriBeta, BOGS, and Natural History club) and announcements in Biology courses will all contribute to involving students, staff, faculty, and citizens of Statesboro. Additionally, we propose a Service Learning component as an option for Environmental Biology students where they will perform insect surveys and identification using iNaturalist on the Statesboro campus as well as help prepare materials for outreach events to learn about mason/leafcutter bee home construction. We will have displays of local Hymenopteran pollinators, an exhibit comparing local pollinators to the Western Honey Bee, and live invasive ant colonies to educate attendants of Greenfest 2019. We will also highlight these displays during No Impact Week activities, specifically during the Farmer's Market Festival on food day, and hand out informational cards about our program with a link to our website and its QR code. Additionally, we will have materials prepared to teach community members how to construct their own mason/leafcutter bee homes from reclaimed and recyclable materials to provide additional habitat for these important local pollinators. Our iNaturalist workshops will be advertised to both students and the public through use of fliers and social media posts to engage the greater Statesboro community in citizen science. Previous Sustainability Fee funded biodiversity surveys were well received by local media, and we anticipate that this project would garner similar responses based on the intense public interest in pollinator health in recent years. By improving our knowledge of Hymenopteran diversity and interactions through the proposed biodiversity survey and by engaging the community through education and citizen science we will continue to support and bolster Georgia Southern University's vision of a sustainable campus and community.

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Part VI: Approvals and Attachments

16. Technical advisors and collaborator – for student proposals only

Not applicable

17. Approval

We plan to use the iNaturalist platform for Citizen Science data collection, and to integrate the data into the Georgia Southern Biology Survey (GSBS) dataset. The GSBS was started by a Sustainability Fee funded project, entitled "Using Vertebrates to Provide a Framework for Sustainable Biodiversity on the Georgia Southern Campus" that was proposed by Department of Biology faculty members J. Michelle Cawthorn, C. Ray Chandler, Lance McBrayer and James H. Roberts. The intellectual merit for the GSBS is attributed to these faculty members and as such we have requested, and received, permission to continue using the GSBS project within iNaturalist (see attachment). We will hold several exhibitions of our findings and workshops related to iNaturalist and pollinator sustainability throughout the year. We are not working with vertebrate species, so no IACUC or IRB approvals are necessary.

18. Attachment

Attachment 1: Message from Dr. Lance McBrayer approving use of the iNaturalist platform for the project.

Attachment 2: Example DIY instructions for mason/leafcutter bee home, from Cowlitz County, WA.

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From: Lance McBrayer lancemcbrayer@georgiasouthern.edu
Subject: Re: iNaturalist GS biological survey
Date: March 19, 2019 at 1:38 PM
To: Joshua Gibson jgibson@georgiasouthern.edu, Ray Chandler chandler@georgiasouthern.edu
Cc: Jamie Roberts jhroberts@georgiasouthern.edu

Dr Gibson

This e-mail is to confirm that you have our permission to use the iNaturalist web platform that we developed for our green-fee funded project "Sustainable biodiversity for the Georgia Southern campus."

We understand that you will add data on the diversity of pollinators and hymenopterans to our existing data on other animals. We will modify the introductory text on the platform to reflect this broader database once your project is underway.

We also approve of the addition of data fields appropriate to your work, but please do not delete any existing data fields or settings. We also encourage you to deposit some voucher specimens in our collections.

Thank you

Lance
Michelle
Ray
Jamie

On Tue, Mar 19, 2019 at 12:46 PM Joshua Gibson <jgibson@georgiasouthern.edu> wrote:
Hi Lance and Jamie,

I sent this to Ray, but just realized I could ask you as well since I'm not likely to hear anything from him. I'm putting in a sustainability proposal to look at pollinator and Hymenopteran insect diversity on campus. This is sort of an extension to the vertebrate survey and Lance's butterfly/dragonfly survey. I'd like to do a citizen science component to it and it seems like iNaturalist is the best route to go. Lance included a permission statement from Ray (though I didn't get to see the actual statement) saying that he could use that project for his proposal. Are you okay with me including this in my proposal? I think it would be a good addition to the overall campus survey. If yes, can you write a brief note that I can attach to my proposal?

Thanks,
Josh

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College of Science and Mathematics
Georgia Southern University
TEL: 912.478.5111
[Webpage](#)

Attachment 1

Making Your Own Recycled Mason Bee Home

Materials:

- Empty container (minimum of 5" deep is a good guideline. Soup cans, soda cans and coffee cans are suitable)
- Unbleached parchment paper or construction paper (there are a lot of materials suitable for this, waxy or dyed surfaces should be avoided)
 - Tape
 - 5/16" or 3/8" dowel or #2 pencil
 - Can opener if using a drink can
 - Screwdriver
 - 1 screw



Step One:

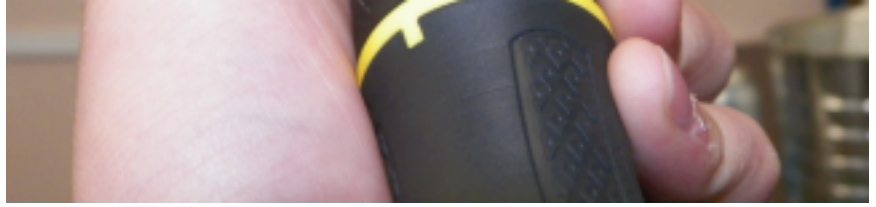
If you're using an empty beverage container, take the top off the can. Shoot for making it as smooth as possible because leaving jagged edges can get your tubes and/or fingers caught.



Step Two:

This step will vary a little depending on what you have lying around. A sheet metal screw will be much easier to work with. Push your screw through the bottom of your can just enough to give yourself a hole.





Step Three:

Flip your can around and place the screw in the hole you made so that it looks like this.



Step Four:

Fasten your container to (ideally) a south east facing location out of the wind and rain. (Not to the wall in your office).





Step Five:

Begin rolling your cells. Cut the paper you're using to roughly the depth of your container. Using your dowel or #2 pencil, roll the paper as tightly as possible and fasten in two places with tape.



Step Six:

Load your mounted mason bee house with

cells as you roll them.



Step Seven:

That's it! Cut all your tubes to equal length. This should be flush with the perforated edge of your container. This will give them just a little more shelter. Results will vary. Mason bees don't necessarily want to avoid nesting in close proximity to other bees, however you may see them skipping every other cell to nest. On the other hand you may very well see all your cells packed.